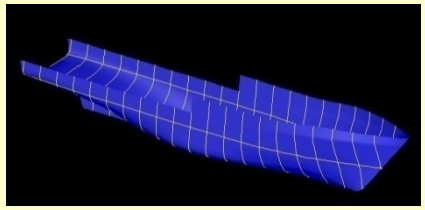
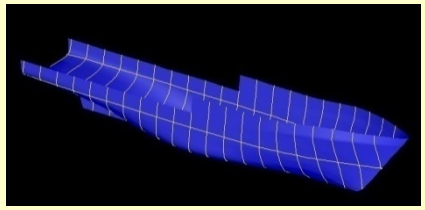
US Research Vessel Programs

ERVO 2009



Current Programs

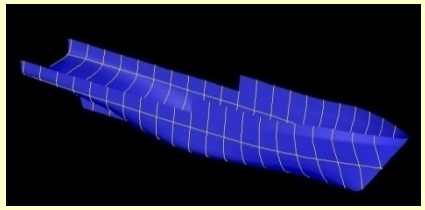
- *Ocean Class AGOR General Purpose RV*
- *Regional Class Research Vessel (RCRV)*
- *Alaska Region Research Vessel*
- *T-AGS 66*
- *T-AGS 60 Class Sonar Upgrades*



US RV Programs

Ocean Class AGOR

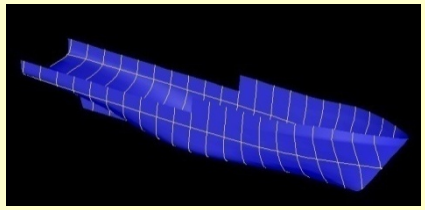
- Class of 2 Mid Size, General Purpose, Monohull Research Vessels
- Funded by US Navy; Operated by UNOLS Academic Institutions
- Concept Design, Requirements Development Performed During 2008/2009
- Solicitation Released in April 2009 for Two Industry Design Teams
- Industry Design Competition During 2010
- Start of Construction for First Ship Expected in 2011
- Delivery in 2014



US RV Programs

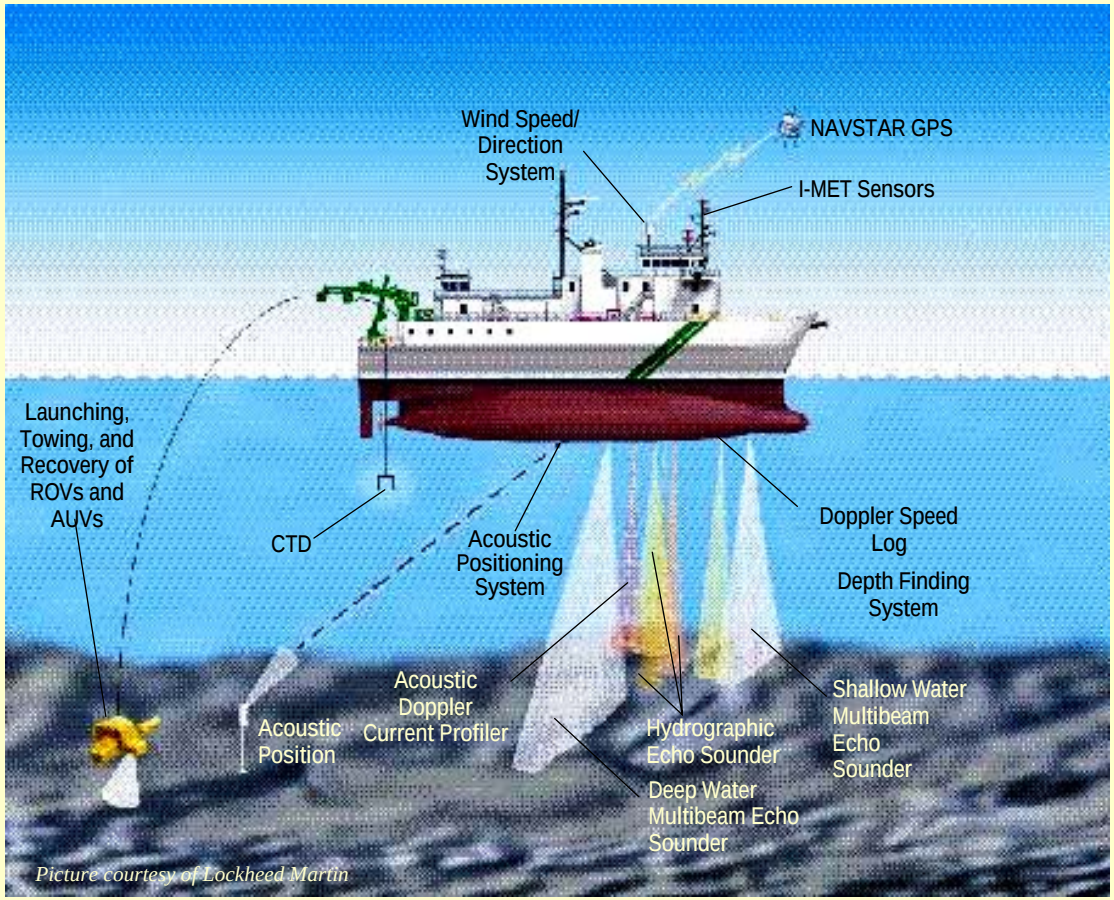
OCEAN Class SMR Highlights

Accommodations:	**20 Scientists, 21 Crew (USCG inspected vessel)**
Range:	**10,000 NM at optimal cruising speed (≈10 Kt)**
Speed:	**11 knots in calm seas, at 80 percent MCR**
Seakeeping:	**OI of 1.0 in SS4, 0.8 in SS5, and 0.5 in SS6**
Science load:	**150 Tons**
Sonars:	**EM122, EM710, SBP120, EA600, ADCP, HiPAP**
Handling Systems:	**Stern frame, side frame, motion comp CTD**
Dynamic Positioning:	**Trackline and station SS5, 35 Kt wind and 2 Kt current**
Design:	**ABS Classed, USCG inspected, SOLAS compliant**
Laboratories:	**2,000 Sq Ft**
Working Deck:	**2,100 Sq Ft**
Vans:	**Carry 2 standard 20 Ft ISO vans**

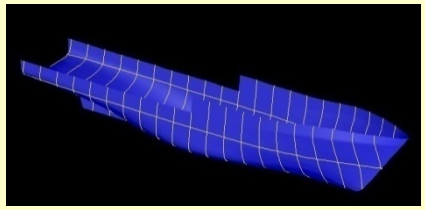


US RV Programs

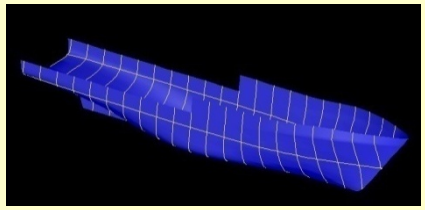
OCEAN Class Sonar Systems



- EM 122 1 x 2 Deg Multibeam
- EM 710 0.5 x 1 Deg Multibeam
- EA-600 Single Beam Echosounders- 12, 30 120, KHz
- HiPAP 500 - Acoustic Positioning System
- SBP 120 6 x 6 Subbottom Profiler
- ADCP – 38, 150, 300 KHz



- *3 Phase Acquisition Process:*
  - Pre-phase I – Notional Design, Trade Studies, Specification, and RFP Development
  - Phase I – Industry Team Competitive Designs
  - Phase II – Downselect To One Shipyard for Detail Design and Construction
  - Phase III – Post Delivery Acoustic System Installation



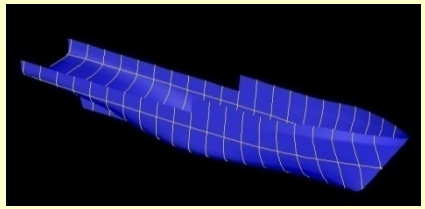
US RV Programs

Phase I Industry Competitive Designs

- Solicitation Released April 24th, 2009
- Proposals Due June 24th, 2009
- Award Expected September 2009
- Period Of Performance is One Year

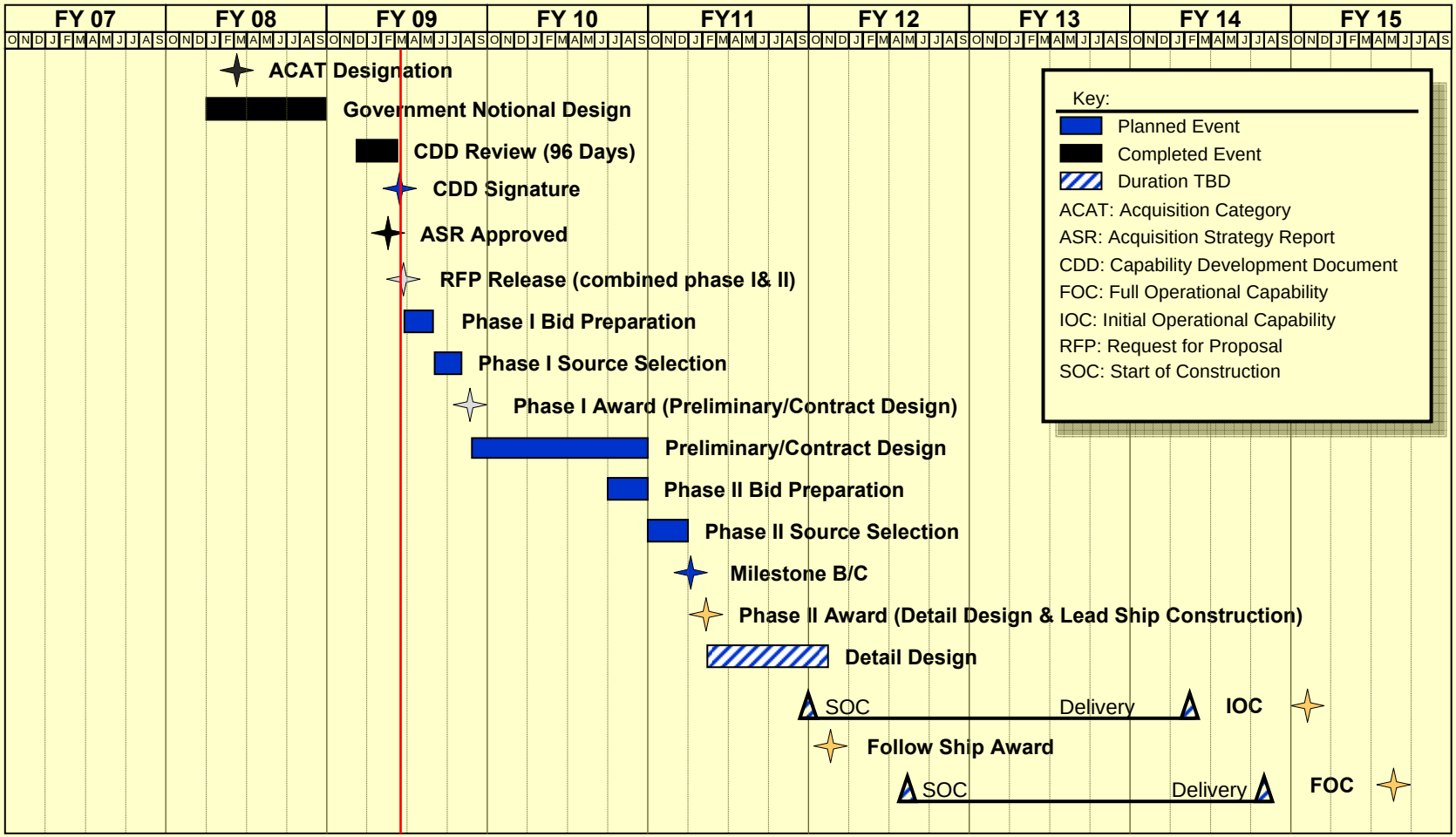
URL for Solicitation and Ship Specification is:

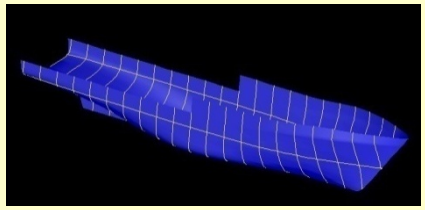
https://www.fbo.gov/spg/DON/NAVSEA/NAVSEAHQ/N0002409R2212/listing.html



US RV Programs

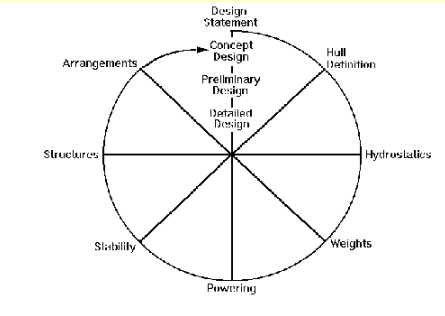
OCEAN Class Schedule



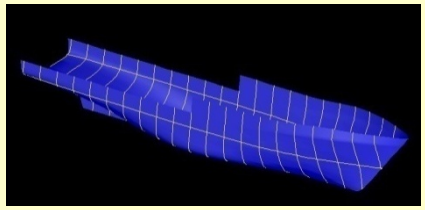


US RV Programs

OCEAN Class Efforts in 2008

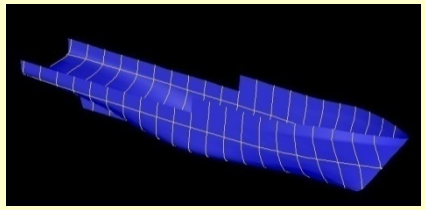


- Notional Designs Developed
  - "Threshold" and "Objective" Requirements Defined
  - To Validate Achievability and Affordability of Requirements
  - Develop Cost Estimates for Planning and Budget Purposes
  - Identify Potential Design Risk Areas
- Trade-off Analyses Performed in Key Areas to Assess Systems/Features with Respect to Performance and Cost
  - *Bubble Sweepdown CFD Analysis*
  - *Sonar Mounting Arrangement*
  - *Multibeam Sonar Performance*
  - *Propulsor Configuration*
  - *Propeller Parametric Study*
  - *Dynamic Positioning Capabilities*
  - *Over-the-side Handling Systems (CTD)*
  - *Radiated Noise*
  - *Improved Reliability/Maintainability*
  - *Corrosion Protection*

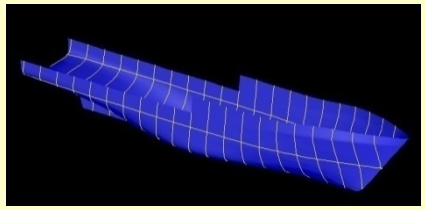


Ocean AGOR Sonar Study Efforts

- Investigate Different Mounting Configurations For Scientific Sonars
- Investigate Impact On Vessel Design, Port Access And Acquisition Cost
- Investigate Impact On Sonar Performance Including Sonar Self Noise And Bubble Sweepdown.

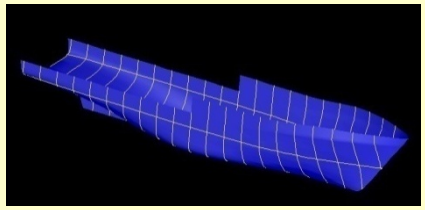


- Bubbles generated by:
  - Natural wind and wave interactions
  - Ship induced turbulent flow at water surface (bow wake)
- Transported by hydrodynamic flow lines around and under hull form
- Two degradation effects:
  - Local noise generated by bubbles
  - Bubbles act as acoustic baffle
- Results in lost signal return
- Effects generally worse in higher sea states and higher speeds

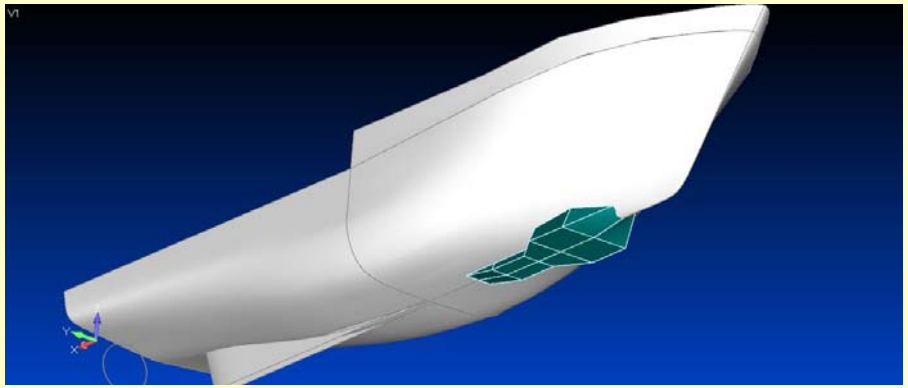


Approaches to Reduce Bubble Sweepdown

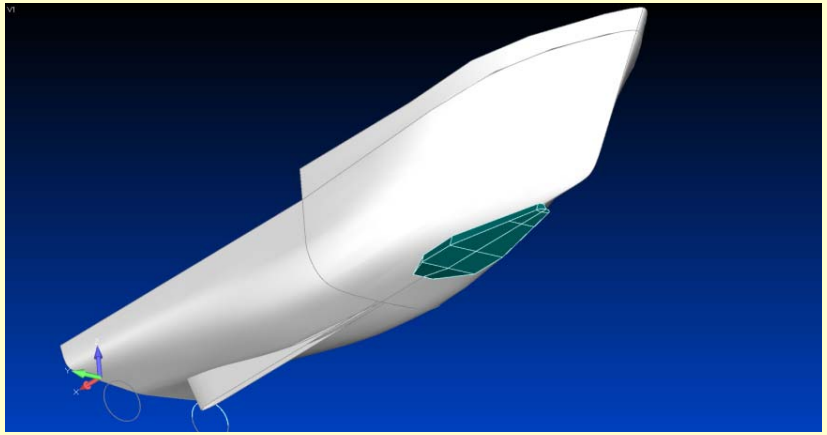
- Install Bubble Diverting Fences
- Install A Gondola
- Install Sonar Fairings To Divert Bubbles Away From Sonar Transducers
- Locate Sonars Forward Of Bubble Flow Streamlines
- Operational Changes
  - Reduce Ship Speed
  - Ballast To Deeper Draft And/Or Trim By Bow
  - Modify Survey Headings To Reduce Pitching
- Bow Shape Design
  - Avoid Bulbous Bows
  - Design Bow Shape To Direct Bubble Flow Streamlines Up And Aft



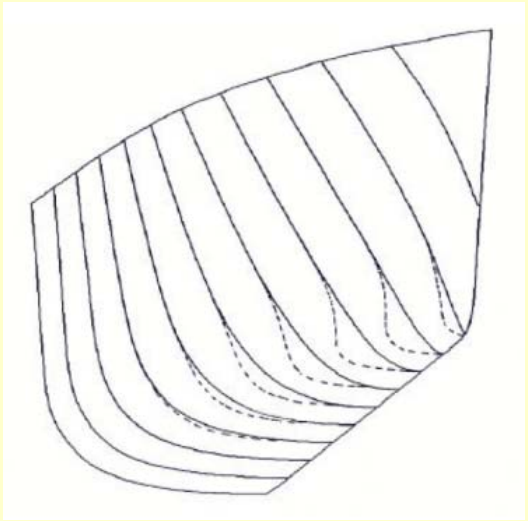
Potential Ocean AGOR Sonar Configurations



Keel Fairing

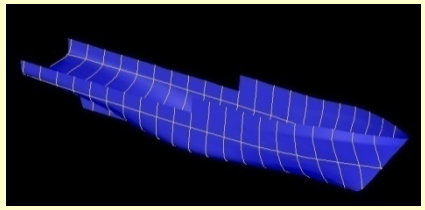


“Cow Catcher” Fairing

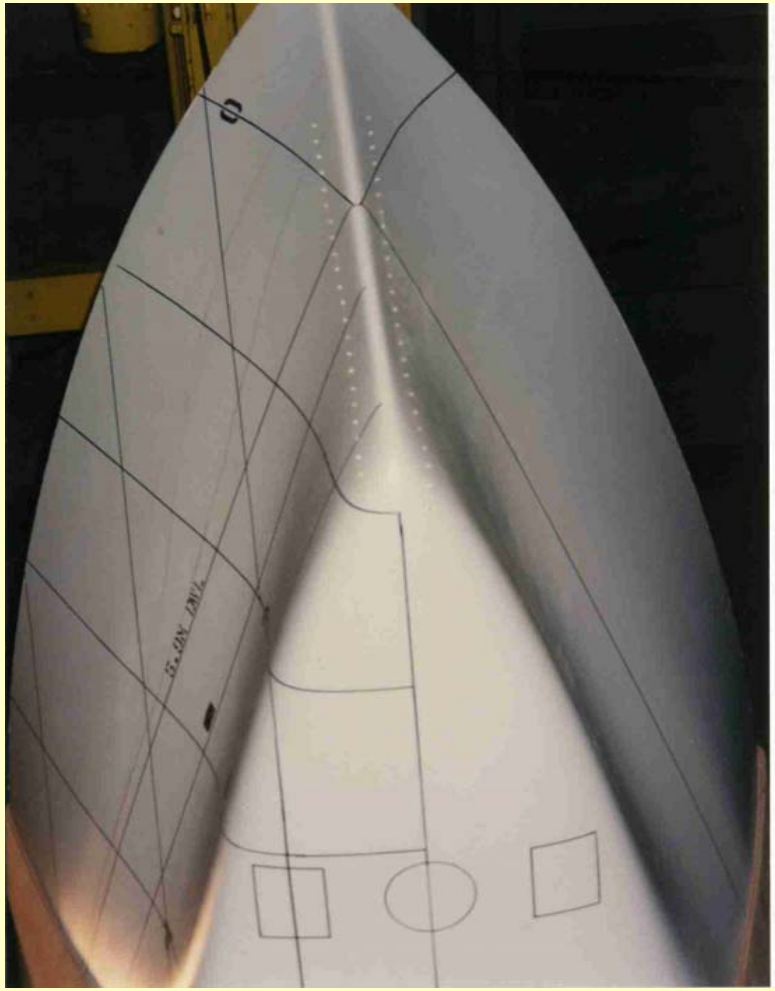


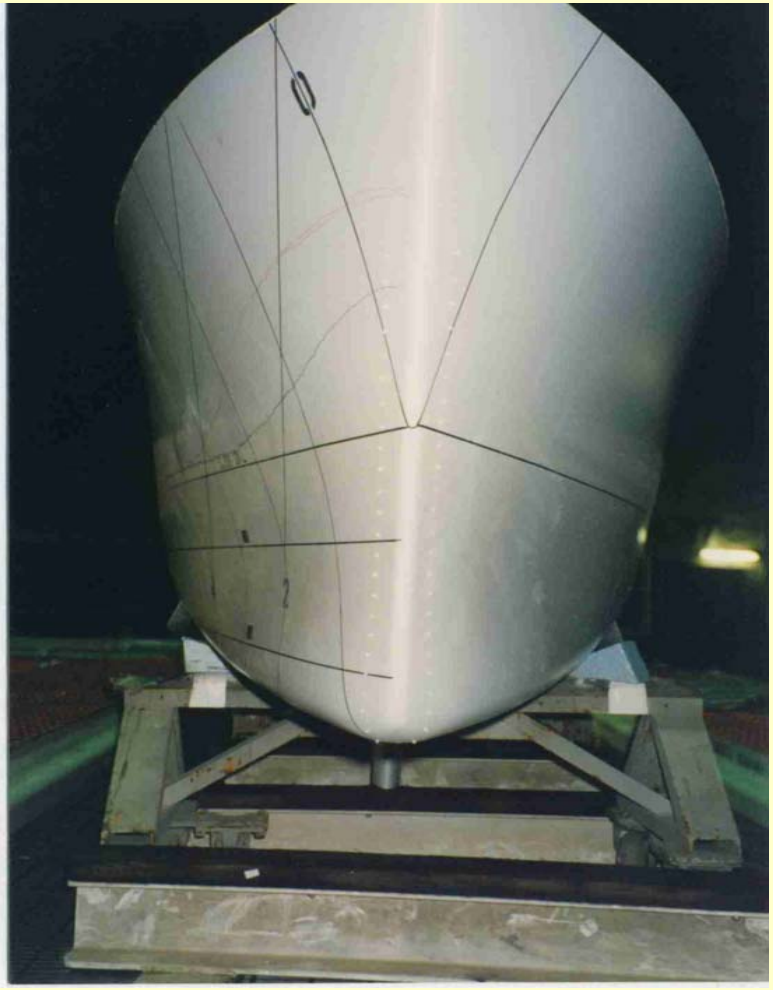
Modified Bow Shape

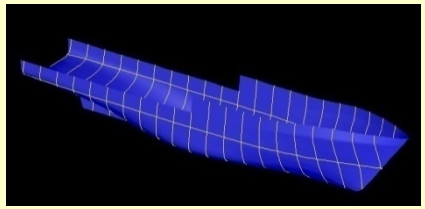
Gondola



US RV Programs







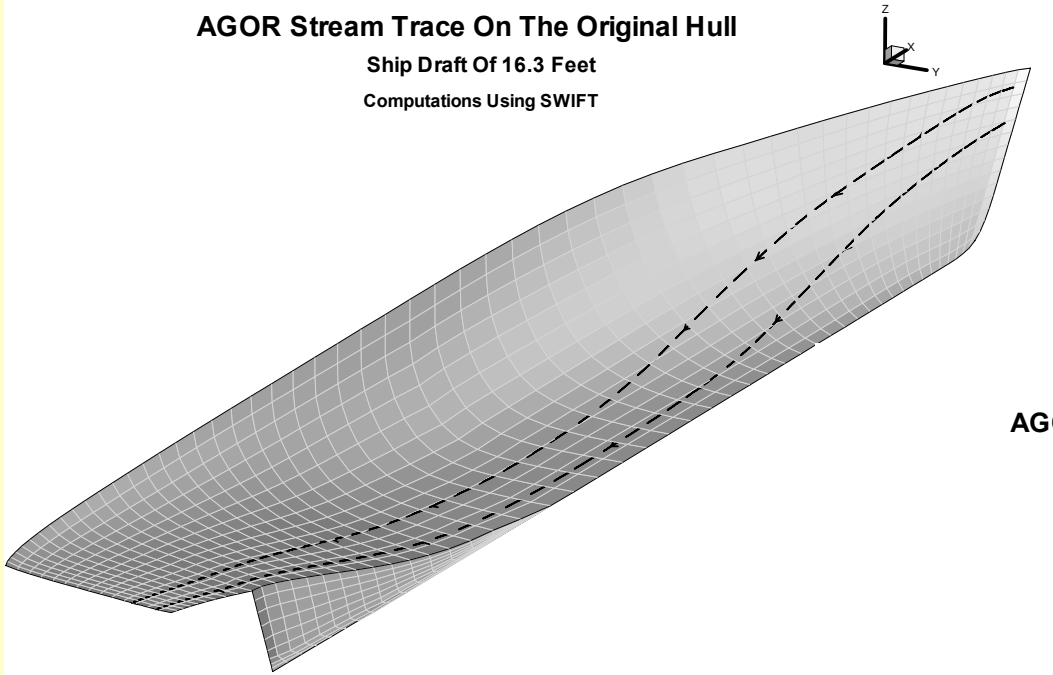
US RV Programs

Sonar Performance Studies

AGOR Stream Trace On The Original Hull

Ship Draft Of 16.3 Feet

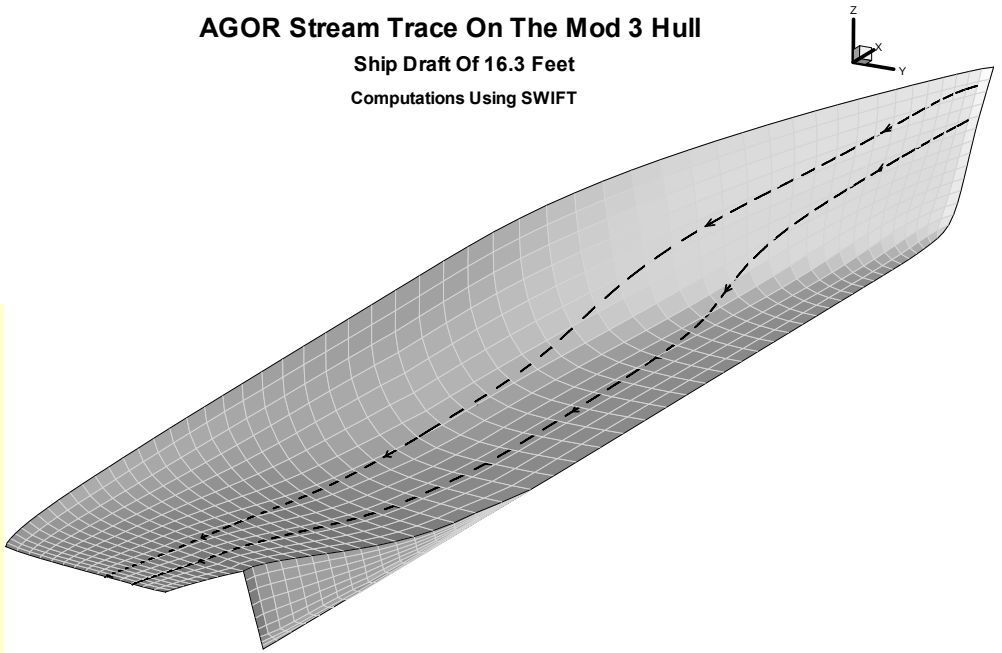
Computations Using SWIFT

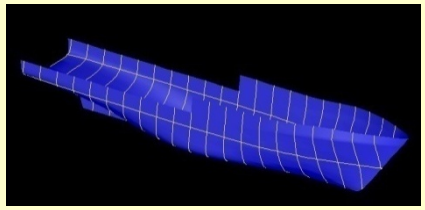


AGOR Stream Trace On The Mod 3 Hull

Ship Draft Of 16.3 Feet

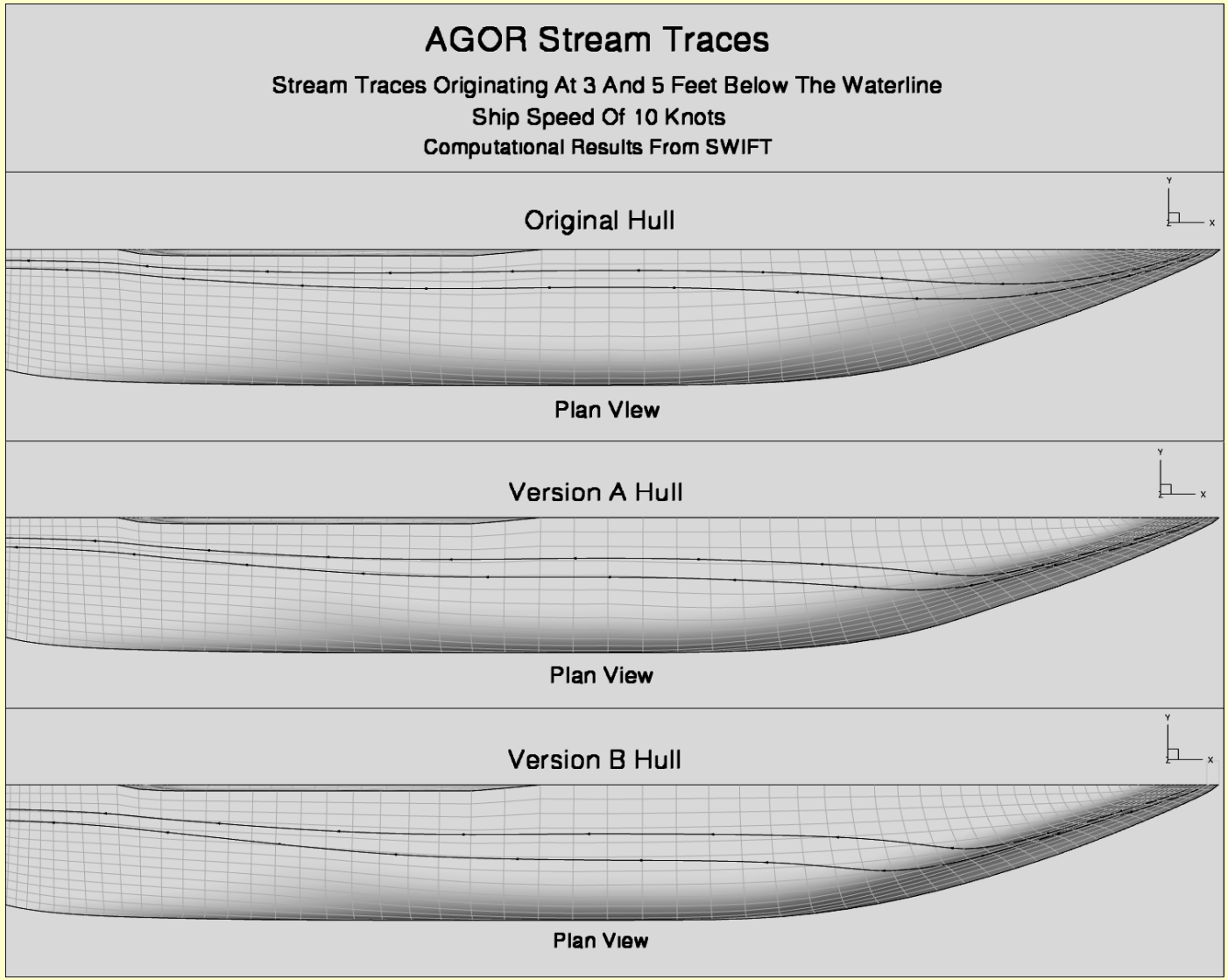
Computations Using SWIFT

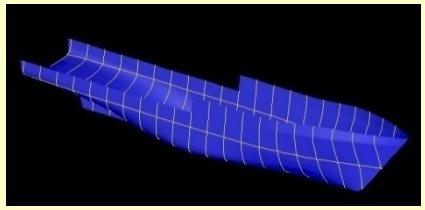




US RV Programs

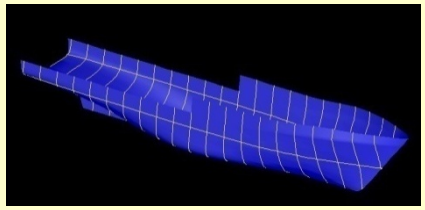
Plan Views of Forebody Variants





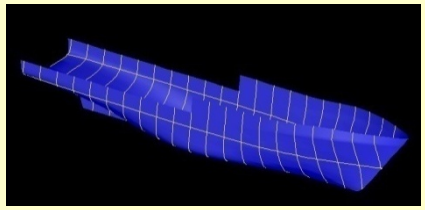
US RV Programs — Sonar Mounting Evaluation

Mounting Option	Impact on Fuel Consumption	Sonar Performance	Impact on Navigational Draft
Flush - baseline hull	Almost zero	Poor - baseline hull	None
Flush - bulbous forebody	Minimal - 1 to 4%	Good - bulbous forebody (4m Rx array)	None
"Cow Catcher" Fairing	Low - <5%	Good - proven on AGOR 23/24 (4m Rx array)	Moderate - adds 0.6 meter
Keel Fairing	Lower - very small projected area	Fair - depth may be insufficient to avoid most bubbles	Minimal to None
Flow Fences	Highest - 20 % added resistance	Good - alignment important, cavitation risk, good remedial fix	None
Gondola	High - 16 % (8m array); 12% (4m array)	Excellent - lowest risk option on many ships	High - adds 1-2 meters

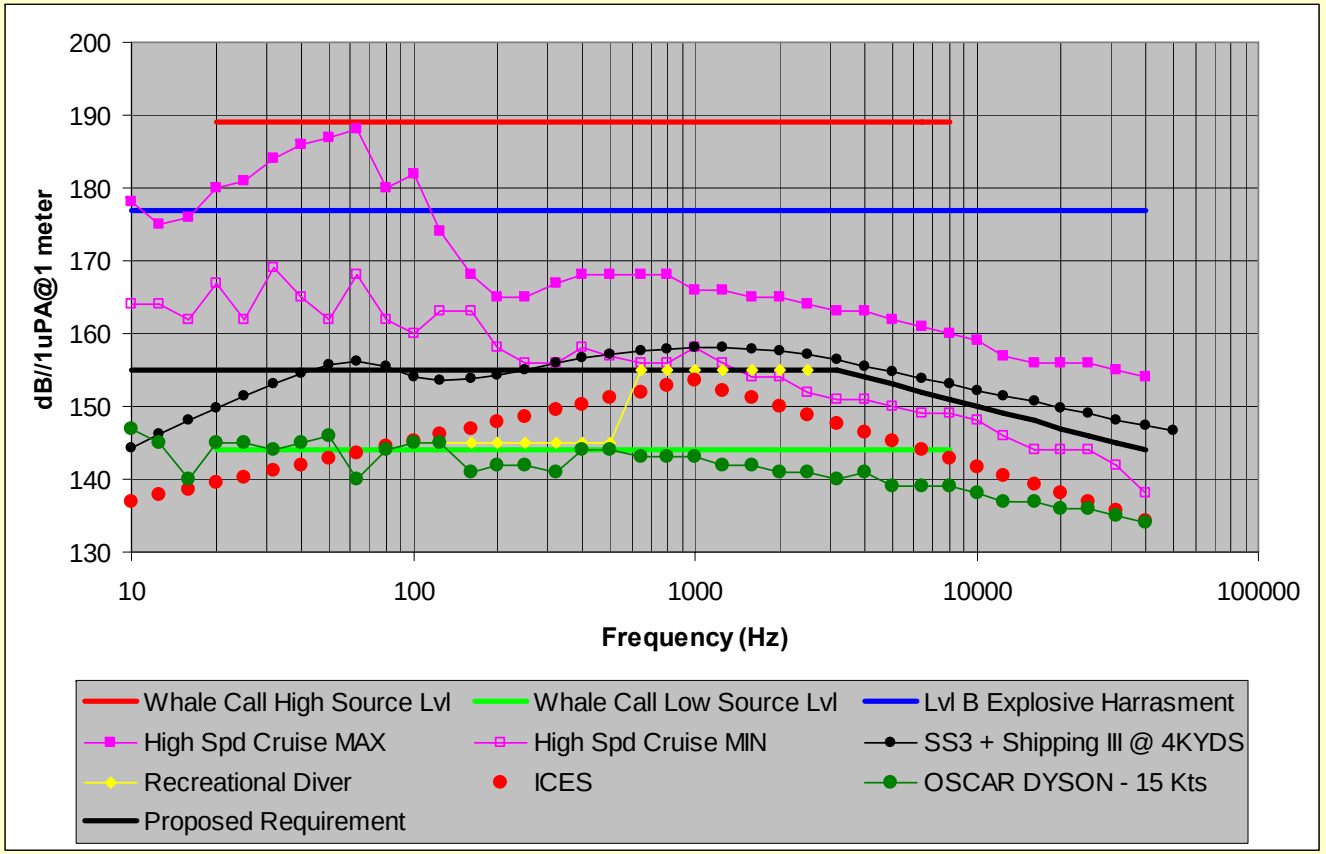


Specification Requirements Related to Bubble Sweepdown

- Require computational fluid dynamic (CFD) analysis
- Specify minimum distance between bow area flow streamlines and sonar locations.
- Consider streamline origination points below DWL to account for pitch motion
- Model scale flow visualization testing using water soluble dye has been found more effective than paint tests in predicting bubble paths and is also required.

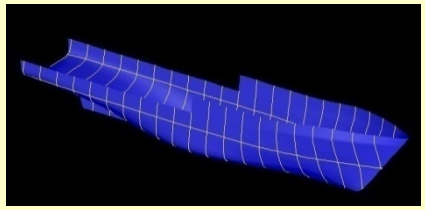


US RV Programs — Radiated Noise Study



Ship Noise will be lost in a State 3 Sea / Shipping Density III at 4000 yards

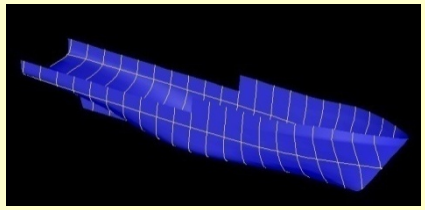
- Full Compliance with ICES 209 is Very Expensive
- Not Required for General Purpose Vessel
- Some Reduced Level of Performance Still Desired
- Developed Standard More Appropriate to General Purpose Mission



US RV Programs

Regional Class Research Vessel

- Class of Up to 3 Small, Regional, General Purpose Research Vessels
- Approximately 40 Meters Long, Monohull
- To be Operated by UNOLS Academic Institutions
- Two Contracts Awarded May 2006 for Competitive Preliminary/Contract Design Period
- Phase I Designs Completed late 2008
- NSF funding shortfall
- Design review to be held in August 2009
- Construction Planned to Start 2010 or 2011



US RV Programs

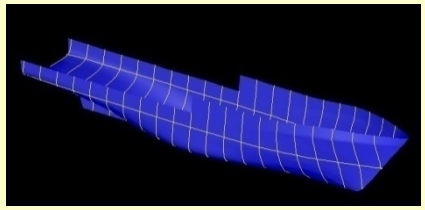
Alaska Region Research Vessel (ARRV)

- Final Design Review Completed October 2008
- $123M Total Budget
- Z Drives To Be Provided Owner Furnished
- Investigating 3.7m Hull Lengthening to Accommodate Anti-Roll Tank
- Funding in Economic Stimulus Bill
- RFP Released March 2009
- Award Expected October 2009
- Delivery in 3 Years +/-

http://www.sfos.uaf.edu/arrv/

Table of Characteristics

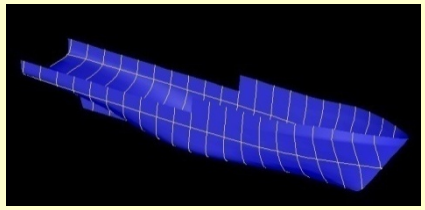
Overall length:	236 feet
Draft:	18 feet
Beam:	52 feet
Speed:	14.2 knots
Endurance:	45 days
Icebreaking:	2.5 feet at 2 knots
Scientist berths:	26
Crew berths:	17-20
Science labs:	2100 square feet
Deck working area:	3,690 square feet



US RV Programs

T-AGS 66 Survey Ship

- 109 Meter, Multi-Purpose, Survey Ship
- Owned by US Naval Oceanographic Office; Supports US Naval Fleet
- Sole Source Procurement from Original Builder of T-AGS 60 Class
- Modified Repeat of T-AGS 60 Class
  - 9 Meter Increase in Length
  - Moonpool for AUV Operations
  - Additional Staterooms
  - Convert DC to AC Propulsion
- RFP Released in April 2009
- Award Expected in September 2009
- Delivery in 2013

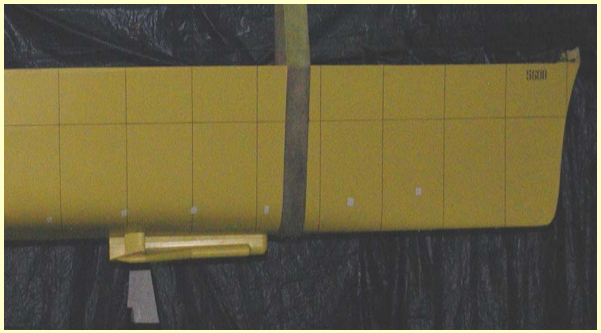


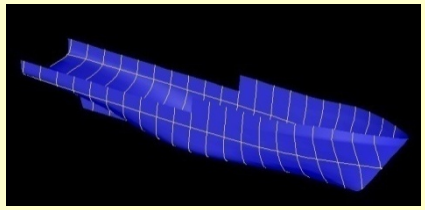
US RV Programs

T-AGS 60 Class Sonar Upgrades

- Class of Six - 100 Meter Survey Ships
- One Upgraded Per Year
- Third Ship Completed in June 2009
- Flush Mounted Systems Replaced with Gondola

Equipment	Frequency
Kongsberg EM122 Deep Multibeam	12 kHz
Kongsberg EM710 Midwater Multibeam	70-100 kHz
Kongsberg EA-600 Single Beam	12, 38, 120, and 200 kHz
Kongsberg SBP120 Subbottom Profiler	2 kHz – 8 kHz 15 kHz – 20 kHz
RDI Acoustic Doppler Current Profiler	38 kHz, 75 kHz, 150 kHz
Acoustic Navigation System	20 kHz – 30 kHz





Thank You