Antarctic Research Vessel Science Advisory Sub-Committee (ARV SASC)
of the Office of Polar Programs (OPP) Advisory Committee

Report on DR #5, September 15, 2023

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INTRODUCTION

In this 5th Interim Design Review, we focus on several major areas. **First**, we highlight revisions and refinement to design that have developed as a consequence of model testing and modeling - including for example, hull design that results in a ship that meets all of the Key Performance Parameters and minimizes bubble sweepdown. **Second,** we review specifics of general and space arrangements - which though they have not changed greatly since DR #4, have evolved as a consequence of our discussions, and through comments from our colleagues. This includes discussion of both science spaces, and shared public spaces and personal spaces, with a focus on changes made to address concerns. Where questions remain, these are noted. **Finally**, we conclude by identifying the next steps forward for our subcommittee, with the goal of broadening outreach to and input from the larger community. Our goal here is to summarize the status of the ARV design, highlighting the positive changes to ship design that have been introduced over the course of the past year, and the elements that remain to be addressed. We include a table that summarizes the specifics of space allocation (Table 1) and refer the Advisory Committee back to previous documents that also include tables that describe General and Space Arrangements and list of science containers.

As has been the case throughout this process, we have found the design team to be closely responsive to our questions and concerns. In DR #5 we note that many open issues identified in DR #4 have been addressed, or are noted as action items for future attention. We are impressed by the progression of design as a consequence of tank testing, modeling, and by the iterative and forward thinking of all involved in advancing design to meet the science demands of the next several decades. We note the stated "Design engagement philosophy" with its singular goal to *Support the Science* and thank all, the design team, our colleagues, and NSF, for their commitment to designing a polar research vessel for the future.

SECTION 1: General Design Review Highlighting Positive Changes

Ship design has evolved tremendously over the past year, most notably with an increase in overall size, to 365 ft x 80 ft x 32.5 ft, an increase that developed so that the ARV could meet the three key performance parameters of icebreaking capability, endurance and berthing capacity, while being stable and seaworthy. In this section we highlight additional modifications to overall design that have improved the ship's capabilities.

First, the design team has iterated through 11 variants of hull shape, through tank-based model testing and modeling. The final model shape (#11) optimized ship performance by minimizing bubble sweepdown, thus improving the quality of hull-mounted sonar systems data, and at the same time reducing both ice and open water resistance. Maneuvering the ARV via “side-stepping” (see https://future.usap.gov/arv-doc-library/ - “over-the-side operations in ice”) demonstrated the capability to clear and maintain an open water area starboard, which will facilitate over-the-side deployments and recoveries in icy conditions, a previously expressed concern given the lack of a moonpool.

A second major change in overall ship structure is the addition of an Aloft Control Station (AloftCon) on the 08 level. Inclusion of an AloftCon allows for greater visibility forward, a benefit to the identification of leads and weaknesses in the sea ice. This structure also provides an adequate view of the ship’s wake. Combined with the movement of the superstructure forward from its previous position, sightlines both forward and aft are improved.

Third, community interest in the details of the aviation deck has been apparent throughout the preliminary design phase, with a focus on the ability of the ARV to support helicopter-based science. Several modifications are incorporated into the latest design (see section 2 below for details), such that the aviation deck can support landing and takeoff of an Airbus Eurocopter H125 (AS350 AStar) or a Bell 407, helicopters selected as they already are in use out of McMurdo Station. These two options have similar rotor diameters, takeoff weights, and personnel capacity. Note that the helicopter cannot be stored inside the hangar; it can be secured on the deck. Refueling a helicopter on the ship will not be possible, and there will not be a dedicated maintenance facility for a helicopter. *We suggest here that future design considerations address the likelihood of accommodating additional helicopter models, with consideration of those currently in use on research vessels that we are likely to partner with during science-support helicopter operations.*

The design team also worked to improve aspects of ship design that are less visible to the science team, but no less important, including for example, workflow of the bridge, the performance of the anti-roll tanks, modifications to machinery arrangement to accommodate the batteries and battery transformers, and access to the scientific transducers. We note as well that green ship technologies continue to be part of the design, addressed to minimize for example, energy use (hybrid battery) and to include a variety of pollution control systems associated with for example, ballast water, sewage treatment, incineration and fuel use (ultra-low sulfur fuel). The dedicated attention to both large and small details of design is greatly appreciated.

SECTION 2: General and Space Arrangements

Section 2a: Science Systems and Spaces:

Science systems and spaces have continued to evolve and reflect careful attention to a combination of optimizing the use of space and efficiency of anticipated science mission workflow while retaining elements for future flexibility. Here we review major changes from DR #4 to DR #5, many of which center around additional details based on recent studies, and which address concerns that have been identified in previous design reviews.

1. **Main Mast and Foremast**:

The ARV will have both a **main mast**, to support antennae and a suite of meteorological equipment, and a **foremast**, that will support atmospheric sampling equipment, with an intake to the atmospheric lab on the forwardmost part of the 03 level. Note that in modifying the Aviation Deck, the foremast was relocated lower, so that the top of the foremast platform is now flush with the 04 deck level. This modification was necessary so that the foremast would not obstruct safe helicopter operations.

Here, we requested input from Shawn Smith, Florida State University, director of the Shipboard Automated Meteorological and Oceanographic System (SAMOS) program and an expert in collecting meteorological data on research vessels, including polar research vessels. Below are his comments, in addition to our own.

Concerns:

- The report highlights that areas above the 08 level are likely to be adversely impacted by exhaust from many ship-relative wind angles. *This means that use of the* ***main mast*** *for measuring air temperature, humidity, and atmospheric pressure would be problematic. This would also be a poor location for optical sensors (e.g., precipitation, radiometers) as their measurements would be affected by the exhaust and they would need very frequent cleaning.*

- Given that the main mast is not a good location for meteorological measurements, a **forward mast** will be necessary to make high quality meteorological measurements on the ARV. *The mast design will have to be sufficiently tall to avoid air flow distortion over the bow and must take into account visibility for the crew on the bridge.*

Positives:

- The report results indicate that the bow location passes the exhaust test with only a few exceptions when ship relative winds are low. This means a bow meteorological mast will rarely be affected by the exhaust.

- Wholeheartedly agree with the report recommendation to complete a full CFD assessment in the next round of the design. As much as possible the CFD should use a realistic model of the vessel including all the planned instrument masts. The CFD should be run for multiple ship relative wind angles (not just a bow on wind as has been done for past vessels).

The design of the foremast remains to be completed. At this time, an 800 lb. payload - this includes the weight of equipment, navigational lighting and personnel access - is anticipated. The design of the bow instrument mast needs to consider access to the instruments (e.g., will the mast fold to the deck or be one that has a safe ladder for crew access while clipped in), ship vibrations, especially during ice breaking (some meteorological sensors are very sensitive to vibrations), the details of air intake to the atmospheric lab and data transmission to the lab from the instruments on the foremast.

2. Aviation Deck:

As described in Section 1 above, the Aviation Deck has been modified as details were developed to accommodate light helicopter operations:

- As noted previously, design has relocated the foremast to below 04 deck level, so that it doesn't interfere with flight operations,
- Increased space allocated for helideck firefighting systems, and for other safety gear,
- Strengthened the Aviation Deck for helicopter landing and stowage,
- Revised the location of 2 lab vans on the Aviation Deck to allow for better access in and out of the Forward Hangar; *note that vans that might be placed on Aviation deck include UAV van, Meteorological Van and/or an Aerosol sampling van that might have a vertical snorkel for intake of samples. If additional space is required to accommodate larger helicopter rotors, evaluate if this space could be provided by changing the location of the 2 lab vans.*

The design team noted that Additional modifications lie ahead, including, "Helideck markings, deck rails that fold down as netting in way of the helideck, and tie down fittings for securing helicopter to the helideck…...Addition of acoustic insulation in nearby compartments, helideck lighting, flight navigation and visual aids, communication systems."

Since the Aviation Deck has increased in size, we suggest that the Aviation Deck crane capabilities (reach and maximum weight) be re-addressed, and that the SASC solicit input concerning potential uses for the Aviation Deck in addition to supporting AUV and helicopter operations.

3. Handling Systems and Scientific Package Deployment: cranes, A-frames and winches
Attention to previous questions about handling systems is clear in the specifications in DR #5 documents. *However, we note that with McGregor no longer an option as a vendor for over-the-side handling equipment, a vendor, and vendor-specific details, need to be identified.*

Concerns about **crane** reach - (can they place vans where they need to be, and reach boats on 01-level?) - have been addressed. The ARV is outfitted with two large and two small, knuckle boom cranes, with one of the smaller cranes located on the Aviation Deck and the other smaller crane portable, that can be used to support staging and utility needs and to help with over-the-side deck operations of lighter gear. The larger cranes will match, as will the smaller cranes, so that spare parts and maintenance are streamlined. We note that stowage arrangements for cranes still need to be addressed; this is the next step with crane vendor input. We also ask that capabilities of the Aviation Deck crane be re-addressed, and described above.

The **starboard A-frame** is rated to be able to support Jumbo Piston Coring operations currently onboard the NBP (maximum 24 m), and that of the OSU MARSSAM group (https://marssam.ceoas.oregonstate.edu/; currently maximum 30 m), and as well, as other heavy workload operations. However, according to the design team, the current P-Spec requirements are not adequate to support coring operations of the OSIL giant piston corer, in terms of A-frame and strength member ratings. The OSIL system has been used successfully in over 15 vessels in the Arctic and Antarctic (https://osil.com/product/jumbo-giant-piston-corer-18m-60m/; maximum 60 m). Several positive features of the OSIL system include the acoustic release mode instead of use of a trigger core, alleviating concerns about accidental release, or "pre-triggering" of the JPC, and the "emergency barrel release" ability to decouple the core barrels from the core head and bomb, in the case that the core gets stuck in the sediment. Two additional coring considerations are first, the use of a cradle to handle the core, minimizing bending and forward extrusion of the core liners into the Baltic Room. *We appreciate the continued attention to the options for long jumbo piston coring, and the associated requirement and note that the size and rating of starboard A-frame are still being studied.*

In our previous review we had concerns about the location of the starboard A-frame and how it integrated into the shell of the Wet Lab. This concern has been addressed through stress analysis, which indicates that integration of the A-frame will have minimal impact on the Wet Lab.

The **stern A-frame** is now rated to the published demands of the MeBo200 seabed drilling equipment, with 120,000 lb. breaking strength and 30 ft of vertical clearance. While selection of a seabed drilling platform is not decided yet (and may evolve over the next several years), we appreciate this step, and understand that advances/changes in drilling capabilities are not likely to have greater demands.

Winches – we suggest additional attention to the identified use of each of the winches, their versatility, and their use over the stern and/or starboard side, and to how quickly changeover can be accomplished.

4. Deck Incubator Space:
Previously, it didn't appear that adequate unshaded deck incubator space was available. In the P4 General Arrangements, the 02 level aft weather deck area is expanded and open, as a consequence of the forward movement of the deck house. Consequently, the 02 aft weather deck appears to solve this problem. *A sun/shade study is recommended for the future, to provide data to users, regarding how clear the incubation area will be, under a variety of conditions.*

As noted in previous reviews, for maximum flexibility of incubation studies we appreciate seawater piping on the main deck, to the 02 deck, and to the Aviation Deck. We also remind the design team that incubators located on upper decks will require extra heavy lifting to move large carboys, but this is something that the elevator could be used for. Smaller, spiked samples in bottles will have to be carried to stay on the exterior of the ship, in accordance with keeping the interior of the ship radiation free.

5. Environmental Chambers:

Temperature-controlled Cold Rooms and Incubation Experiments:

We suggest that the two independent "cold rooms" be re-identified as "environmental chambers," since they will be used for experimental work in addition to their role in storing samples at low temperatures. The room temperature range should be -20C (-4F) to +10C (+50F); the -20C is needed so that this space can be used for extra -20C storage that can't be accommodated in lab freezers, including items that are too large to fit in smaller freezers. As noted in our previous report, colleagues have indicated the need for tight temperature control (+/- 1 degree C may not be adequate, suggest +/- 0.5 degree C) with adequate air circulation in each environmental chamber to maintain a consistent temperature throughout the room, but they recognize the challenges. *We will work with colleagues to identify lighting controls that will be needed, for example, if specific spectral qualities of light are needed.* We appreciate that these rooms will have seawater plumbing.

Example of environmental chambers on the Sikuliaq:
https://www.sikuliaq.alaska.edu/ops/skq_science_work_spaces.html#07
SIKULIAQ has a temperature range of -20F to +40F +/- 1.8F equal to -29C to +4.4C
Comments: The environmental chambers on the Sikuliaq look quite small and the lighting is not good for holding live animals.

Comments from Nick Middelstadt, Project Manager, Design and Construction, Facilities Services, University of Alaska Fairbanks

- I don't know if one would deploy a conventional insulated metal panel box, or if one would instead use a shipbuilder like Teknotherm (https://teknotherm-inc.com/freezing-solutions/) to construct an insulated compartment and tie into ship infrastructure. If there are any vessels known to have similar facilities it would be interesting to see how they tackled it. In a typical building we use heated floors and air vented around the outside of the chamber to prevent condensation/icing on the outside but these may need a different tactic on a vessel. Things like the humid and corrosive marine environment, ship vibration, ocean movement/keeping stuff safely stowed and contained, space and infrastructure constraints will all play a part.
- Would they be integrated into the ship's cooling/refrigeration plant? Our chambers each have their own dedicated equipment (sometimes redundant systems if continuity is a concern) but my limited understanding of vessels is that they sometimes have a larger overarching refrigeration system.
- Maybe there is a tried and true method out there for plumbing seawater in a freezer, I would think that the system would eventually freeze and burst if left cold and still enough. Our applications have always kept the water source outside the chamber and used pass-through ports to bring in hoses and cables as needed.

6. Lab vans:

A concern expressed in earlier reviews was the location and access to the 20 scientific / lab vans. The total of 20 vans now can be accommodated on the ARV, including 10 on the main deck, 8 in the science hold (double stacked) and 2 on the Aviation deck. Three of the main deck vans can be located within the Lab Van Garage, facilitating access to the ship's interior. We appreciate the continued reminder that certain vans cannot have interior access - the Rad Van and the Core Scanning Van - for example, due to the potential for radiological contamination. A plan for moving the 8 cargo hold vans into the hold, and then stacking, has been developed. These vans will be accessible via their end doors and electrical service will be provided to the refrigerated van(s) in hold, however these vans will not be considered "active" lab vans. Finally, the 2 vans on the Aviation Deck will need a shore-based crane for placement on the deck; we anticipate that these might include a UAV van, Meteorological Van and/or an Aerosol sampling van.

7. Science seawater systems:

We note that DR #5 did not present any updated information about the science seawater systems. A comprehensive review of our concerns was presented in our DR #4 report. Here we simply note that having a robust and flexible science seawater system remains an extremely high priority - this is a fundamental system essential to almost every science group. We recognize the need for high and low pressure outflows, and that flow rates are consistent (for example, all low pressure valves could be open and flow rates would not be impacted, and higher flow to the Aquarium Room and to incubators won't crash the system). Multiple intakes are needed, as is a way to minimize ice clogging, and a low residence time between instruments and the seawater chest.

From the Design Summary Report: "There are two separate seawater systems: the Incubator Seawater System supports high flow to the incubators and Aquarium and a second, Science Seawater system that provides pressure-sensitive seawater to the sensors in the lab and lab vans. Each will have two pumps for redundancy and the pumps will draw water from the forward or aft sea chest, and there will be a third sea chest in the centerboard."

We recognize the difficulties of working in very cold, icy waters and *suggest solicitation of additional input from the science community*.

8. Hazmat:

We understand that past needs for hazmat space have been utilized to design the space proposed for the ARV, and that at 214 ft² the storage exceeds the 100 ft² requirement. However, the space still looks too small. In addition, it can only be accessed from the main deck, consequently chemicals in the Hazmat space won't be accessible while in transit. *As noted during DR #5, the "Design team waiting on regulatory authority decision on the ability for interior door allowed for the Chemical Waste Storeroom."* In the associated chemical waste storeroom, only 4 drums can be placed side by side. The space identified likely will be adequate for a typical cruise, but for cruises that have heavy chemical-use, we recognize that a van on deck will be needed to store additional waste.

9. Microscope room:

The current layout of the microscope room will have space for three microscopes (and their associated supporting computers) and include two float tables. This is adequate since use of a binocular microscope does not require a float table, and not all who use a light microscope use a float table at sea. We note that a sink is included (thank you), to support other work, such as fluorometer work, which, like fluorescence microscopy, requires dark conditions, and bench space, as opposed to desk space.

10. Aquarium Room

The size of the aquarium room, 420 ft², decreased from P3 to P4, however it meets the request from the 2019 SMR. The decreased square footage is the consequence of space allocated inboard of the Aquarium Room, to the Marine Tech Shop; this re-location is discussed below. Another consequence of this new arrangement is the Aquarium Room no longer has direct access to the main passageway, which may impact the ability to access the lift easily. *We suggest that this be addressed further.*

11. Marine Tech Shop

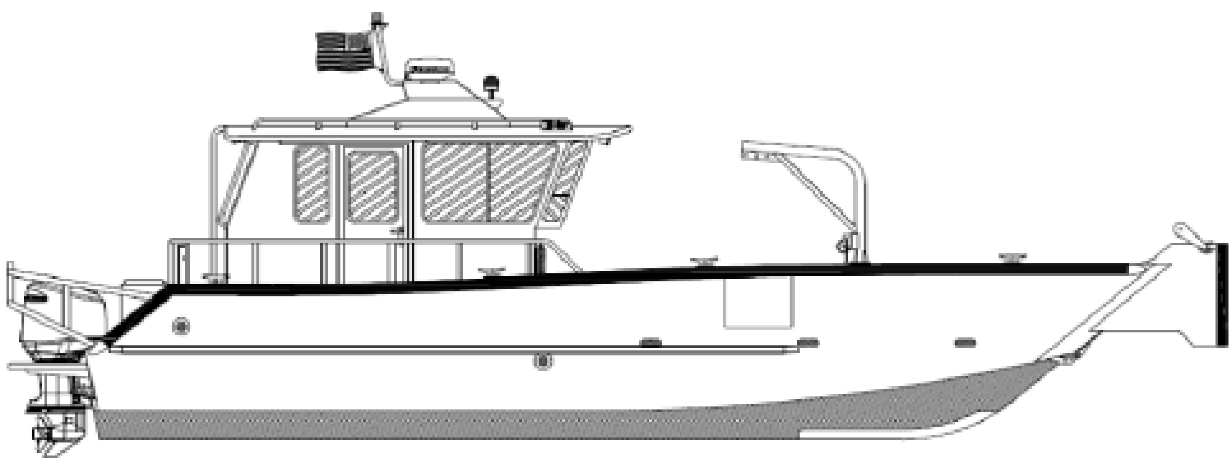
As noted above, the location of the marine tech office was moved and is now located adjacent to the aquarium, which results in a decrease in the size of the Aquarium Room. Also, The MT shop now has an interior location without direct access to the main deck. We understand that equipment needed for deck operations (blocks, deck bolts, etc….) will be stored and accessed from the Bosun Shop, which does have direct access to the main deck. The Carpenter Shop is located just aft of the Bosun Shop, and has direct access to both the main deck and the Bosun Ship. *The current design does not seem optimal; we suggest further discussion on the location, needs and space of the Marine Tech, Bosun and Carpenter Shops.*

12. Cyberinfrastructure:

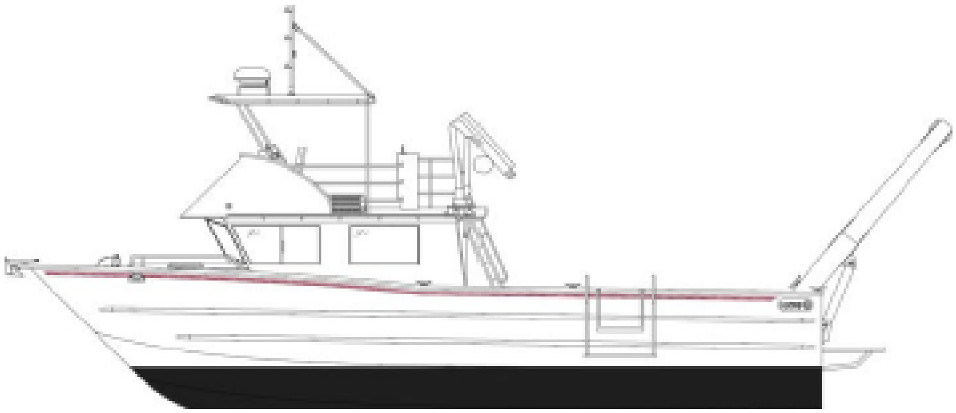
We anticipate increased cyberinfrastructure demand in the future. We suggest planning now, for expansion of "cruise footprints" that will enable real time communication of large data sets back to shore-based science team members who will assist in rapid data analysis and strategic daily planning of science missions.

13. Workboats:
The DR #5 documents include builder specifications for the 4 ARV workboats, which include a landing craft, a scientific survey workboat, and two Rigid Hull Inflatable boats (RHIBs). Here we quickly review the intended science missions for each of the workboats, and elements of specific interest, as indicated by questions from the community. Note that concern about how quickly / efficiently boats could be launched has been a consistent concern; dedicated davits for one of the RHIBs and for the Scientific Survey workboat will facilitate rapid launch. *We look forward to working with the scientific community on the details of design to match the science needs.*

The **Landing Craft** (30-34 ft long and 12 ft max width) is intended to be used to facilitate access to shore-based science, with a capacity for 2 crew and 4 (threshold) - 6 (objective) scientists. As described in DR #5 documents, “The LC will be a platform for science with a mission of transporting crew, scientific equipment, and shelter supplies to and from the beach and/or ice in a safe and cost-effective way with minimal impact to the local environment.” This includes the ability to transport vehicles, such as a standard sized 4-wheeled ATV, that can then be used to move people and equipment once ashore. The LC also will be able to deploy, retrieve and tow glider packages. At National Academy meeting, colleagues expressed interest in the speed/range of landing craft:
Transit Speed - Threshold: 20kts [Objective: 22kts].
Max Speed - Threshold: 25kts [Objective: 30kts].
Maximum endurance without replenishment: - Threshold: 12hrs [Objective: 36hrs].
Range - Threshold: 192nm [Objective: 576nm].



The **Scientific Survey Workboat** (~30 ft length, width 12 ft max; capacity for 2 crew and 4 (threshold) - 6 (objective) scientists) “will be a platform for science with a mission of conducting scientific experiments and collecting high quality data in a safe and cost-effective way with minimal impact to the local environment.” This includes the ability to support scientific diving. Like the LC, this boat will be able to deploy, retrieve and tow glider packages. It will have an ice window for sonar (Shallow Water Multibeam equivalent to EM 712), a research winch and an A-frame. Examples of the kinds of science that could be conducted from the Science Survey Boast include acoustic surveys, net tows, CTD casts, light geophysics (CHIRP, sparker and towed profilers), surface water sampling and mooring / instrument recoveries.
Details regarding speed/range:
Transit Speed - Threshold: 20kts in SS2 [Objective: 22kts]
Max Speed - Threshold: 25kts [Objective: 30kts]
Range - Threshold: 192nm [Objective: 576nm]
Endurance Speed – Threshold: 16 kts.
Endurance – Threshold: 12 hrs. [Objective: 36 hrs.]



The two **RHIBs** (19-to-23 ft length, 9 ft max width; 1 crew, 9 scientists) will be multi-purpose in the kinds of science that can be supported, including, for example, support of scientific diving, close approach work such as tagging animals, support of autonomous vehicles, and passenger transfer.
Speed/range threshold details include:
Transit speed [17 kts]
Max speed [25 kts]
Endurance speed [16 kts]
Endurance [8 hrs Endurance speed]
Range [128 nm]

Section 2b: Public and private non science spaces:

In previous reports we discussed the importance of creating a workspace and living environment on the ARV that is positive and supportive, noting that promoting a respectful and safe environment, and preventing uncivil behavior and harassment will be increasingly important given the longer missions and with a greater number of people on board. In addition, the likelihood of 2-ship operations and international cooperative programs adds the potential for programmatic differences that can impact interpersonal relationships and cruise operations. This objective can be addressed, in part, through design and arrangement of personal and community space on the ship. Accordingly, personal and public space arrangements have evolved over the past year.

First, most notably in response to the March 2023 Ad Hoc Advisory Committee meeting discussion about “dayrooms,” additional work spaces that are separate from cabins have been included in ship design. Note that both the Chief Scientist and MPC (and Captain and Chief Engineer) staterooms still will have attached, exterior dayrooms. These dayrooms can be used for a variety of purposes including: private space for cruise planning, daily planning meetings with senior PIs, small social gatherings, and confidential meetings. However, in addition to these attached dayrooms, the ship’s plan now includes six “stand-alone” individual work spaces that can be used for quiet, private work, spread over 4 deck levels:

04 level (crew berthing): 1
03 level (mixed crew and science berthing): 2
02 level (science berthing): 2
Main Deck (just forward of main lab): 1

These workspaces could accommodate 2-4 scientists/crew as semi-private workspaces and/or meeting spaces and provide equitable access to work areas.

We also note the inclusion of a wide variety of public spaces, also spread over several decks, and the inclusion of laundry spaces on each of the 4 berthing decks:

05 level crew library with natural lighting, laundry
04 level crew lounge with natural lighting, laundry
03 level conference room with natural lighting, interior library, laundry
02 level interior lounge, laundry; also note that 02 level includes the hospital, which has been designed to have direct access to a weather deck in addition to interior access, providing ease of exterior access.

These smaller spaces are in addition to the 01 level large public spaces which include a gym, lounge, conference room and mess. We note the desire to have large picture windows in the mess, lounge and conference room; a structural design study will be done to evaluate this (see page 11, Design Summary Report).

We note the identification of an **MPC office** on the 01 level, currently named the “onboarding office.” The central location will make for easy access. While the MPC completes a broad range of administrative tasks here, it also serves as a space for confidential discussion and as a central social space for science and science support personnel, perhaps facilitated by a coffee machine and comfortable seating.

SECTION 3: FINAL COMMENTS AND NEXT STEPS FOR THE ARV SASC

As we have written in all of our reports, we appreciate the design team for their responsiveness to our comments and questions, clearly visible in the changes, large and small, to vessel design from DR #1 to this fifth iteration. Our comments and questions, all of which have led to closer examination of aspects of design, are the outcome of discussions within our subcommittee and with our colleagues - researchers, technical support experts, and advisory committees - all who provided valuable guidance based on their experiences.

Our community is deeply invested in the design of our new research vessel, and committed to their involvement in vessel design. We are so grateful for their contributions and recognize the importance of community building as we work to open the process up more widely. Accordingly, at this time we would like to move forward with a series of open discussions to be held periodically over the next phase of ARV development, to widen community involvement. We note that some decisions may have cascading impacts in terms of design, and also may require a long lead time in terms of investigating and identifying vendors. Reaching out to the expertise of colleagues in our communities, in a timely manner, is essential.

In terms of an effective structure for gathering productive input, we propose to offer several well-defined "Online Town Halls" that will be well-advertised and open to all through registration. Based on past experiences with this format, we suggest that registration be limited to a maximum of 25 participants, and that sessions are recorded and then available on the usap.futures.gov website. If interest exceeds 25 people, we propose to hold repeat sessions.
We propose that focused topics for these first set of these sessions include:

- Science Seawater Systems (including trace metal work)
- Environmental Chambers & Aquarium Room
- Aviation Deck use
- Workboats
- Coring / Drilling

We welcome additional suggestions. Thorough, productive discussion during these sessions will be increased by posting of documents specific to each topic - for example, deck plans and handling equipment. While many of these documents already are available at the usap.futures.gov website, identification of the most critical documents for each of the sessions will help our colleagues sort through the maze of materials! To accomplish this form of community engagement we request assistance from the NSF to facilitate wide advertising (ideas welcome!) of sessions and identification of potential experienced participants.

We also recognize continued community interest in the capability to support on-land and ice-based science for the US Antarctic Program. Identifying the ways in which these can be supported by the proposed ARV, along with other alternatives, will be important for our colleagues whose work requires the ability to place personnel and their gear onto the ice (ice sheet, ice shelf) and coastal outcrops. While some of the science missions can be accomplished through fixed wing landings and/or landing boat support, this is not universally possible. We hope that there is continued discussion of (1) international partnerships for two-ship operations, and (2) maximizing the use of helicopter support through dedicated heavy helicopter use cruises, preceded by a call for proposals, a model similar to the Deep Field camps on the continent.

From the SASC team, we thank you for this opportunity we have had to contribute to the design of the proposed ARV. At this time, we recognize the need for the evolution of our subcommittee with the addition of new members and a rotation schedule that ensures continuity of discussion through the entirety of the ARV process.

TABLE: Size of spaces (ft^2)					
	2022 Habitability Study	***2019 SMR***	***P1 General Arrangements***	***P3 General Arrangements***	***P4 General Arrangements***
MAIN DECK					
Science Operations Center (Forward Dry lab).	1400	~1100	1131.8	1127	1236.6
Main Lab (Aft Dry Lab).	1400	~1100	1550.2	1619.3	1764.2
Computer/Electronics Lab	700	~700	792.7	821.2	823.2
Baltic Room	700	~700	703.6	705.5	704
Wet Lab	580 (more if possible)	~900	900	689.1	648
Aquarium Room	340	~400	420.2	560.9	420
Hydro Lab	530 (more if possible)	~750	737.1	738.7	789.9
Biochem / Analytical Lab (Bio Lab)	500	~400	758.3	772.6	723.5
Cold Rooms	2 @ 100 each, climate control/cold labs		144 each	144.0 each	176.0 each
Autosal Room		~100	100	100	100
Microscope Room		~100	191.9	127.8	128
Gravimeter - no longer needs separate space					
Bottom Mapping Transceiver Room / Acoustics	195		180	163.7	
Science Stores	4130 (forepeak main deck), Science Hold (16,000)		1098.6	966.8	899.1 (another 150.6 on 03 level and 1500 in Science Hold)
Marine Tech (MT) Shop	250	~150	280	321.6	260
Carpenter Shop			360	279.4	280.3
Marine Lab Tech (MLT) Space (science space)	260		80	334.7	168
ET Shop	100	~100 (ET Shop/Electronic equipment room	234.1	590.4	584.7
Electronic Equipment Room (Server Room)	230		771.4	751.2	583.3
Changing Room/Mud Room		~100	520	400	315
Hazardous Materials Storage	650		60	84.2	214
USW Instrument Room (Bow thruster room)	100		?	?	
Transceiver Room	200		180	163.7	224
Gas Bottle Storage Room			?	?	?
IT Office				262.2	168
Individual work space					100
OTHER DECKS					
Science Stores (03 level)					150.6
MPC Office (01 level)				needs to be identified	? 01 level identified as office (240)
Atmospheric Lab (03 level)	300		1661.3	526.5	525.5
Meteorologic Lab (07 level)	340		331.6	see below, included with MMO platform	see below, included with MMO platform
Marine Mammal Observation Platform (07 level)	550		1142.4	2043.7 (includes met lab space)	1163 (includes met lab space)
DECK SPACES					
Staging Bay (main deck)	450		480	654.7	700
Lab Van Bay (main deck)			369.7	382.1	382.4

Forward Hangar and Deck (04 level)	450 (hangar)		494.1 (hangar) + 5562.8 (weatherdeck)	1394.9 (hangar) + 7183.4 (weatherdeck)	1472.4 (hangar) + 6651.5 (weather deck)
Aft Winch Control Room (Deck operations station, 01 level)			146.3		260.6
LEISURE/SOCIAL/MEETING SPACES					
Deck/Level 05:					
Crew Laundry					144
Crew Library					400
Deck/Level 04:					
Individual work space					115
Crew Laundry					144
Crew Louge					560
Deck/Level 03:					
Individual work space					2 @ 120 each
Laundry					144
Conference Room					560
Deck/Level 02:					
Individual work space					120
Lounge			600	401	400
Laundry			487.4	783.9	168
Hospital				829	784
Deck/Level 01:					
Lounge - intended for noisy social activities, like movies and cards			809.4	450.3	1077.2
Conference Room - group work			649.6	705	583.3
Gym / Sauna			441.3 + 181.9 + 51.6	684 + 192.9	601.2 + 150
MPC Office					240