

**UNOLS Recommendations Appended with JJMA Responses:**

**X-Craft Recommendations, Suggestions & Questions:**

1. Increase longitudinal depth of working deck space aft. The present configuration does not have enough depth to be useful. During the X-Craft ship visit, Nigel Gee indicated that from frame 20 aft on the baseline drawing could be opened up and still maintain the structural integrity of the vessel. It is recommended that the maximum allowable aft opening of the superstructure be evaluated.

Comment: We can open up it up a little more. Going all the way to frame 20 may be difficult. I discussed this with our structural person and he said you can do almost anything if you compensate with enough other structure. Removing the box structure requires compensation with wet deck structure. Because the depth of the wet deck is so much less than the hangar, the compensating structure will have to be heavier than what is removed. That will add weight and cost to the ship. Also keep in mind that the ONR X craft is a sea state 6 ship – it will be easier to remove the hangar there than it would be on a sea state 8 or 9 ship.

2. Fewer vans (~6)/smaller hanger

Comment: We'll concentrate development on the small hangar variant. By decreasing spacing between the vans (which is necessary to accommodate double wide ROV vans) we can actually accommodate 8 vans in the small hangar variant.

3. Larger staterooms

Comment: Can do.

4. 1-deg multibeam receiver - If this cannot be accommodated in the hulls, explore options (sword).

Comment: My thought on this is it might be feasible to design an appendage that is flush with the bottom and extends inboard without protruding outside the max beam of the ship. I'll make a sketch for the meeting. This I consider a risk area – not infeasible by any means, but more difficult and expensive and potentially risky – i.e. unforeseen vibration or flow noise which compromises performance. The transducer array needs to be very rigid and can't have any cavitation or flow noise nearby.

5. Add working deck space forward - Explore this for both the X-Craft and SWATH. Dan cautioned that this is a high impact area.

Comment: Should be able to incorporate a small area forward. This will also add weight to the ship and introduce deck area which could be subject to slams.

6. Explore alternate handling systems/methods (elevators, docking systems) and locations so that large buoys, gliders, AUVs and other tethered or nontethered

instrumentation can be safely and effectively deployed and recovered in normal working sea-states. The ability to connect lifting equipment to floating instrumentation and vehicles in the water without having to use small boats is an important requirement.

**Comment:** We haven't had time to look into handling systems yet. Also, I think they are independent of hull form to some extent. The twin hulls have more freeboard to contend with, but all hulls have similar problems with regard to overside handling in rough seas.

7. Arrange the over-the-side handling location so that it is at the ship's pivot point. This is tied to the comment above and in particular impacts the operation of tethered over-the-side equipment so that pitching motion does not affect the deployed equipment as much.

**Comment:** Can do.

8. The crane needs to be able to lift 20,000 lbs (a container) from a pier with a reach of 20 ft. Is it possible for these cranes to be anchored on the flight deck?

**Comment:** This is within the static load capability of the types of marine cranes installed on previous AGORs. Dynamic load capacity is much lower (maybe 5,000lbs), so container handling at sea won't be possible.

9. An aft working deck with a passageway like that shown for the monohull is desired.

**Comment:** This is doable for the SWATH (like KILO MOANA, up a level from the main deck) but will be difficult for the X craft because it requires interrupting the structural side members. This causes structural problems and also reduces the available width of the hangar which impacts athwartship van stowage. An appended walkway on the outside of the ship may be potentially dangerous and a maintenance problem.

10. Develop arrangement to allow doublewide vans.

**Comment:** I think we can get this if we delete one of the stanchions between the containers. That should be doable with a new design, especially a short hangar one.

11. Minimize space between vans

**Comment:** Should be more doable with a short hangar design – more likely we can eliminate or reduce stanchions between containers.

12. Evaluate moon pool feasibility. Larger moon-pools nearer to the pivot point or LCF have been effective on smaller twin hull vessels.

**Comment:** At this stage, I would say moonpools are a high risk area for a twin hull ship and require more study – perhaps model testing or instrumentation of KILO MOANA to

measure wave characteristics between the hulls for different speed/heading and sea state combinations.

13. Minimize overhead space requirements of gantry system

Comment: We can do this with a hatch loading scheme that eliminates the gantry and elevator.

14. Will powerful bow thrusters fit in the X-Craft hulls? Recent comments from KILO MOANA users indicate that the bow thrusters on the ship are underpowered. Dynamic positioning (DP) requirements needed for AUV operations should result in larger more powerful thrusters.

Comment: KILO MOANA's bow thruster is the same model as on the AGOR 23/24/25. LM sized it based on the dynamic positioning requirements for that ship. There is definitely more windage on KM, so that would suggest a bigger thruster might be required for the same environmental conditions. For a new design, it shouldn't be a problem to design the hulls to accept the required thruster. Another option is a second thruster in the other hull.

15. Minimize/Reduce Freeboard (aft elevator) (relates to comments in # 6 above)

Comment: I think an elevator idea is a high risk area – a potential maintenance problem and possibly dangerous. Would need much more study including survey of any existing systems.

16. Minimize Radiated Noise- Radiated noise from the ship engines and systems (DP) must also be minimized. New vessels will likely be required to meet ICES Standard 209, underwater radiated noise of research vessels. Radiated noise must be minimized to allow tracking of AUVs (Note recent problems associated with ABE operations from KILO MOANA). Lowering tracking equipment below the keels via a moonpool may mitigate the vehicle tracking issue. The tracking array can be lowered when needed.

Comment: In theory, I don't believe radiated noise should be any different for a twin hull or a monohull (sonar self noise is different). KM has a Simrad HPR 418 which is on a retractable probe that extends from the keel. AGORs 23/24/25 have similar systems (Nautronix RS916 I believe). Off the top of my head, I can't think of anything different about KM's configuration that would cause performance to be worse than the other AGORs. Running the bow thruster concurrently with tracking may be difficult but could be accomplished if defined as a design requirement up front. The lowering devices get the transducers below the boundary layer to avoid bubbles, but I don't know if they do much for radiated noise.

17. Provide a clear 80-ft by ~8-ft length on one side (for coring and over-the-side operations). If a container is to be placed in this area, the width should be increased to

10-ft. If over-the-side equipment handling systems are located in this area, then the width needs to accommodate safe handling and landing of large CTD rosettes and other equipment.

Comment: This is in the area of possible, but not recommended because of major impact to the structural design. My recommendation would be to avoid for now. If a twin hull concept is selected and the side working area is considered very high priority, then the designer can explore (through finite element analysis) what would be required to accomplish. It will likely be a weight and cost increase.

18. Provide outside deck space for Radiation Van - Radiation vans probably have to remain outside superstructure as the present policy states.

Comment: Is the existing working deck area suitable? Also, the hangar top is available.

19. Are there any safety considerations required for landing a helicopter on the ship? Are specialized fire-fighting systems and/or support personnel required?

Comment: There are requirements in CFR and USCG NVIC 9-81 covering helicopter landing and hovering on ships. These specify structural requirements, rotor clearances, deck markings, visual aids, safety warning signs, routes of access and escape, and firefighting systems. The firefighting systems are not specialized – just water hoses and AFFF hose reels in certain locations. Personnel requirements should not be any different – just some additional training. The requirements for firefighting and safety are the same for landing or hovering since the USCG considers hovering to be as, or even more, dangerous than landing.

20. Vessel Draft - An X-Craft optimized for speeds up to ~15 knots and for station work, would likely result in hull configurations that require deeper drafts. The vessel draft should not be so large that it precludes all but a few ports. Evaluate ways to minimize draft.

Comment: Draft can possibly be minimized through a variable ballast system but this will be less effective on a catamaran than a SWATH because of higher waterplane area. The other way would be to limit the weight of the ship by reducing some SMRs (fuel load, mission load, etc.).

21. Stack Arrangement - Evaluate modification of the stack arrangement so that only a port stack is needed. Investigate routing of the starboard exhaust to the port stack and the fresh air intake and exhaust could possibly be on the inboard side above the STBD machinery space or aft of the machinery space.

Comment: Don't think this will be feasible. The global AGORs have a single port stack (not entirely to port, but off center), but they are only 52 feet in beam. With an 80 foot beam, the runs will be much longer. In addition, this will require running large diameter

pipes transversely through the overhead of the hangar area which will interfere with handling systems and reduce headroom.

22. Side Walkways - Evaluate ways to provide a STBD side walkway at the main deck level without compromising structural integrity. Walkways on both port and STBD sides would be optimal.

Comment: Addressed in comment #9

23. Small Hanger Arrangement - move vans forward into storage area.

Comment: Can do.

24. Berthing - Is it possible to have some berthing below the main deck level?

Comment: I'm not sure we would pick up much usable space this way. The hulls are already fairly well occupied with tankage, machinery, and storage.

SWATH Recommendations, Suggestions & Questions:

25. The vessel draft should not be so large that it precludes all but a few ports. Evaluate ways to minimize draft or have a variable draft capability. JJMA will try to evaluate the impacts of a variable draft (amt of ballast, rough estimates).

Comment: We will address this during the presentation. It's going to be a fairly high impact item but may be feasible within some constraints (i.e. maybe we can reduce draft to something in the low 20s vice going all the way to 17 or 19 feet.

26. Increase longitudinal depth of working deck space aft. The present configuration does not have enough depth to be useful.

Comment: Addressed in X craft comments.

27. Fewer vans (~6)/smaller hanger

Comment: Addressed in X craft comments.

28. 1-deg multibeam receiver - If this cannot be accommodated in the hulls, explore options (sword).

Comment: Addressed in X craft comments.

29. Explore alternate handling systems/methods (elevators, docking systems) (see comment 6 for X-Craft above).

Comment: Addressed in X craft comments.

30. An aft working deck with a passageway like that shown for the monohull is desired.

Comment: Addressed in X craft comments.

31. Evaluate moon pool feasibility (see comment 12 for X-Craft above)

Comment: Addressed in X craft comments.

32. Minimize/Reduce Freeboard (aft elevator) (see comments for X-Craft above)

Comment: Addressed in X craft comments.

33. Minimize Radiated Noise- Radiated noise from the ship engines and systems (DP) must be minimized. New vessels will likely be required to meet ICES Standard 209, underwater radiated noise of research vessels. Radiated noise must be minimized to allow tracking of AUVs (Note recent problems associated with ABE operations from KILO MOANA). Lowering tracking equipment below the keels via a moonpool may mitigate the vehicle tracking issue. The tracking array can be lowered as needed.

Comment: Addressed in X craft comments.

34. Provide a clear 80-ft by ~8-ft length on one side (for coring and over-the-side operations). If a container is to be placed in this area, the width should be increased to 10-ft. If over-the-side equipment handling systems are located in this area, then the width needs to accommodate safe handling and landing of large CTD rosettes and other equipment.

Comment: Addressed in X craft comments.

35. Provide outside deck space for Radiation Van - Radiation vans probably have to remain outside superstructure as the present policy states.

Comment: Addressed in X craft comments.

36. Are there any safety considerations required for landing a helicopter on the ship? Are specialized fire-fighting systems and/or support personnel required?

Comment: Addressed in X craft comments.

37. Will powerful bow thrusters fit in the SWATH hulls? Recent comments from KILO MOANA users indicate that the bow thrusters on the ship are underpowered. Dynamic positioning (DP) requirements needed for AUV operations should result in larger more powerful thrusters.

Comment: Addressed in X craft comments.

38. Side Walkways - Evaluate ways to provide a STBD side walkway at the main deck level without compromising structural integrity. Walkways on both port and STBD sides would be optimal.

Comment: Addressed in X craft comments.

Monohull Recommendations, Suggestions & Questions:

39. Optimize length to beam ratio for optimal sea keeping. The 1989 wide-beam monohull design was estimated to have slightly better seakeeping than the largest ships in the current UNOLS fleet. Also, larger beam vessels gain some of the advantages for more real estate that you get with twin hull vessels.

Comment: In progress. We'll have some results for the meeting.

40. Fewer vans.

Comment: Addressed in X craft comments.

41. Review EWING Replacement plans since the LEGEND is basically a big monohull (Length 235, Beam 56 feet) with a box superstructure opened at the end. LDEO plans to cut it open at the side to allow general oceanographic use.

Comment: Will do.

42. It looks from the drawings that a container is slightly higher or the same height as a normal deck, hence the wasted space above the containers and the depression in the monohull lower level. Can space be minimized?

Comment: Containers, I believe, are 8x8x20, so eight feet tall. That will force deck heights probably at least 2 to 10 feet higher depending on structure and handling systems above. The deck height is minimized for a simple hatch loading scheme. Overhead gantry cranes require considerably more space but also allow for movement of containers around the hangar.

43. Evaluate a monohull variant that falls in size between the baseline and lengthened variant to increase mission storage space

Comment: We haven't had time to accomplish for this meeting.

44. Identify methods for transporting/handling the ROVs aboard ship (how will they be moved around the ship?)

Comment: Can't address in detail this for 5 January. Most likely cranes on the deck and monorails or overhead gantries inside the ship.

45. Provide outside deck space for Radiation Van - Radiation vans probably have to remain outside superstructure as the present policy states.

Comment: Same as for X craft.

46. Are there any safety considerations required for landing a helicopter on the a ship? Are specialized fire-fighting systems and/or support personnel required?

Comment: Same as for X craft.

47. Minimize Radiated Noise- Radiated noise from the ship engines and systems must be minimized. New vessels will likely be required to meet ICES Standard 209, underwater radiated noise of research vessels.

Comment: Same as for X craft.