X-Craft Site Visit
November 16-17, 2004
Lynnwood and Freeland, WA
Meeting Summary Report

Introduction – Representatives of UNOLS were invited by the Navy to visit Nichols Bros. Boat Builders in Freeland, WA to tour the construction of the X-Craft vessel. The visit included a series of meetings beginning on Tuesday evening, November 16 and continuing through Wednesday evening, November 17 2004. There was an opportunity to meet with Navy representatives, the Naval Architect, the project contractor and shipyard representatives. A list of attendees is included as an Appendix.

Summary of Action Items

Below is a list of action items identified during the series of X-Craft meetings:

Task	Due Date	Assignment
ONR/Navy requirements - Obtain from ONR the list of Navy requirements that are not addressed by the current Ocean Class SMRs. Integrate these requirements into the SMR document.	1 Dec 04	UNOLS request to ONR
Ocean Class Advisory Committee (OCAC): • Rename as the Ocean Class Advisory Committee. • Review membership and recruit additional members to adequately maintain a disciplinary and geographic balance. • Draft a charge and time-line for task completion for the OCAC	1 Dec 04	Office, Dave, Peter
Request additional information regarding the following X-Craft issues: • Definition of Survivability at high sea states. • Life Expectancy – aluminum hull life expectancy and special maintenance requirements. • Availability of Worldwide Repair/Service Sites for aluminum hulls	1 Dec 04	Office
Provide input to JJMA regarding Ocean Class characteristics, X-Craft questions, comments and concerns	1 Dec 04	UNOLS – FIC and OCAC
JJMA provides first cut at X-Craft vessel consistent with SMRs: phone/web meeting	Mid December	JJMA
Community Input – UNOLS will need to engage the	Mid	UNOLS

community. Carry out the following: • UNOLS Newsletter – message from Peter. • Letter from Peter to the UNOLS Directors • Feature Fleet Renewal in the UNOLS booth at AGU • UNOLS website – Post announcement and information • Email blast (one paragraph) to representatives of ORION, ARCUS, RIDGE, MARGINS, etc. The message could include: - A few bullets describing the project - Hull forms under consideration - Timeline - Committee membership	December – Mid February	Office, Dave, and Peter
Pre-meeting Web discussion – to review JJMA material on potential hull/vessel configurations	3 January 05	FIC, OCAC, Navy, JJMA
Meeting at ONR Arlington to discuss conclusions on down selection: Hold a meeting with ONR, NAVSEA and JJMA in Arlington to review, prioritize modifications, and down select to an X-Craft for oceanographic purposes.	Early Jan 05 (5 January)	FIC, OCAC, Navy, JJMA
JJMA Final brief on single design spec: Hold a meeting with ONR, NAVSEA and JJMA in Arlington to review the final X-Craft variant and compare it to the Ocean Class SWATH and Mono-hull.	Late Jan 05, (25 January)	JJMA
Final Decision, detailed JJMA spec – solicit community comment via posting on UNOLS Web site.	05 Feb 2005	FIC, OCAC, Navy, JJMA, Office
UNOLS Letter from Peter Wiebe, UNOLS Chair, to Admiral Cohen to clearly articulate the hull selection decision of the oceanographic community. This letter should be open for community comment prior to sending. The trade-offs in the various designs under consideration must be identified and clearly articulated in Peter's letter.	Mid Feb 05	Peter Wiebe

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Meeting Summary Notes

November 16, 2004 – Hampton Inn, Lynnwood, WA, 8:00 pm

Pre-Shipyard Briefing

Welcome, Introduction - Frank Herr (ONR) welcomed the group and discussed the purpose of the meeting. He provided a brief summary of the Ocean Class studies conducted and the project status.

Over the past year the Navy tasked JJMA to conduct studies that would compare various hull forms to the UNOLS Ocean Class SMRs. At the Annual Meeting the community learned of Admiral Cohen's plans for funding construction of Ocean Class vessel(s). We also learned of his great interest in the X-Craft hull form. In response to Admiral Cohen's plans, the Navy has requested that JJMA collect additional information about the X-Craft and correct some information that had been presented earlier.

The JJMA Phase II study evaluated the monohull, SWATH, and X-Craft hull forms:

1. The monohull hull form was based on a scaled down AGOR 23. The capabilities of this variant are known.
2. The SWATH hull form was based on the KILO MOANA and it was also known.
3. The X-Craft hull form characteristics weren't as well known. An X-Craft design that could carry out oceanographic research is needed.

Frank explained that ONR is trying to get UNOLS and the academic community to the point where the three possible hull forms for the Ocean Class Research Vessel are all known well enough to make a rational decision about what hull form should be selected for Navy construction. In addition, this trip was also to allow Dan Rolland (JJMA) to get accurate input as to the dimensions and other attributes of the current ship because earlier design efforts were done with dimensions that were not quite right.

Frank said that Admiral Cohen wants an X-Craft to be the Ocean Class ship of the future and that we must understand what he sees in this design and we must come to know the advantages and disadvantages. The questions are: Can it meet the SMRs and can it be an oceanographic ship? Admiral Cohen will, as he said at the Annual UNOLS meeting, abide by the community decision, but he must have exceedingly good documentation about why the choice was made and it must include careful consideration of an oceanographic research vessel version of the X-Craft.

ONR will invite others from outside the UNOLS community to be involved in the hull selection process. They plan to invite:

- Ocean Studies Board - Admiral Paul Gaffney
- An NSF representative
- CORE – Admiral Dick West
- Oceanographer of the Navy and FOFC – Bob Winokur

He would look to this group for advice on the design selections.

UNOLS Letter Required - Ultimately, a letter from Peter Wiebe, UNOLS Chair, to Admiral Cohen is needed to clearly articulate the hull selection decision of the

oceanographic community. This letter should be open to the community and suggested the UNOLS website or an article in EOS for distribution.

He said the ultimate decision might come down to construction costs, or operations costs - there is, however, not enough information to know yet what it might be.

Timeline – Frank reviewed the timeline and steps for making the hull form selection:

> 17 November – X-Craft tour. Identify issues that need to be considered by JJMA as they evaluate the X-Craft hull form.
>
> 1 December – Post yard ideas/comment due. JJMA is to generate ideas on how an X-Craft could be used for oceanographic research. UNOLS needs to provide comments to Navy/JJMA regarding X-Craft capabilities, comments, issues, questions, etc.
>
> Mid December (Post-AGU) – Web meeting to discuss JJMA's first cut at X-Craft design concepts consistent with SMRs.
>
> 3 Jan 05 – Pre-meeting Web discussion – NAVSEA, JJMA & UNOLS.
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> 5 Jan 05 – Meeting at ONR in Arlington, VA to discuss conclusions on down-select of X-Craft design concepts
>
> 25 Jan 05 –JJMA's final brief on single design spec – Ocean Class X-Craft design, monohull, and SWATH are compared.
>
> 05 Feb 05 – Final Decision, detailed JJMA spec, solicit community comment via posting on UNOLS Web site. Physical meeting to review the three hull variants – monohull, SWATH, X-Craft and down select to final design.

Discussion followed. Some questions for tomorrow's tour were identified.

Question - Jack Bash wondered if part of the Navy's drive to construct an oceanographic X-Craft was to have a vessel that the Navy might be able to take back into their fleet. The answer to this was No.

<u>Design:</u>

Question – Will the selected design be the design for all Ocean Class vessels? Frank – This is an unknown. It will probably take 3 years for this ship to get funded and begin construction. Options for an additional 2 or 3 ships is TBD.

Question - Can we consider modifications of the monohull and X-Craft that would improve upon those designs? Frank – Yes.

Comment – A flexible design is needed that can support state-of-the-art research over the next 30 years.

X-Craft Ride:

Question– Will there an opportunity to ride the ship before making a hull selection? Seakeeping is major concern and a ship ride might allow a better evaluation. Frank said the time-line might not be as compressed because of funding constraints. Right now the money is in the FY06 defense request, but it won't be known until end of January if it will actually remain there. However, as it stands now, the ship will not be available until after a decision needs to be made.

Question – The *Fairweather* hull form is almost identical to the X-Craft. Can we ride it or charter it? Frank – If the timeline changes, perhaps there will be an opportunity to ride the ship. Dan Rolland pointed out that if we charter the ship it might not be a rough sea state day. He added that seakeeping model results have been fairly accurate.

SMRs:

Comment – Mike Prince brought the discussion back to the need to do the evaluation based on what is in the Ocean Class SMRs and that the X-Craft is nominally in competition with the Kilo Moana and the scaled down AGOR hull form.

Comment - Frank commented that in discussions with Admiral Cohen he has indicated that the Navy has not worked well enough with UNOLS to develop the Ocean Class SMRs. In their view, the SMRs are based on recent experience. The SMRs do not address how the Navy might use these ships over the next 30 years. UNOLS needs to consider the Navy's missions. The Navy will not be interested in building a ship that cannot support Navy research interests. As an example, he said that current ships carry huge deep-sea cranes and heavy winches and wire that enable G&G missions (in particular) to reach the deep-sea floor and bring samples back and thus G&G drives ship design considerably. The Navy is not likely to do this kind of mission and will be operating in a different fashion. He said that the SMRs cannot be thrown out, but they do not reflect Navy needs or missions. Prince asked Frank to give examples of SMRs that were not in the Ocean Class SMR. Frank raised the issue of variable mission payloads and fact that deep-sea winches compromise this. The Navy's interests have shifted to the littoral. The Navy might not see the deep ocean capabilities as a high priority.

Bob Knox Question – Is the Navy creating specification for a ship that would ultimately be an agency specific ship? This is a fundamental difference in the approach taken for fleet renewal.

Request – The UNOLS Ocean Class SMRs have provided the basis for evaluating hull variants. They were created by the community and were publicly available for broad community input. The SMRs were quite robust and versatile and that if they are

inadequate, we need to know about this right away. The Navy needs to identify where the UNOLS SMRs are lacking in terms of Navy requirements.

Comment – If the Navy is going to redefine the SMRs, we need to reexamine the monohull and SWATH hull variants to see how they match up to the new SMRs.

Bob Knox Question – What is the nature of the mission for the X-Craft vessel? What was it designed for? Frank said that Cohen saw the X-Craft as a technology demonstration including risk reduction for a littoral combat ship. Issues of primary concern are such things as ASW mine countermeasures and maritime interdiction. The craft must move very fast (faster than torpedoes). It is designed for work on the continental shelves. The X-Craft has number of these elements. The other attribute of importance was the open box structure. He said the longest lasting ship in the fleet was an aircraft carrier, which is mostly hangar in which things move in and out. So the X-Craft is meant to do this as a multi-configurable ship. One element that Frank said that the X-Craft has that is new to the Navy is that it will be doing much more "oceanographic" related work with AUV-sonar systems and surface floats. It would be able to support recovery and deployment of vehicles, sensors, floats, other gear, etc. There will be an emphasis of access to the ocean that many Navy ships don't have now. Over-the-side work is not usually done. One of the requirements was to have a high-speed ship that could rapidly move things in and out (roll on roll off).

Speed:

The issue of ship's speed was raised and Frank quickly said that a high-speed X-Craft was not operationally feasible for the UNOLS fleet. We could not afford to operate it. It was more or less a given that the ship would not be a fast ship. Speeds less than 20 kts were expected. Question - If speed is no longer a consideration, why do we want to take a hull design that is geared for speed and convert it to slower speeds?

Berthing:

Comment – The X-Craft berthing configuration is low. Additional berthing capacity will be needed. The issue of van berthing was raised and it was noted that berthing vans are not really feasible in the long run and permanent berthing for science was needed. Berthing vans have not been historically successful in past. Vans for other kinds of work might not be cost effective. Dan Rolland reported that JJMA has added berths to the X-Craft design, but it uses a good deal of the open space now available.

Survivability:

The issue of the X-Craft handling of high sea state conditions was raised. Frank said that if it was found that an X-Craft could not deal with the sea conditions expected to be encountered that would be a showstopper.

Comment - The Ocean Class needs to be more sea capable than the current Intermediate Vessels, it should be able to operate at higher sea states.

Life Expectancy:

The life expectancy of the X-Craft was discussed. The ship's specifications call for a 5-year ship life, (Later we learned from Nigel Gee rep that the ship is being built with a 25-year life span). It is an aluminum ship. The X-Craft for oceanography can be built from steel.

Dan Rolland commented that the 2400-ton X-Craft in the Phase II study was aluminum. A steel hull would add additional tonnage.

Inspections - Will need to be an ABS classed, USCG inspected and SOLAS compliant ship.

Hanger and Decks - Frank emphasized the need for the group to think strongly about the big hangar and the upper deck. He thought that Cohen would not like it if the community did not adopt these elements. If the upper deck has value, the Navy could consider a big elevator (size of room) for equipment handling. There is a gantry system on the mission bay deck.

Freeboard – There is about 14 feet from the water to the main deck.

Hull Protection - Question – what kind of hull protection will they use on the X-Craft?

Multibeam: The issue of whether the Catamaran hull could accept a 1-degree multibeam system was raised. Herr said that it might be possible with a gondola on the bottom of one of the hulls. (Apparently this system needs a width of 8 meters, which is wider than a catamaran hull). A question for UNOLS is, what is the priority of the 1-degree multibeam system? The X-Craft will likely have bubble problems. This will be a potential problem for all three hulls variants.

Funding and hull selection: Frank – The funds for the project have to be awarded and billed in FY06. Bills have to be on schedule or the money gets pulled back and is lost. The Navy does not want the hull selection to be part of the RPF for the shipyard. The decision is too critical for it to be part of the RFP.

10:00 pm - Evening meeting adjourned.

November 17, 2004 – AM meeting, Beach Fire Grill, Whidbey Is., WA

0815 – Introduction by Frank Herr. Frank Herr opened the meeting by briefly setting out the agenda and doing around-the-table introductions. Participants of the meeting

included representatives from UNOLS, Titan, Nigel Gee, Navy, JJMA and Nichols Bros. A full list of attendees is provided at the end of these notes.

He then provided an overview of how we got here. He reviewed the UNOLS role in operating research vessels and the role of NSF/ONR as agencies that support the operations and infrastructure. He briefly went through the Ocean Class ship definition and specifications and how UNOLS provides quality level support for work at sea. He explained how the day rate was fixed each year and that how the system was set up so that all ships were competitive in cost. He characterized it as a market based use and ship operation.

Frank explained that we are now in the process of determining what kind of Ocean Class vessel is needed for the future. This involves looking at monohull, SWATH, and X-Craft (which is a novel design) to determine how they can meet the Science Mission Requirements. We need to see if the X-Craft is possible for use as an Ocean Class vessel. ONR is very interested in the X-Craft. They have some experience with catamarans, but not on the scale of an ocean class vessel. ONR will ask JJMA to come up with a ROM spec for an X-Craft that would be a viable Ocean Class design.

Frank said that this meeting is a fact finding/information gathering session about the X-Craft. The choice of the Ocean Class hull form will be made in 3-months. This will be followed by an RFP for a ship operator in the 2nd quarter of 2005 and an RFP for a design team in the summer. The procurement strategy is not yet set, but is likely to be like that set for the Regional Class ships with two IPT teams in competition for the preliminary design and then one selected to do the final design and build. He said we must learn about the X-Craft because it is very important for ONR to have a ship that is competitive with other ships in the UNOLS fleet. It has to be able to do a range of missions and move freely in the ocean. What we don't know is how the X-Craft can fit the missions.

The ship needs to be competitive and attractive to the user base. It must be capable of carrying out the science that needs to be done.

1. ONR is not looking for a high-speed vessel.
2. They are looking for a 30-year ship
3. The ship must be an ABS/USGS/SOLAS inspected vessel.

Discussion followed and touched on a variety of topics. These topics are briefly reported below:

Matt Nichols – what is the desired ship speed? –14-15 knots? Frank – 14 knots seems favorable.

Nichols – Can the ship be built from steel? Frank – Navy is open to this.

Nichols – Comment – Construction of an X-Craft (two-hull) will likely be more than the price of the monohull.

Roger Stewart (Titan) – It would be useful to have a matrix of the Ocean Class requirements (SMRs). Frank cautioned that potential builders of the vessel must be distanced from the hull selection process.

Frank emphasized that the UNOLS ships carry a lot of payload both fixed and variable, that dynamic positioning was important (in SS5 and 35 kts wind etc), that slow speed operations were frequent, and that there was a need to optimize life cycle costs to be efficient. Ocean Class operating year definition is 270 days/year, which includes days in port away from homeport.

Nichols – How many vessels will be built? Frank – unknown.

Habitability – UNOLS requests single staterooms for crew and doubles for the scientists.

Sea Keeping - The issue of sea state operations was raised. The vessel needs to be fully operational in SS5 and can operate in SS6 on station. Rich Findley was asked how the Walton Smith stays on station. Rich stated that while on station the ship is kept stern to the seas. They normally set and retrieve gear off the stern a-frame. They have been out in rough weather. They haven't had a problem with wet deck over the stern. The ship has a 6' freeboard. Rich said that they do have some difficulty steaming directly into the sea with hull slamming, but can make way OK if they go into the seas at an angle. Also steaming with seas abeam is OK.

The question was asked if there are any seakeeping studies available for X-Craft operations at low speeds? Ed Dudson (Nigel Gee) said that the X-Craft hull was designed for high-speed operations. Al Suchy asked what the factors of a re-design were? What would be the level of effort needed to design/redesign X-Craft for a comparison with the other two hull forms? Ed Dudson said there is a need for a substantial re-configuration. There are high lateral accelerations associated with the X-Craft at low speeds.

Bubble Sweep down effects – Question - Are there models that analyze bubble sweep down effects on the X-Craft? This will greatly impact transducers performance and is of great concern to research. Ed replied that nothing has been done in this area.

X-Craft Construction Timetable - Matt Nichols reviewed the schedule:

- 12 Feb – Launch and transit to Everett, WA for final outfitting.
- 30 days later - High-speed tests. They will conduct test in the Juan de Fuca Straights. There will be extensive testing. They will go offshore. UNOLS could go aboard if interested. He said that the semi-SWATH catamaran will ride well at speed, but he was worried that it would not do well in the stationary situation.

Procurement Strategy – Matt Nichols asked if NAVSEA would be as nice as ONR? This is a big concern for them. Pete Kilroy talked about NAVSEA and PMS 325 (the auxiliary ship building unit for NAVSEA). Matt Nichols said that ONR was very good to

work with, nice and professional. He said he was worried about NAVSEA - he doesn't know them well, but has talked with colleagues that had bad experiences. Frank said that the procurement mode has not been picked yet and that ONR is good for science and technology effort, but NAVSESA would provide ship building expertise. P. Kilroy said he had been at NAVSEA 25 years and most of the time had built small auxiliary vessels. He said it was not NAVSEA's business to beat people up - they want to do things cooperatively. M. Nichols said that he wants to do work on time, on cost, and with high quality - all commercial and not military (not MilSpec). P. Kilroy said they do not build to MilSpec - and the Navy does not operate the ships built. He said the procurement strategy would likely have a phase 1 for the contract award (1-year to use requirements to produce the vessel design) and a phase 2 for building the ship. There would be two competing design teams (both paid) to see who wins, so that there will be a firm fixed price to build a ship that meets the requirements. Bob Knox said that NAVSEA did well with the REVELLE construction. Frank said that Admiral Cohen would pick the procurement strategy.

Protection Hull Coatings – The question was asked regarding the type of protection coatings used on aluminum hulls? Are there any galvanic action issues? Matt Nichols replied that a lot more is known today about aluminum. They now water blast to get a finish that wears very well. He did not specify a lifetime for an aluminum boat, but said that it was long. He cited aluminum boats built by his father that were still operating. He stressed the efficiency of maintenance. He talked about the new welding techniques the yard is using (stir friction welding and pulse arc welding) that result in stronger welds and no heat distortion.

Tim Askew asked about how the galvanic action was countered. Answer: there is some special system on the high-speed boats, but on slow speed boats, zinc anodes are used. In addition there are special bottom coatings to reduce settlement (the X-Craft will get five coats of special bottom paint @ $400/gallon).

As long as aluminum is cared for properly, it should have a long life. Steel has gone up 50% in cost, while aluminum has gone up 15%. Aluminum seems to be the material of the future.

Worldwide Service Sites – The issue of getting access to shipyards that can make aluminum hull repairs in the U.S. as well as worldwide was asked about. This was recognized as a problem, but one that increasingly is reduced by spread of the technology. Matt Nichols said that aluminum is a growing industry. It is specialized, but more people are learning. It is a concern that we should be aware of. Nichols can send out teams for repair work.

High Latitude Operations - The Ocean Class geographic operating area was discussed. The Ocean Class SMRs call for some ice strengthening. Ice loading was also discussed. This area will need to be explored more thoroughly.

Ed (Nigel Gee) provided details on the size of the X-Craft currently under construction:

- 950 tons light ship load
- 1600 tons – full load (with wave height/speed limitation)
- 1400 tons – operational load
- 80 m LOA (260 ft LOA)
- Service life growth – no allowance
- ONR performance period – 5 years

The FAIRWEATHER is designed with a 25-year life

- 74m LOA
- Displacement = 740 tons
- Speed = 38 knots

The X-Craft design is owned by the Navy for military use.

Survivability - The issue of survivability was discussed – additional clarification is needed – what is the maximum sea state that the X-Craft can survive in? It seems to be above SS6?, but there is some question. Frank said that we must discriminate between the current X-Craft and the ship that meets our SMR needs. Al Suchy said that this is why we need a full-scale model to determine things like station keeping.

Frank Herr commented that the trade-offs in the various designs under consideration must be identified and clearly articulated in Peter's letter. Frank said that all the trade offs for the different hulls must be well known so that we can make the open letter ironclad.

Procurement - Justin Nichols asked what was the current view about the need for a prime contractor/integrator, or could the boat yard negotiate directly with the group building the ship. Frank said the method of procurement was not set yet; it would likely be a fixed price arrangement with a completed design. Frank said that we should know the budget realities and the method of funding by 26 January (State of the Union).

Inspection – The X-Craft is inspected to IMO-HSC-2000. The HSC stands for high-speed craft.

The X-Craft has a crew size of 26 people.

Noise issues:

- The X-Craft design was not concerned with noise reduction. They had no noise requirements/specifications to meet. Interior noise levels are high for the X-Craft. It could be as high as 110 dB in the hangar, but more likely around 80 dB. This is still higher than CG standard of < 60 dB.
- Hull radiated noise is a major priority for research vessels. This needs to be investigated on the X-Craft.

Communications: Is there communication from the bridge to the engine room on the X-Craft? Ed (Nigel) - the X-Craft will have an integrated bridge communications system.

Aft control systems – Do aft control systems exist for over-the-stern and side operations? Ed – the X-Craft will have video capability for over-the-side operations.

Structural Issues: Al Suchy asked if there are any structural issues that we should be aware of? Science groups take a lot of gear on and off the ship. Can any hull or topside material be removed to allow larger openings? We need to know of any structural concerns. Ed Dudson said that twisting between the hulls was the issue and the transverse box at both the bow and stern were very important to eliminating this problem. It is ok to make larger openings in the topside structure.

This was the end of the morning session. The meeting reconvened at the shipyard for a tour of the X-Craft.

Nichols Bros. Boat Builders, Freeland, WA – X-Craft Tour: 10:45 – 1:30 pm

Meeting participants were given a tour of the X-Craft and the Nichols Bros. Facilities. The tour was lead by Justin Nichols. A picture gallery that includes pictures taken of various parts and places in the ship during the walk around will be posted.

Ship yard and X-Craft Construction images are available at the Nichols Brother's Website: <http://www.nicholsboats.com/current_projects.htm >. Additionally, a photo gallery of photographs taken during the tour will be made available on the web. (A message will be sent when they are available.)

Some observations about the X-Craft tour:

- The vessel is very large with a lot of internal volume
- The hangar bay area is huge and open, with a large lift/elevator at the forward end for moving vans from the hangar deck to the upper deck
- The high speed propulsion machinery and switchboard rooms take up a large amount of space.
- The machinery spaces were very cramped, with tight working spaces and were not designed for ease of maintenance and overhaul. Major machinery would require holes to be cut in the side for removal and possibly for repair of major components.
- The hydraulically lowered stern launching ramp was very large and complex, but would be something to consider carefully in terms of launch and recovery of scientific equipment.
- The berthing, galley and mess deck areas are small and cramped (three crew per stateroom) and do not accommodate very many people (26?).
- There is a cutout in the port side of the main hangar bay area that is large enough to fit a van through, that could be enlarged. A similar opening could be made on the starboard side.
- The distance to the waterline is not overwhelming (~14 feet).
- The upper deck is a completely unobstructed flat deck, with the exception of the pilot house/helo control station and the opening for the lift/elevator. This is ideal

for helo operations and would allow for a lot of "incubator" experiments. No wind breaks, so this would be a windy area for most work.

- Visibility from the pilot house to the flight deck is good, but is limited over the side and astern without the use of video cameras.
- The pilot house is small, is offset to the port side and does not extend from beam to beam.
- The structure of the hulls at the bow is very fine and has been reinforced to withstand blows from debris at high speeds.

In 1939 Nichols built their first boat. They have built 33 catamarans, SLICE vessels, SWATHs, and traditional hulled vessels. The largest vessel built is over 300' LOA.

November 17th - Beach Fire Grill – Afternoon Meeting – 2:00 pm

Following the X-Craft tour, the meeting resumed at the Beach Fire Grill and discussion continued:

The discussion opened with Dan Rolland saying that there was very nice workmanship on the X-Craft. He asked about the other kinds of work that the boatyard did and if they have much experience with steel construction. Matt Nichols said that the yard does ½ steel work and ½aluminum. They are also thinking about doing more composite work. The issue of how to join aluminum and steel was discussed. Matt N. said they use a steel/aluminum data couple - explosive join that works well. Very little steel is used in the X-Craft, but there are vertical steel tubes supporting the top deck in the hangar for safety reasons.

Rich Findley suggested that the back top deck be opened up to expose the main deck and to square off the stern. A research ship would need a large clear area on the aft deck. This was not a problem according to Ed Dudson. Justin Nichols said that the circuit board on the mission deck could be moved forward since far fewer switches will be needed on the Oceanographic ship. Then the aft end could be opened up.

The ship needs to be self-sufficient – they have to be able to get things on and off the ship in remote ports. If a crane could be installed on the ship it would most likely eliminate the need for an elevator.

Helicopter discussion –The issue of helicopters requirements was raised and the loading needs and refueling needs were questioned. The oceanographic version of the X-Craft might only need a hover capability. In addition, it was pointed out that lightweight helicopters might land safely even if the deck was not rated for larger ones. The CG requirements were said to be less stringent. Frank explained that there are various types of applications for helicopter operations. One of these options wouldn't require that the helicopter land on the ship, it could just be used to just move things on and off ship. This would eliminate the need for deck reinforcement and fire safety support. Frank stated that UNOLS would need to address this to determine what is needed for helicopter

support. He added that UAV activities would be much more important and handling systems for them would be an issue.

Propulsion – Since high-speed is not needed the propulsion system will not be water jets. It may use z-drives and bow thrusters.

Aluminum – Nichols commented that aluminum technology is getting better and better. Dan Rolland asked if at slow speeds aluminum should still be considered for the hull material? Matt Nichols – yes.

Will aluminum be able to withstand deck wear and tear that is common in science operations? Matt Nichols – Aluminum can be made as strong needed. Also a protective, disposal surface can be installed on the working deck; such as, wood or recycled plastic.

Surface protection – Nichols plans to use a process of water/sand blast. This method is very attractive since it eliminates the need for painting. Another option is vinyl coating. It has a life of 10-20 years.

Economics – Matt Nichols indicated that some projects weren't worth doing if they were a one off. Identical designs will reduce the price. There are also cost savings when there are little to no time gaps between the ship constructions. This keeps the same people doing the work, increases the efficiency of doing the construction, and reduces cost.

Question – Are there are any low speed catamarans? The Navy has some, but not constructed of aluminum.

Question - What is the advantage of a low-speed catamaran? The advantage seems to be the large open space that the design offers and sea keeping. X-Craft is a semi-SWATH and at very low speed a SWATH would offer advantages. It becomes an issue of water plane.

Mike Prince asked to what extent is the box integral to structure? Ed Dudson answered that a reconfigured boat could put strength into the hull and not worry about the super structure.

The afternoon meeting adjourned. UNOLS, JJMA and Navy representatives traveled to Lynnwood, WA for an evening meeting.

November 17, 2004 – Hampton Inn, Lynnwood, WA, Evening Meeting - 5:00 pm

The meeting resumed at 5:00 pm at the Hampton Inn.

Frank explained that ONR would task JJMA to develop three notional X-Craft designs of which UNOLS will chose one.

The discussion turned attention to what elements are missing from the Ocean Class SMR from the ONR perspective? Is the topside arrangement most critical to Admiral Cohen or the hull form and the modularity in a box? Is it a combination of all of these? It was agreed that the high-speed catamaran design was not of any use, so that the X-Craft design needs to be largely redesigned. The lower hull form is a major question. A low speed catamaran design might be very different from the current X-Craft design – it may be more like a SWATH. Would it be acceptable to change the hull configuration? Frank replied that if there are very good reasons for moving away from the X-Craft design then we have to move away from the design.

Bob Knox said that we need a better understanding of what Admiral Cohen finds important. Frank replied that Admiral Cohen desires the topside characteristics of the X-Craft (box like structure). This structure allows modularity. Frank explained the features that are attractive in the X-Craft:

- Modularity is important (vans) – This is not a new capability, but the X-Craft design would allow it to be taken to another level. This is a major characteristic.
- Size of the vessel is generally important.
- The ability to transport equipment to and from the ship by air is important
- Access to the sea with AUV's and other autonomous gear is very important. The ability to support operations of a fleet of underwater autonomous vehicles is required.
- Support for untethered air vehicles (UAVs) is important.
- High speed is a low priority for research operation. Additionally, the cost would be prohibitive.

Frank wants a ship with the capability to work with lots of AUVs - up to the width of 30' and at SS3 or more. There must be an easy handling capability. Emphasis should be on avoidance of taking gear over the rail and on the use of remote docking technology. He envisioned the use of 20 or more winged gliders operational in an undersea network. He also saw the use of helicopters, but not necessarily landing them. However, UAVs would be important. For the fleet of the future, he foresaw use of multiple fleets of AUVs and the facile use of UAVs for local and remote sensing. Frank is ready to eliminate the need for high speed. All three ships that ONR builds will need to handle the additional Navy SMR elements.

Frank said that if there is a large standard deviation in berthing requirements from cruise to cruise, modularity of berthing should be considered. We may need to explore this further.

Terry Whitledge said that rather than trying to prioritize the SMRs, the ship should be designed to meet the SMR specifications in the beginning and then back off if necessary.

Peter Wiebe said that we would need to get the Navy missions identified so that they can be clearly articulated in the UNOLS SMRs. Then we can determine what changes are needed for the X-Craft design so that it can support science. Seakeeping is an area that is

important and will need to be analyzed in the X-Craft. The new SMRs will need to be examined for all three hull designs.

Frank explained that initially, JJMA would be asked to develop designs for three X-Craft notional ships. The three designs might be as follows:

1. Slow speed (~14 knots) ship with big hangar
2. Slow speed (~14 knots) ship with half a hangar and more fixed space for labs and bunks, etc.
3. Slow speed (~14 knots) ship with small hangar

Things to consider in each of these notional designs may include:

a. Where do you put the cranes and winches on all of these arrangements?
b. Is the upper deck useful?
c. In-port independence for handling vans and other large equipment.

The optimum ship speed needs to be defined.

Peter Wiebe chaired much of the remainder of the meeting. He continued the discussion by asking what did we learn today? The following items were identified:

1. The X-Craft is big and spacious.
2. We can modify X-Craft topside (the box) – add bigger holes. The boxy topside is not required for structural support for a slow-speed catamaran.
3. Aluminum may be a possible hull material. – We need to find out about serviceability worldwide.

The following Issues were identified and will need to be addressed:

1. X-Craft survivability needs additional evaluation.
2. The Ocean Class Committee and other members need a charge and time-line for task completion.
3. We need to write down the SMRs that are missing from the ONR/Navy perspective.
4. We need to know more about the aluminum ship repair servicing worldwide.

Next, the Ocean Class Committee membership was reviewed. The current membership includes:

Dave Hebert – Chair
Al Suchy
Tim Cowles
Gary Hitchcock
Jim Cochran
Charlie Flagg
Bob Knox

Suggestions for additional members included:

- Rich Findley, RVTEC representative (he agreed at the meeting to participate)
- Patty Fryer (UH) – ROV and Long coring

- Paul Johnson (UW) – ROV user and equipment deployments
- Marv Lilley (UW) – Geochemistry, ROV user.

Frank reminded us that ONR plans to invite Paul Gaffney (OSB), Bob Winokur (Oceanographer of the Navy), an NSF representative, and Dick West (CORE) to participate.

Frank commented that we could rule out the current configuration of the X-Craft.

Community Input – the remainder of the meeting was spent discussing ways to engage the community and alert them to the urgency of the Ocean Class hull decision. How do we get the message out to the community? The following methods were suggested:

- UNOLS Newsletter – message from Peter.
- Letter from Peter to the UNOLS Directors and Representatives.
- Feature Fleet Renewal in the UNOLS booth at AGU
- UNOLS website – Post announcement and information
- Email blast (one paragraph) to representatives of ORION, ARCUS, RIDGE, MARGINS, etc. The message could include:
    - A few bullets describing the project
    - Hull forms under consideration
    - Timeline
    - Committee membership

The meeting adjourned at approximately 7:30 pm.

Appendix A

Participants - Participants of the shipyard visit and meetings included:

Name	Organization	16 Nov, 2000	17 Nov AM	X-Craft Tour	17 Nov-PM	17 Nov, 1700
Askew, Tim	RVOC Chair, HBOI, taskew@hboi.edu	X	X	X	X	X
Bash, Jack	URI bash@gso.uri.edu	X	X	X	X	X
Cochran, Jim	FIC/OC, LDEO, jrc@ldeo.columbia.edu	X	X	X	X	X
DeSilva, Annette	UNOLS, office@unols.org	X	X	X	X	X
Dudson, Ed	BHT Nigel Gee & Associates, ed@ngal.co.uk		X	X	X	
Findley, Rich	RVTEC, U. Miami findley@hboi.edu	X	X	X	X	X
Freitag, John	ONR freitaj@onr.navy.mil	X	X	X	X	X
Graves, Margo	ONR/X-Craft contracting officer		X			
Herr, Frank	ONR, herrf@onr.navy.mil	X	X	X	X	X
Houtman, Bob	NG1, Oceanographer of the Navy bauke.houtman@navy.mil	X	X	X	X	X
Jones, Fred	OSU	X	X	X	X	X
Kilroy, Peter	NAVSEA, PMS325 peter.kilroy@navy.mil	X	X	X	X	X
Knox, Bob	OC, SIO/UCSD	X	X	X	X	X
Nichols, Justin	Nichols Bros. Boat Builders		X	X	X	
Nichols, Matt	Nichols Bros. Boat Builders mattn@whidbey.com		X		X	
Nordtradt, Steven	Titan Corp, snordtvedt@titan.com		X			
Prince, Mike	UNOLS, office@unols.org	X	X	X	X	X
Rolland, Dan	JJMA drolland@jjma.com	X	X	X	X	X
Schwartz, Dan	U, Washington, Schwartz@ocean.washington.edu	X	X	X	X	
Stewart, Roger	Titan, rstewart@titan.com		X			

Suchy, Al	FIC/OC, WHOI, asuchy@whoi.edu	X	X	X	X	X
Whitledge, Terry	FIC, UAF	X	X	X	X	X
Thomas, Mark	NAVSEA		X			
Wiebe, Peter	UNOLS Chair, WHOI, pwiebe@whoi.edu	X	X	X	X	X
Note:	OC = Ocean Class					