UNOLS Ocean Class Meeting
January 5, 2005
NOESIS Conference room, 4100 Fairfax Dr, Arlington, VA

EXECUTIVE SUMMARY

An Ocean Class project meeting was held on January 5, 2005 to review JJMA's evaluation of various hull form variants and show how UNOLS suggestions and comments have been considered in the design process. The goal of the meeting was to converge on one design for each of the three hull variants, monohull, SWATH, and X-Craft. Dan Rolland provided a series of slides summarizing variant arrangements, seakeeping characteristics, speed analyses, draft issues, operating costs, and projects costs.

UNOLS down-selected each of the three hull forms to one preferred variant. Their hull recommendations are as follows:

- X-Craft – The UNOLS representatives recommend the short hangar X-Craft variant.
- SWATH –UNOLS has a strong desire for shallower draft SWATH (<25 ft) so that it could access the ports required to support Ocean Class research. A variable ballast system is desired. Alternatives for coring/over-the-side handling should be identified. The small hanger arrangement is recommended.
- Monohull – UNOLS recommends the baseline monohull variant. The beam dimension should be optimized for seakeeping and to a lesser degree speed. Add approximately 10 feet to the hangar to increase equipment/system maneuvering and 10 feet to the overall length of the vessel to maintain working deck space aft. Optimize the hull form for fuel efficiency as needed.

PROJECT TIMELINE AND TASKS

Prior to January 25th:

- Review the SMR Priorities Table and determine if any items should added. Determine weight/scoring method. Request FIC and the Ocean Class steering committee weigh the SMRs listed in the table. Provide initial scores.
- Hold a teleconference/web meeting for the FIC and Ocean Class steering committee to draft initial recommendations regarding SMR weights. Identify items where additional input is needed from JJMA.
- Draft an outline for letter to RADM Cohen (Peter Wiebe and others)

January 25th: Ocean Class project meeting in Arlington, VA.

- Final review of JJMA's three Ocean Class hull variants
- Finalization of the SMR prioritization table
- Down-selection to one Ocean Class hull form
- Summarize UNOLS recommendations for UNOLS letter to RADM Cohen.

January 26th: Meeting of small UNOLS group to draft letter to RADM Cohen. Circulate draft after meeting to FIC and Ocean Class committee.

5 February: Post Ocean Class Recommendations, SMR Priorities Table, and Draft Letter for community feedback.

28 February: Peter Wiebe sends letter to RADM Cohen with UNOLS Ocean Class hull recommendations.

MEETING REPORT

Meeting Participants:

1. Tim Askew, HBOI
2. Jim Cochran, LDEO
3. Annette DeSilva, UNOLS
4. Rich Findley, U.Miami
5. John Freitag, ONR
6. Dave Hebert, FIC Chair, URI
7. Frank Herr, ONR
8. Bob Houtman, Navy
9. Pete Kilroy, NAVSEA
10. Bob Knox, SIO
11. Mike Reeve, NSF
12. Dan Rolland, JJMA
13. Alexander Shor, NSF
14. Jason Thomas, JJMA
15. Peter Wiebe, UNOLS Chair, WHOI
16. Craig Willett, CSC
17. Marc Willis, OSU

Joining by Phone/Web Conference:

18. Dick Pittenger, WHOI
19. Mike Prince, UNOLS
20. Dan Schwartz, UW
21. Al Suchy, WHOI
22. Terry Whitledge, UAF
23. Bob Winokur, Oceanographer of the Navy/FOFC Chair

Meeting call to order, Introductory Remarks - Dr. Frank Herr, ONR Code 32 called the Ocean Class Project Review meeting to order on January 5, 2005 at 10:30 am and welcomed the participants. He explained that Dan would review the various Ocean Class hull variants and show how the UNOLS suggestions and comments have been considered in the design process. The goal of the meeting will be to converge on one design for each of the three hull variants. The meeting agenda is included as Appendix I.

Peter Wiebe, UNOLS Chair, continued the opening remarks. He asked what are the UNOLS guidelines for selecting a hull design? In October RADM Cohen set out some guidelines and it appears these have changed. Are there any constraints that UNOLS should be aware of?

Specifically, four constraints of concern are:

1. Does the selected design need to be an existing design? Can a new design be considered?

2. Speed – Resolution is needed on the desired speed. The new Navy SMRs indicated a speed in the low 20s. This is still much higher than current ship speeds. What is the optimal speed?

3. Vessel drafts – UNOLS needs to determine a practical draft specification for Ocean Class vessels.

4. Roll on-roll off concept – Is this still valid? How many vans are required?

Frank Herr commented that they have been keeping RADM Cohen abreast of the design progress and issues. He is aware that a low speed catamaran would have some of the characteristics of a SWATH. As a result of the reduced speed requirements and added platform weight, the current X-Craft design cannot be used directly. RADM Cohen understands that the current X-Craft design would not be applicable, and a new design is needed.

Frank remarked that Dan Rolland's study is analyzing the optimal speed for the Ocean Class vessel. His calculations will be reviewed later in the meeting and will need to be addressed further by UNOLS. Vessel draft limitations, as well as van requirements will also require further consideration.

Participant introductions – Meeting participants introduced themselves. The list of attendees and phone/web conference participants are included at the beginning of this report.

Dick Pittenger asked what was the funding status for Ocean Class construction. Frank Herr explained that the funds are included in the budget request for FY06. OMB will have their budget on 1/25, at which time we will know if the construction funds have stayed in the budget.

Presentation by Dan Rolland, JJ McMullen Associates, Detailed studies of the three hull forms under consideration – Dan Rolland continued by reviewing the status of the Ocean Class design studies. His slides are available on the UNOLS website at <http://www.unols.org/_projects/fic_ocean/xcraft/JJMAslides_010505.pdf>. The study continues to examine the characteristics of the X-Craft, SWATH, and monohull variants. For this meeting, the study has completed:

- Modifications of the variants in response to UNOLS comments
- Seakeeping comparison including the AGOR X-Craft
- Wide beam monohull seakeeping study
- Variable draft SWATH "quick look"
- Operating cost update
- Speed analysis
- Construction cost update

Dan reviewed the modifications to the arrangements based on the UNOLS comments. A series of slides were presented showing the previous arrangement in comparison to the new, modified arrangement.

X-Craft Variants - The new arrangement for the small hanger X-Craft (slides 4 & 5) on the Main Deck and 01-Level has:

- A more open working deck
- A moonpool
- Tighter van spacing
- The vans are moved forward
- Larger staterooms

Moonpool discussion - There was discussion on locating the moonpool in the air-conditioned space on the main Deck. Dan Rolland explained that he considers the moonpool as a risky item. The KILO MOANA moonpool is not being used, due to safety issues and potential equipment damage.

Mike Prince stated that the KILO MOANA moonpool shouldn't be used as the model. The WESTERN FLYER moonpool is used extensively with success. Dan explained that the KILO MOANA is a much larger SWATH that operates in heavier sea states. The wave dynamics between the hulls is unpredictable making operations from a moonpool risky. He is not sure if it is solvable. Bob Knox said that it would be interesting to find out how MBARI designed their moonpool on WESTERN FLYER. Marc Willis pointed out that WESTERN FLYER's primary mission is ROV support and the moonpool was an integral part of the design. Rich Findley pointed out that WALTON SMITH also has a small moonpool and has used it successfully. Dick Pittenger said that WHOI decided not to include the moonpool in their coastal SWATH design after some consideration. In conclusion, Dan Rolland stated that the moonpool is a risk area and more study is needed.

Working Deck length – The working deck length on the X-Craft variants is 48 feet. Jim Cochran stated that a longer side rail is needed for coring operations. LDEO had a lot of feedback from the community during the EWING replacement planning indicating that space for long coring operations was required. This is very important.

Dan Rolland indicated that a large open side-rail on a twin hull is even more risky than the moonpool. The closed side rail is required for structural support on twin hull vessels. Peter Wiebe asked if it would be feasible to have openings along the rail, but not a full open rail; this would still allow access to the core. The core would be over the side and

have the ability to pivot. Pete Kilroy responded that this might still present a high risk. The side structure is still needs to handle transverse loads. There would be tradeoffs.

Craig Willett asked if the coring operations could be carried out from the X-Craft 02 deck. Sandy Shor indicated that a coring expert would need to study and comment on this suggestions. It could potentially work.

Mike Prince commented that UNOLS would like the Ocean Class design to be able to meet the SMRs. Although all of the answers are not known, we need to know the plausible alternatives so that we can compare the three variants. The key is to come up with methods of carrying out SMRs.

Three X-Craft variants (slide 6) – Arrangements for three X-Craft variants are shown on slide 6; large, medium, and small hangar. The engines are located below deck. The small hangar version can accommodate 8 vans and has 3,210 ft^2 of permanent lab area. The large hangar version accommodates 13 vans and has 700 ft^2 of permanent lab space.

Winch arrangements – There was some discussion on the winch locations. It was suggested that the hydro winch could be located above the wet lab on the upper deck.

SWATH Variant arrangements (slides 7-9) – The new SWATH arrangements opened up the working deck a bit and provided more hanger space. A moonpool was added. The new designs are not based on AGOR 26 and are 14 feet longer.

Slide 9 shows a comparison of a large versus small hangar bay. The large hangar bay accommodates 11 vans And the small hangar bay accommodates 8 vans.

Marc Willis pointed out that the labeling of the wet lab on the drawing is incorrect. With the winch in the wet lab space, it becomes an equipment workspace. This is important and needs to be relabeled. Dick Pittenger asked if the winch could be mounted on the wet deck, below the wet lab? Dan Rolland responded that there is only about a 6-ft space below the wet lab, but it might be possible. However, the haunch area is below the wet lab and this could be a problem.

Peter Wiebe asked why the arrangements for the SWATH and the X-Crafts aren't the same. Dan replied that they could be. The reason they are not in this study is because JJMA tried to maintain some of the characteristics of the original ONR X-Craft.

The SWATH has an 88-ft beam and the X-Craft has a 72-ft beam. The beam on X-Craft may need to be reduced to minimize lateral accelerations.

Monohull Variants (slides 10 – 14): Three monohull variants were studied: a baseline monohull, which is the same as the Phase II study (42 ft beam, 210 ft LOA), a lengthened monohull (32 ft longer than the baseline), and a wide beam variant (56-ft beam, 200 ft LOA). The wide beam monohull is similar to the LANGSETH, but shorter. Dan indicated that fuel consumption goes up with the wider beam. The hull resistance can be

improved with a more slender forward, but this comes at a cost. The fuel cost and seakeeping will be addressed later in the presentation.

Dick Pittenger suggested that the ARRV design, volume, seakeeping and fuel usage be studied. The ARRV seakeeping is comparable to KNORR. The ARRV is an existing design. Dan Rolland replied that if they looked at the ARRV, they would need to back out the ice capable features and see what they are left with. The ice capable features are a significant design component.

Van arrangements - Slide 10 shows the notional arrangements for vans on the three monohull variants. On the lengthened variant, the vans are arranged athwartship and there is an elevator. On the baseline and wide beam variants the vans are arranged fore-and-aft and access is by hatches. The CTD handling equipment would be located above the wet lab (conventional). Slide 11 provides and an alternative van arrangement for the wide beam monohull with the vans arranged athwartship with an elevator. Slides 12,13 and 14 show two options for van arrangements on the lengthened monohull variant. One option is for van arrangement athwartship with a gantry and elevator system. The other option has the vans arranged fore and aft with some below deck. Loading would be through hatches. This option allows for additional vans (12 vans total). The winch room is moved forward.

Gantry System - Bob Knox asked if the gantry system is needed? It was realized that there might be other vehicles that will need to be moved around the deck. The gantry system may be useful in these operations.

Helicopter - Dick Pittenger asked why the helicopter was needed? It was explained that this is one of the Navy's new requirements. Dick pointed out that there could be some serious constraints involved with helo operations, in addition to safety equipment and space issues. Frank Herr commented that the concept of ops for the helo capability has not been fully worked out. RADM Cohen has given this some thought. To the extent that a helo capability can be accommodated, it should be considered. An UAV landing area would be useful. A hover capability for resupply purposes would also be good.

Pilot House locations – There was discussion on the advantages/disadvantages of the pilothouse locations. Dan Rolland explained that a pilothouse located forward allows good visibility forward, but visibility problems with the working deck. A mid ship pilothouse location would provide an improved view to the working deck. Pete Kilroy said that on the SWATH and X-Craft a forward bridge might be needed to balance the ship's CG. Frank Herr asked if the bridge must be able to see directly to stern, can video cameras be used as an alternative? Sandy Shor commented that there might be some risk problems with losing video/power. Bob Knox remarked that an aft control station for direct vision would be desired. Fog and spray issues would impair visibility from the bridge and would also foul the camera lens. With an aft control station, either pilothouse location would be fine.

X-Craft Structural Issues - Slides 15 shows an X-Craft starboard side laydown area, but this is not recommended for structural reasons. It is a high-risk area. Slide 16 demonstrates the effect of a side cutout on strength of a twin hull ship as compared to a monohull ship. On a twin hull a side laydown area with fall below the strength deck. Peter Wiebe summarized that on the twin hull variants long coring operations either cannot be carried out, or a system/process for doing these operations will need to be developed. This area needs additional study. The question was asked if an 80-ft core capability is required. Dave Hebert responded that the SMRs call for an 80-ft long coring area. The Ocean Class vessels are intended to be more capable than the current intermediate vessels so that they can accommodate some of the work now being done by the Global ships. The FOFC plan call for fewer global ships in the future.

Frank Herr indicated that we don't need to go beyond the level of design that JJMA can provide by this study. The designer and builder will be required to do the detailed design. UNOLS will provide the input for the Navy's RFP regarding capabilities. It is likely that UNOLS will need to establish some design priorities.

One Degree Multibeam (Slide 17) – Slide 17 shows a conceptual sketch of a one-degree multibeam fairing installation on an X-Craft. Dan stated that this is a risk area. Pete Kilroy added that there might be noise issues with engine noise from the other hull. This is a novel approach with little data to analyze. It is a high-risk area. Dan Rolland stated that the monohulls would likely need a gondola system to accommodate the 1-degree MB. Mike Prince asked it the MB array could be split in two? Dan replied that flexing between the hulls is complex. He has spoken to Simrad about this and they are considering it.

Seakeeping:

Dan's next series of slides focused on seakeeping characteristics of the variants. Slide 19 provides a seakeeping comparison of the three variants (SWATH, baseline monohull, and 2,400 ton X-Craft) along with REVELLE in short crested seas. Wetness criteria as well as the SMR motion criteria were considered. At sea state five all variants meet the criteria. In sea state six, the SWATH exceeded pitch motion, but probably not by much. The monohull and REVELLE also exceeded the pitch motion in head seas. The X-CRAFT exceeds the criteria in head and lateral seas. The 2400-ton X-Craft has a lot of transverse stability, but this results in heavy rolling. The hulls act they way we expect them to behave. The X-Craft might not have as great a roll, but it is quicker with greater accelerations.

Dick Pittenger asked what are the seakeeping characteristics while on station. Dan Rolland replied that they have diagrams for 0-2 knots that show the performance. These can be re-examined. Wave slamming is a factor, but more so on the twin hulls.

Mike Prince commented that there are SWATH antidotal reports that stability is great until a certain sea state, then it gets worse than a conventional hull. Can this be evaluated? At 2003 RVOC meeting they heard a presentation from Thomas G. Dobie,

National Biodynamics Laboratory regarding the Critical Significance of Human Factors in Ship Design <http://www.unols.org/meetings/2003/200310rvo/200310rvoap23.pdf>. This may be of interest. Dan commented that the motion criteria used in the JJMA study is fairly conservative. The old Glosten reports were roughly twice what they are considering now.

Frank Herr asked how the seakeeping characteristics compare to the existing intermediates and KNORR/MELVILLE. Dan Rolland stated that the seakeeping program used by this study couldn't take into account the impact of anti-roll tanks. However, to estimate the effect of anti-roll tanks, JJMA reduces the motion criteria by a factor (roughly a 50% improvement). The ARRV seakeeping estimates look similar to the monohull variant. Oceanus would likely look worse than the X-Craft in SS5. Although some of the existing ships have POS-MVs (Position & Orientation System – Marine Vessels), the sea states during operation are not known.

Frank Herr asked what is the assessment of the KILO MOANA sea keeping? Does productivity increase? Dave Hebert replied that from the phone debriefs, the chemists are very happy with the ship's stability performance. There is some discomfort with the motion, but overall they are pleased. Mike Prince added that there is a sea state threshold that once crossed, motion seems to be worse. This hasn't been quantified. Terry Whitledge reported that operations from KILO MOANA have been stern to the seas.

Sandy Shor asked if the KILO MOANA has had to shut down operations because of heavy sea? Yes, operations were in the Gulf of Alaska. A monohull would have had to shut down operations in similar conditions.

Lunch break.

Wide Beam Monohull Seakeeping Analysis – Slides 20 summarizes the 1989 UNOLS wide beam monohull design seakeeping characteristics. The 1989 wide beam ship specifications were 224 ft length, 62 ft beam and 15 f draft. Seakeeping performance for the wide beam was slightly improved over AGOR 14/15 (stretched). Lateral accelerations were reduced slightly on the Main Deck and below; but increased above the Main Deck. The penalty with the wide beam design is a 30% higher power requirement (power requirement or fuel consumption??) than for the Phase II slender monohull.

JJMA analyzed three wide beam monohull variants. The results show:

- A slight reduction (~10%) in lateral acceleration at the working deck level
- Wide beam monohulls may not work with anti-roll tanks (clarification is needed to determine if this applies to both passive and active roll tanks) because of excessively stiff roll characteristics. They physics may drive tank size impractically large (larger than ship beam).
- For normally proportioned monohulls, anti-roll tank is assumed to provide approximately 50% roll reduction.
- For wide beam variant, roll reduction may be less or zero

- 30% increase in fuel consumption translates into about $850 per day increase in the day rate
- Phase II monohull meets lateral acceleration criteria, so wide beam won't improve operability figures

Slides 22 and 23 provide the speed polar diagrams for the five monohull variants in short and long crested waves:

- Baseline monohull
- Lengthened monohull
- Wide Beam 1 (LWL=211 ft, beam = 53 ft, draft = 17 ft)
- Wide Beam 2 (LWL=197 ft, beam = 56 ft, draft = 17 ft)
- Wide Beam 3 (LWL=197 ft, beam = 56 ft, draft = 14.6 ft)

The wider beam ships show greater roll because they have no roll tanks. The dark shaded area is pitch and light shaded area is roll.

Slide 24 provides a lateral acceleration chart for the 5 monohull variants, the X-Craft and the SWATH for SS4, SS5, and SS6. They variants do not exceed the criteria by a lot. The X-Craft has the highest lateral accelerations.

Variable Draft SWATH – Next Dan reviewed their findings regarding a variable draft SWATH. A full load draft SWATH variant is 25 feet. To get to 19 feet an additional 400 tons of buoyancy is needed. This additional volume is filled with ballast when at 25 feet and empty at 19 feet. The WHOI variable draft SWATH had about 75 tons of buoyancy. Frank Herr pointed out that at the start of a cruise the ship is often at full load and this is when the most buoyancy is needed to reduce drafts for in-port water depth limitations. Once underway a deeper hull depth would likely be desired and ballast would need to be added.

Dan reviewed four options for obtaining variable draft:

- Increase the diameter of the lower hulls. This decreases the distance between the hulls and adds drag. It may require an increase in beam overall to maintain hull separation to avoid hull interaction. It also adds structural weight and more fuel weight.
- Increase length. This adds structural weight plus all the additional outfitting and storage in the box area.
- Increase prismatic coefficient (fullness) of lower hulls:
    - Adds 175 tons of buoyancy
    - Adds drag at cruise speeds and requires more fuel weight
    - Remaining 225 tons of reserve buoyancy must be obtained with other options.
- Increase Strut Width. This increases the waterplane area, which degrades seakeeping performance.

A feasible compromise might be to:

- Increase strut width 3 ft

- Increase prismatic coefficient
- Increase lower hull beam by 10%

Slide 29 shows the powering impact of variable draft. The chart indicates that a variable draft can be achieved, but speed will need to be kept below 12 knots.

Mike Prince suggested that weight could be reduced by changing materials (i.e. aluminum). Dan replied this might offer a savings, but a ballast capacity is still needed to get to full operating depth.

In conclusion:

- Speeds over 12 knots cannot be achieved within existing SWATH overall dimensions with 400 tons of extra buoyancy.
- >400 tons of buoyancy will ultimately be required to offset weight impacts from:
    - Structure for increase in overall size
    - Fuel weight from higher SHP
    - Deeper full load draft
- Increased length is required to achieve speeds in excess of 12 knots

Ballast locations were suggested and included between the wet and main decks and in the struts. Dan indicated that he could look into these.

Dick Pittenger added that there are some advantages of a variable draft besides portage. The ship might offer a better ride.

Peter Wiebe asked how much length is needed for variable ballast. Dan replied that they haven't looked into this. Additional length, would also add more weight.

Peter Wiebe asked the group to consider the question that if the SWATH design is for a 25-ft draft does this eliminate it as an option? This issue will be discussed further later.

Operating Costs – Dan's next series of slides (slides 31-33) concentrated on operating costs. He updated some of the figures since the last meeting. Slide 32 shows the van impacts on operating cost. Shipping of vans is a major expense. The annual cost for a ship with 13 vans (assuming a 50% van turnover per cruise) is $880,000, with 4 vans the annual cost is $271,588.

Slide 33 provides a table showing the operating costs for 7 different variants:

- Baseline monohull = $22,246 (day rate)
- Stretched monohull = $22,749
- SWATH – low vans = $24,783
- SWATH high vans = $26,041
- X-Craft – large hangar = 26,763
- X-Craft – medium hangar = $26,009
- X-Craft – mall hangar = $25,003

Ocean Class SMR Comparison – The table on slide 34 shows the ability of the different hull types to meet SMRs. There are no "red" areas (cannot meet SMRs) because all of the variants are new designs that were developed to meet the SMRs. There are items for each of the hull variants that can only meet the SMR if at a higher cost and greater impact to the ship.

Hull scoring versus SMRs – Slide 35 is a blank table showing some of the major science mission requirements with columns for each of the three variants. The UNOLS meeting participants agreed that this table could be a useful tool in evaluating and comparing the hull forms. Each SMR would be weighted on a scale from "absolutely essential" to "not very important." This would essentially serve as a prioritization of the SMRs. The weights would then be multiplied by absolute scores on a scale of "excellent" to "poor" to obtain a weighted score.

Dan Rolland indicated that he has completed the table with his scores, but is not going to share his scores with us. Dan said that the table should be reviewed to determine if additional categories are needed. He avoided items that could easily be met by all three hulls.

Peter Wiebe commented that the table is a great tool and should be completed by the FIC and Ocean Class Steering Committee. Mike Prince added that it would be helpful if we had Dan's input regarding hull performance for some of the characteristics. Bob Knox also suggested that it would be useful to have the risk factors. Mike Prince pointed out that the table with FIC's recommendations should be shared with the community for feedback. Community feedback was received when the Regional Class SMRs were prioritized.

Higher Transit Speed Analysis – Slides 36 - 43 provide summarize higher transit speed analysis. The graph in slide 37 shows average day rates for various Ocean Class hull types versus transit speed. The day rate is the average of all modes of operation (transit, survey, on station, and pier side) for the ten SMR sample missions. Salaries of the science party are not included in day rate. Non-fuel daily cost assumed to be $18,000 for all hull types. The monohulls and SWATH day rates increase rapidly at higher speeds. They aren't designed for speeds above 16 knots. The X-Craft hull form has an advantage at higher speeds.

The graph in slide 38 shows total mission cost which is the average day rate multiplied by the number of days required to complete an average mission (average of the 10 missions in the SMRs). The low points in the curves represent the most economical transit speeds. Above that speed - the savings in number of days begins to be offset by the rapidly increasing fuel cost. Below that speed - the savings in fuel cost begins to be offset by the increased number of days at sea. Salaries of the science party are not included in the cost. Based on this calculation, the most economical transit speed appears to be 13 knots (monohull), 14 knots (SWATH), 14 to 15 knots (2,400 ton X Craft), and 16 to 18 knots (1,400 ton X Craft). There is not much difference in the curves when the focus is on a

mission that requires the most transit (mooring deployment). If the hulls are lengthened, cost can be optimized a bit at higher speeds.

At the higher speeds, cruises can be completed faster allowing time for more cruises. However cost is higher at high speed and if budgets are limited, it would mean completing work earlier in the year and tying up sooner.

The graph in slide 41 includes the salaries of the science party (assumed $700 each x 25 in the science party) in its calculations. This results in an increase of the most economical transit speeds - 15 knots (monohull), 15 knots (SWATH), 17 knots (2,400 ton X Craft), and 20 knots (1,400 ton X Craft). As the "cargo" becomes more valuable, the economical transit speed increases.

Frank Herr commented that life cycle costs are critical. Perhaps fewer ships are needed if work can be completed faster. Peter Wiebe replied that there are many cruises where the duration cannot be shortened. In many cases the time is needed for setup, processing, analysis, incubations, etc.

Sandy Shor asked if the X-Craft has adequate ship control at slow speeds, 0-2 knots for station keeping. Often, cruises need to go slow. Dan Rolland replied that the existing X-Craft is not optimized for slow speeds, however, the new X-Craft variant can be designed for operations at slow speeds.

Peter Wiebe remarked that the problem reported during the ABE cruise by Dana Yoerger on KILO MOANA needs to be investigated further to determine if it is hull related. They had difficulty tracking ABE from KILO MOANA. There are some reports that the dynamic positioning (DP) system may be underrated on the SWATH. If the Ocean Class vessels are to support AUV operations, the ships must have low radiated noise and be able to track the vehicles while in the water. Dick Pittenger will try to get the memo from Dana.

Craig Willet commented that the TAGS DP system required many months of tuning before it operated properly. We should find out if KILO MOANA's system has been tuned.

Slide 42 shows the operating profile for 22 knots for a 2,400-ton X-Craft. The operating profile indicates a wide range of operating speeds with a lot of low speed operations. The shaft horsepower requirements ramp up significantly over 16 knots. There is a large difference in horsepower between normal cruises and "sprint" speed:

- 2,500 hp at 12 kts vs. 16,000 at 22 kts
- Slower speeds require diesel electric for speed control and efficiency of operation
- If the plant is sized for 22 kts, the majority of operations would be at very off-peak levels resulting in efficiency loss, much larger plant than normally required, and maintenance problems with diesels under low load

- For higher speed, best solution would probably be a combined electric and gas turbine or high power diesel drive. Reduction gears have two input pinions - one for electric motor and one for gas turbine or diesel.

This speed capability primarily applies to only the X-Craft. It would be too expensive to implement on the SWATH and monohull variants.

Program Cost Estimate - Dan's last slide provides an Ocean Class program cost estimate.

- Baseline Monohull = $70-75
- Revised SWATH = $95 – 100
- X-CRAFT = $95 – 100 (steel)

Frank Herr indicated that explicit details of the program costs should be provided to the group.

Mike Reeve stated that the program cost for the ARRV is estimated at $86M.

Interactive discussion of variants and down selection to one representative of each hull form – Peter Wiebe led a discussion on the hull variants and other issues. The group worked to identify the preferred variant for each hull form.

X-Craft – The UNOLS representatives recommend the short hangar X-Craft variant.

SWATH – There was considerable discussion on the draft specification for the SWATH. A small hangar bay design and variable ballast system that will allow 19-ft or less draft is desired. The feasibility of the variable draft option would require further by JJMA. Frank Herr stated that when considering a draft specification, UNOLS should consider where the ships would operate and port call locations. Draft should not be an issue of homeport locations. He cautioned that the bid process for ship operators might not be to limited to only UNOLS institutions. The specifications should not be exclusionary.

Dick Pittenger asked if we are currently designing anything other than a UNOLS ship? Frank replied that we are designing a ship that might be in the UNOLS Fleet. Mike Reeve commented that NSF also has ships that are operated by others (non-UNOLS institutions) for the academic community. Frank added that the ships under consideration are primarily going to be used for academic research, but they don't preclude use by NRL, labs, and private entities.

Peter Wiebe summarized the SWATH preferred hull characteristics: UNOLS has a strong desire for shallower draft SWATH (<25 ft) so that it could access the ports required to support Ocean Class research. A variable ballast system is desired. Alternatives for coring/over-the-side handling should be identified. The small hanger arrangement is recommended.

Monohull – There was discussion on some of the new Navy SMRs and how they would impact the monohull specifications. The Navy wants more vans than currently on the UNOLS ships and they want the vans to be located in a covered space. A fleet of AUVs is an important future research need and the Ocean Class ships should be designed to support them.

There was discussion on UAV support requirements. John Freitag reported that he has contacted CIRPAS regarding UAV support requirements. They indicated that none of the ships being proposed would allow UAVs to land on their decks. They would likely land by parachute in the water for shipboard recovery. Any of the existing ships would be able to support recovery operations.

Frank Herr stated that the Navy is considering vertical take-off UAVs. These vehicles might be useful for oceanographic missions. An open deck would be of value for these operations.

The group agreed that the lengthened monohull variant (242-ft in length) is growing beyond the desired size of the Ocean Class. Also, the wide beam variant doesn't offer much advantage.

Peter summarized the preferred monohull variant. UNOLS recommends the baseline monohull variant with a few modifications. The beam dimension should be optimized for seakeeping and to a lesser degree speed. Add approximately 10 feet to the hangar to increase equipment/system maneuvering and 10 feet to the overall length of the vessel to maintain working deck space aft. Optimize the hull form for fuel efficiency as needed.

The hangar should have large doors for easy access during mooring operations. Sophisticated systems or elevators should be considered for UAVs handling while aboard ship.

Project timeline and process for community input:

Dave Hebert stated that a teleconference/web meeting for the FIC and Ocean Class steering committee is needed to address the SMR priorities table and make initial recommendations.
Dave Hebert stated that a teleconference/web meeting for the FIC and Ocean Class steering committee is needed to address the SMR priorities table and make initial recommendations regarding weights and scores. As a first step we need to look at the table and determine if any items should added. The teleconference will need to take place prior to January 25th.

The next Ocean Class meeting is scheduled for Tuesday, January 25th. The meeting would be for:

- A final review of JJMA's three Ocean Class hull variants
- Finalization of the SMR prioritization table

- Down-selection to a preferred Ocean Class hull form(s)
- Summary of UNOLS recommendations to be included in UNOLS letter to RADM Cohen.

All agreed that an in-person meeting would be beneficial. Mike Prince recommended that a small UNOLS group stay in Virginia for a meeting on January 26th to draft the letter to RADM Cohen. In addition to a draft of the Ocean Class SMR Prioritization Table, an outline of the key items to be included in the letter to RADM Cohen should be prepared prior to 1/25.

After the January 25-26 meeting, the draft Ocean Class hull recommendations, SMR prioritization table, and draft letter to RADM Cohen can be posted on the UNOLS website for community feedback.

Frank Herr indicated that they would like to have UNOLS' final recommendation by late February. This recommendation is needed soon so that NAVSEA can have the builder teams selected and in place by October 2005

Closing remarks – Frank Herr provided brief closing remarks. He feels that this project has come further than any other AGOR project in the past in addressing future needs and evaluating hull forms. He thanked UNOLS for the effort. In the future they will be able to look at back at this record of events and it will be useful documentation.

17:00 Adjournment

Appendix I

Agenda for 5 January UNOLS Ocean Class meeting, 10:30 NOESIS Conference room, 4100 Fairfax Dr, Arlington, VA

10:30	Meeting call to order, Introductory Remarks by Dr. Herr ONR 32 and Dr. Peter Wiebe, UNOLS Chair
10:45	Participant introductions, connection to call in participants.
10:50	Presentation by Dan Rolland, JJ McMullen Associates, Detailed studies of the 3 hull forms under consideration. X-Craft variants SWATH Hull vessel Monohull vessel
12:30	Lunch
13:30	Reconvene meeting: Dan Rolland finish presentation and question period.
14:00	Discussion of UNOLS comments
14:30	Interactive discussion of variants and down selection to one representative of each hull form.
16:30	Review project timeline and process for community input. Schedule next meeting, decision for web or live, vehicle for community discussion.
17:00	Adjournment