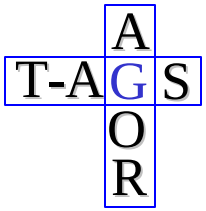
Progress Review
September 2002

Purpose:

To minimize acquisition costs and maximize technology leverage for new Navy oceanographic ships by examining the feasibility of a common (or similar) hull platform for future AGOR and T-AGS ships



Common Hull Oceanographic Ship Study

- **Four New Classes of Navy Oceanographic Ships Considered In The Study:**
  1) OCEAN Class AGOR
  2) T-AGS 66 (Stretched T-AGS 63 with AUV Moon Pool)
  3) T-AGS(X) - Battlespace Characterization Ship
  4) REGIONAL Class AGOR

- **Study Tasks:**
  1) Compile Desired Capabilities for Each Class
  2) Perform ROM studies for each class for various hull forms
  3) Identify areas of commonality and attempt to find common or similar hull forms
  4) Develop Construction and Operating Cost Estimates

- **Snapshot of Current Status:**
  1) IPTs have completed draft desired capabilities for each ship class
  2) ROM designs have been completed for each class, including monohull, SWATH, SLICE, trimaran, catamaran, and HSV variants
  3) Work in Progress: Construction Cost Estimate, Refinement of ROM Designs, Development of Recommendations, Final Report

• ONR To Report to Congress By 01 Feb 2003 on UNOLS fleet replacement recommendations.

COMMON HULL STUDY APPROACH

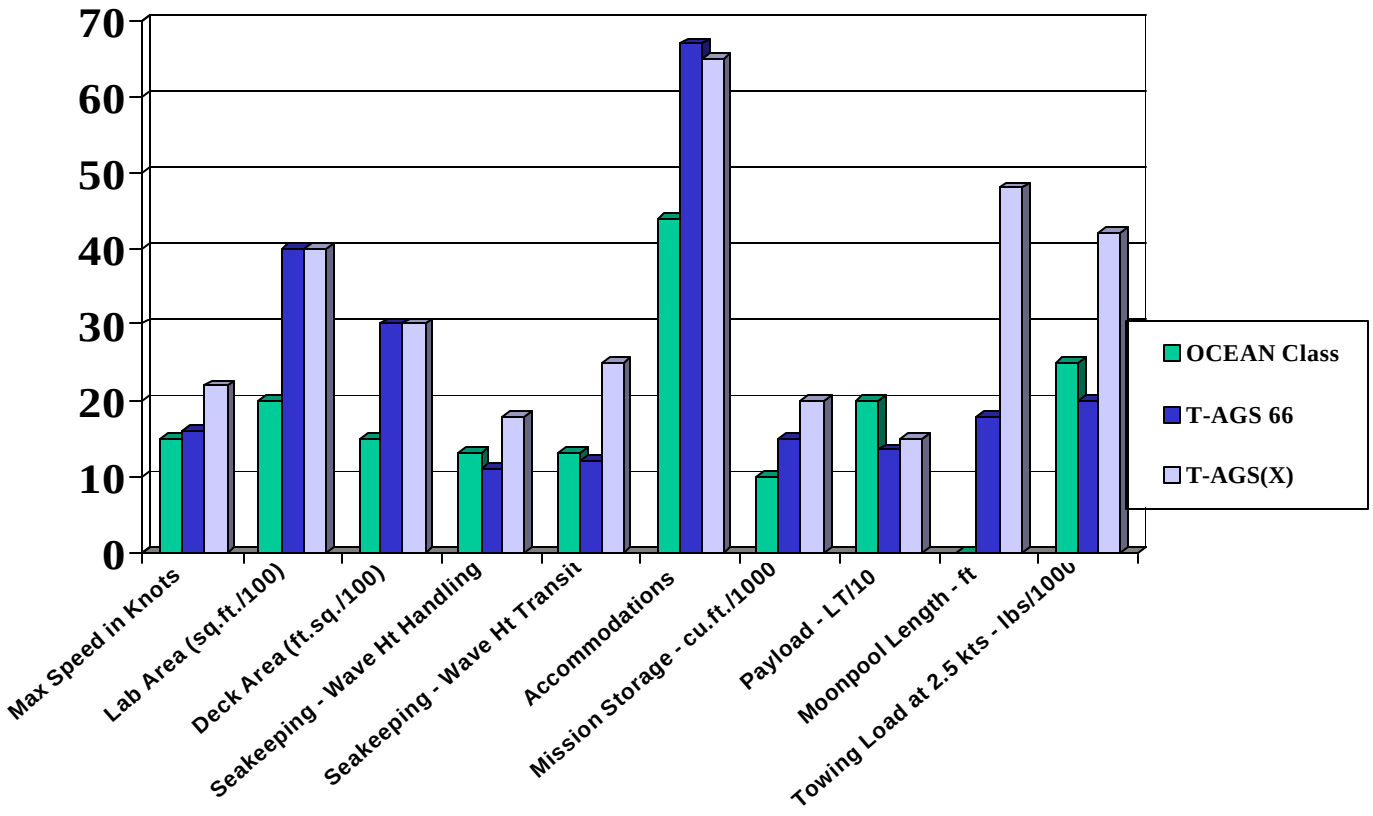
- Recent Successful Ships Used As Baselines
  - Monohull - AGOR 23/24 Class
  - SWATH/Twin Hulls - AGOR 26

- Developed ROM Platform Sizes to Meet OCEAN Class Desired Capabilities

- Stretched OCEAN Class Platform to Sizes Necessary To Meet Capabilities of T-AGS 66 and T-AGS(X)

- Also Looked T-AGS 60/63 Class as Baseline and Stretching to Meet T-AGS 66 and T-AGS(X) Capabilities

Comparison of Desired Capabilities By Ship Class



Oceanographic Ship Desired Capabilities by Class

	T-AGS(X)	***T-AGS 66***	***OCEAN Class***	***REGIONAL Class***
Accommodations	50-65	72	25 + Crew (39 to 44 total)	20+crew (25 to 30 total)
Seakeeping	Operations - SS6 All Headings, Flight Deck & Moonpool Ops @ SS5	Transit, 18 kts, all headings w/ 8.2 feet wave. 10 kts, best heading 12.2 feet waves	SS5, 6	9 kts in SS4, 80% operability on station. SS5 @ 7 kts w/ 50% operability on station. SS6 @ 4 kts w/ 25% ops on station. Survive SS7.
Draft	18-22	18	19 feet	
Speed/Power/Endurance:				
Speed, sustained	14-16	16	12 in SS4	10 to 12 (10 kts sutained thru SS4)
Speed, maximum	20-22	16	15	12 to 14
Speed, survey	15 in SS4	15		
Towing	42000 @3-6kts?, 10,000 @8-12kts, 20,000@6-10kts	10000@5kts, 20,000 @ 2.5 kts	10000@6kts, 25,000@2.5kts	10000@6kts, 20,000@4kts
Endurance	10-12,000nm @16 kts w/ 10% reserve, 30-35 days on station	12000 nm @12kts plus 29 days at 3 knots	20 days, 10,800 NM @ at least 12 kts	30 days, 8100 NM

Oceanographic Ship Capabilities by Class

	T-AGS(X)	*T-AGS 66*	*OCEAN Class*	*REGIONAL Class*
Certifications:				
ABS	Yes	Yes	Yes	Yes
USCG	Subchap U	Subchap U	Subchap U	?
Ice Class	Unk	C	D0	
Space and Payload:				
Total Lab Space, sq ft	4,000	4,000	2,000	1000-1500
Number of Labs	Multiple	5		
Working Deck Space, sq ft	2,500	3,500	1,500	1,300
Mission storage, cu ft	20,000	15,000	5000-10000	400-500
Mission payload, long tons	150	135	200	
Van Capacity	4	4	4	2
Helicopter Capability	Landing	Day hover	No	No
AUV/UUV Handling	Full capability	Moonpool	Articulating Cranes	Yes
UAV Handling	Full capability	None		

Oceanographic Ship Capabilities by Class

	T-AGS(X)	***T-AGS 66***	***OCEAN Class***	***REGIONAL Class***
Mission Electronics Systems:				
Dynamic Positioning	Yes	Yes	Yes	Yes
Deep multibeam	Yes (1x1 deg)	Yes (1x1 deg)	Yes (1x1 deg)	
Shallow multibeam	Yes	Yes	Yes	Yes
Single beam echosounder	Yes	Yes	Yes	Yes
Subbottom profiler	Yes	Yes	Yes	Yes
ADCP	Yes	Yes	Yes	Yes
Seismic	Yes	Yes	Yes	
Magnetometer	Yes	Yes	Yes	Yes
Acoustic positioning	Yes	Yes	Yes	Yes
Phased array weather radar	Yes	No	No	No
Handling Systems:				
Moon Pool/Centerwell	Yes (48 ft x 24 ft)	Yes (18 ft x 18 ft)	No	
Stern U frame	1	Yes	Yes	
Side U frame	1	Yes		
Towing crane	1	Yes	Yes	
Boom cranes	1	Yes (1)	Yes	
Traction winch	1	Yes	Inside Ship	
Hydrographic winch	2	Yes (2)	Inside Ship	
Hydro survey launches	2	Yes (2)	1	1 16' workboat

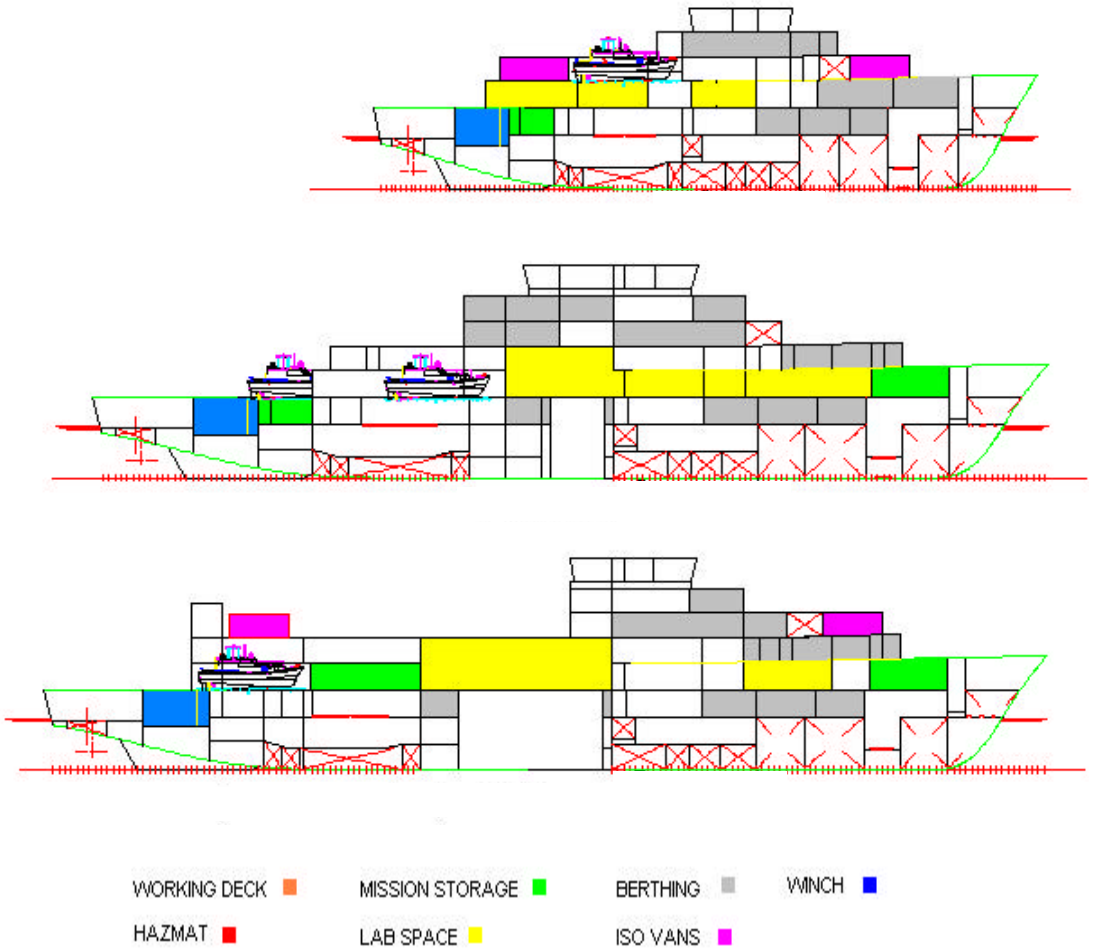
Common Hull Oceanographic Ship Study

ROM Platform Principal Particulars

	T-AGS(X)				T-AGS 66				OCEAN CLASS				
	Monohull	SWATH	Catamaran	Trimaran	Monohull	SWATH	Catamaran	Trimaran	Monohull	Monohull (52.5' Beam)	SWATH	Catamaran	Trimaran
DIMENSIONS													
LWL, ft	316.7	276	276	369	300.7	220	220	347	207.2	207.2	156	163	295
B, overall, ft	54	88	88	74	52.5	88	88	74	43.05	52.5	88	88	74
B, demihull, ft	NA	24.6	25	7	NA	22.5	25	7	NA	NA	21	24	5.25
Draft, T, ft	18	29.2	24	21	17	27	18	17.5	17	17	25	20.6	19
Displacement, LT	5,637	5,575	5,812	5,745	4,129	3,741	3,703	3,629	2,230	2,566	2,550	2,415	2,639
SPEED/POWER													
Endurance Fuel, LT	1,281	1,541	1,498	1,485	574	781	665	687	397	415	488	460	516
SHP	18,845	19,626	23,959	17,475	5,056	6,057	7,991	6,721	3,608	4,090	4,450	6,903	5,019
Top Speed, knots	20	20	20	20	16	16	16	16	15	15	15	15	15
Endur. Speed, knots	16	16	16	16	12	12	12	12	12	12	12	12	12
SPACE/VOLUME													
Lab Space, sq. ft.	4,300	4,100	4,100	4,000	4,000	4,100	4,100	4,000	2,000	2000+	2,000	2,000	2,000
Working Deck Area, sq. ft.	2,550	2,500	2,500	2,800	3,650	3,500	3,500	3,670	1,590	1590+	2,020	2,020	1,550
Mission Storage, cu. ft.	20,700	21,300	21,300	24,400	15,400	17,600	17,600	15,000	5,800	5800+	5,500	5,500	7,900
COSTS													
Yearly Operating Fuel Cost, $K	1,362	1,701	1,574	1,621	730	940	1,086	965	403	427	493	497	527
Yearly Operating Manning, $K	3,346	3,346	3,346	3,346	2,788	2,788	2,788	2,788	2,119	2,119	2,119	2,119	2,119
Yearly Maintenance Cost, $K	1,213	1,203	1,244	1,239	842	802	798	787	483	589	551	524	568
Yearly Misc Cost, $K	2,386	2,367	2,446	2,438	1,655	1,552	1,570	1,548	950	1,158	1,084	1,030	1,116
Yearly Operating Total Cost, $K	8,307	8,617	8,610	8,644	6,015	6,082	6,242	6,088	3,955	4,293	4,247	4,170	4,330

Common Hull Oceanographic Ship Study

MONOHULL VARIANT

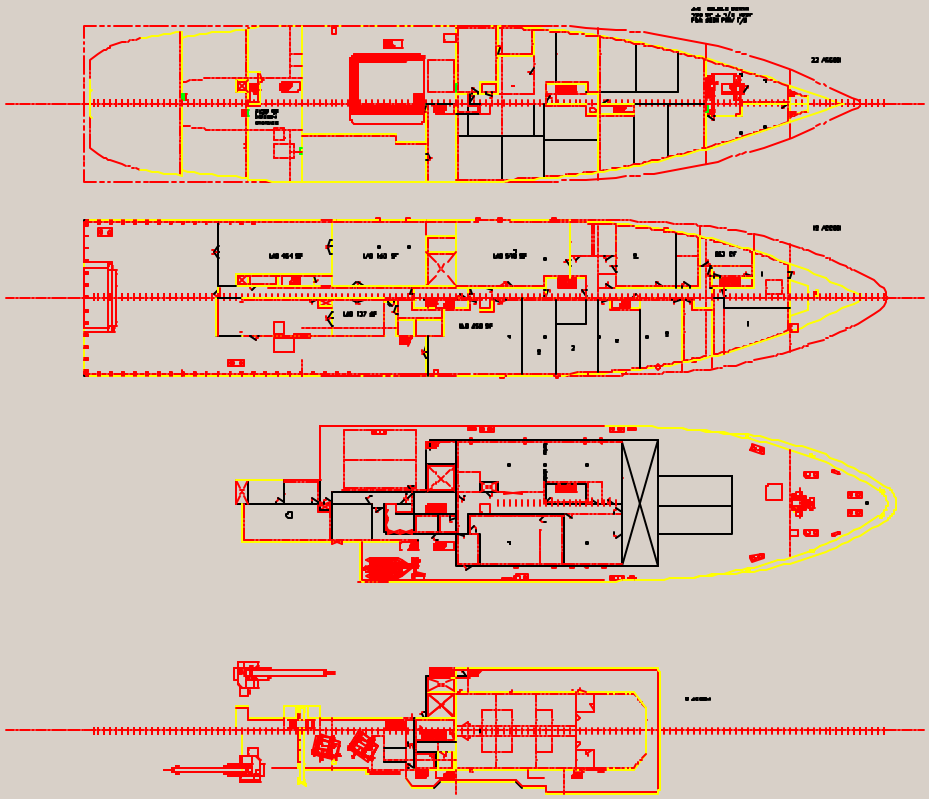


- OCEAN Class AGOR
  - L=207’ B=43’
  - T=17’
  - DISPL=2,230 LT
- T-AGS 66
  - L=300’ B=52.5’
  - T=17’
  - DISPL=4,200 LT
- T-AGS(X)
  - L=316.7’ B=54’
  - T=18’
  - DISPL=5640 LT

T-AGOS

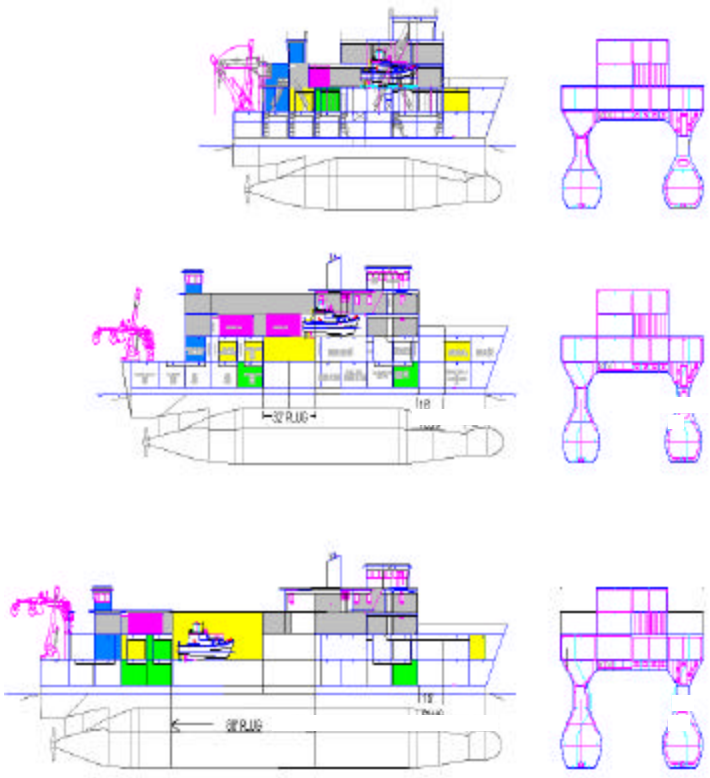
Common Hull Oceanographic Ship Study

ROM Arrangement For A Monohull OCEAN Class:



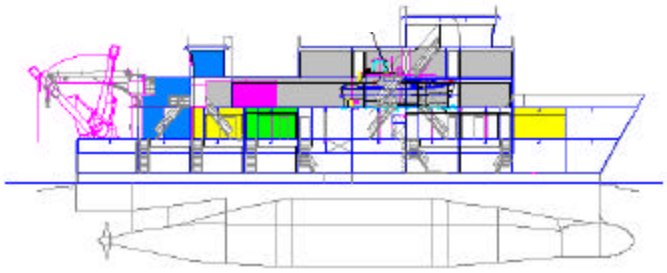
Common Hull Oceanographic Ship Study

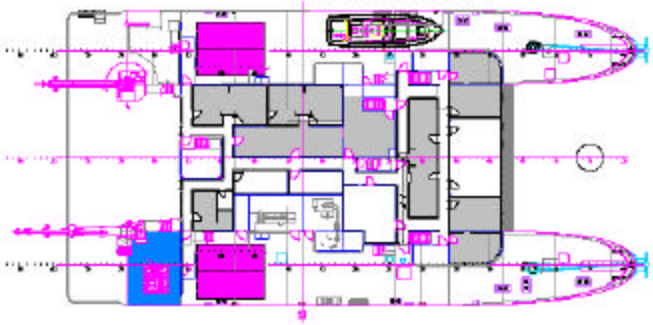
SWATH VARIANT



- OCEAN Class AGOR
  - L=156’ B=88’
  - T=25’
  - DISPL=2550 LT
- T-AGS 66
  - L=220’ B=88’
  - T=27’
  - DISPL=3741 LT
- T-AGS(X)
  - L=276’ B=88’
  - T=29.2’
  - DISPL=5575 LT

Common Hull Oceanographic Ship Study





AGOR 26 ⟶ OCEAN Class:

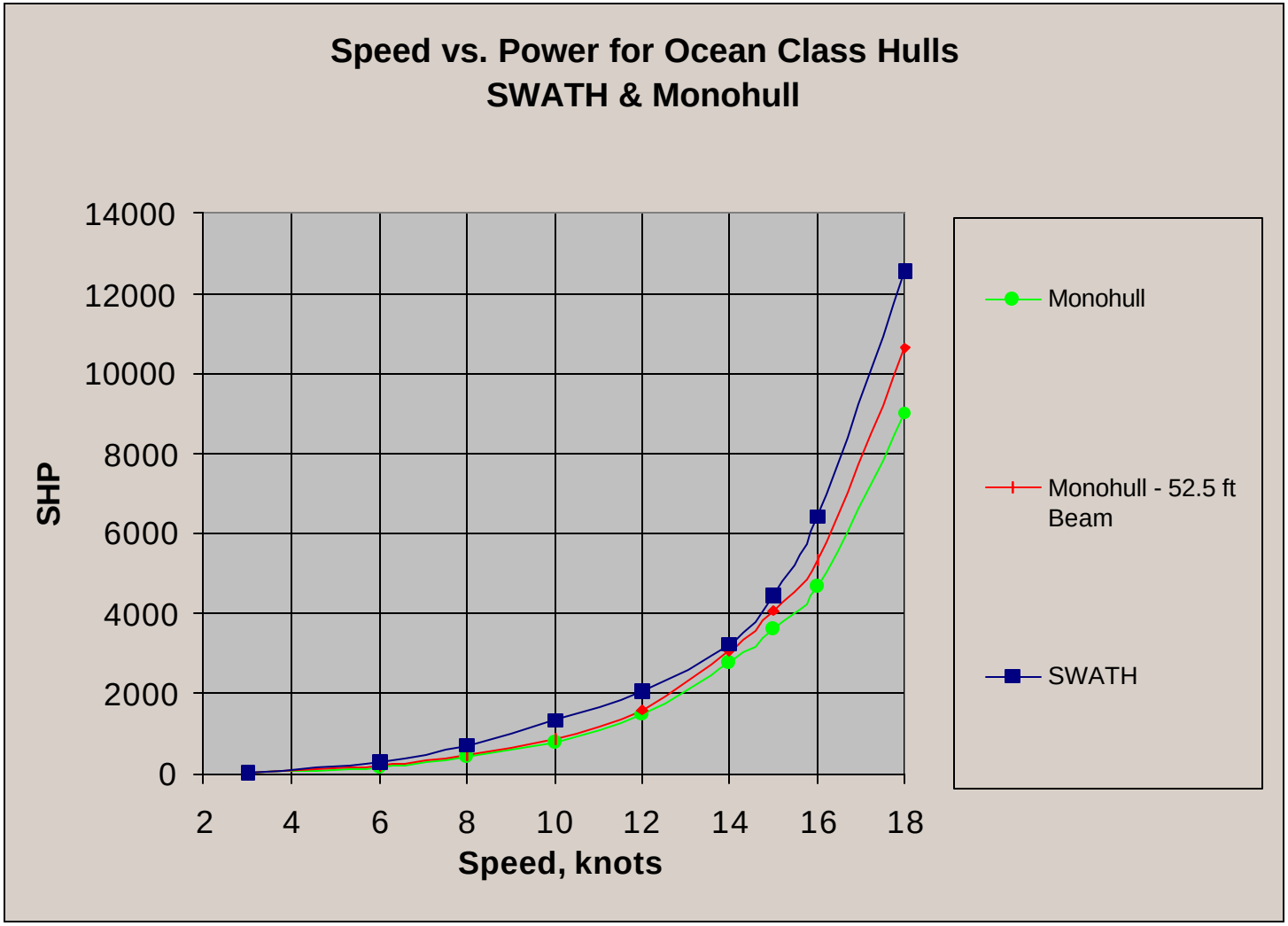
- Reduce Length
- Reduce # Berths (48 to 42)
- Reduce Lab Area (3,000 to 2,000)
- Reduce Working Deck Area (2,200 to 1500)
- Reduce Mission Storage (15K to 5K)
- Increase Endurance Speed (11kts to 12kts)
- Increase Hull Breadth to Carry More Fuel
- Increase Payload (100 to 200 tons)

T-AGOR

Common Hull Oceanographic Ship Study

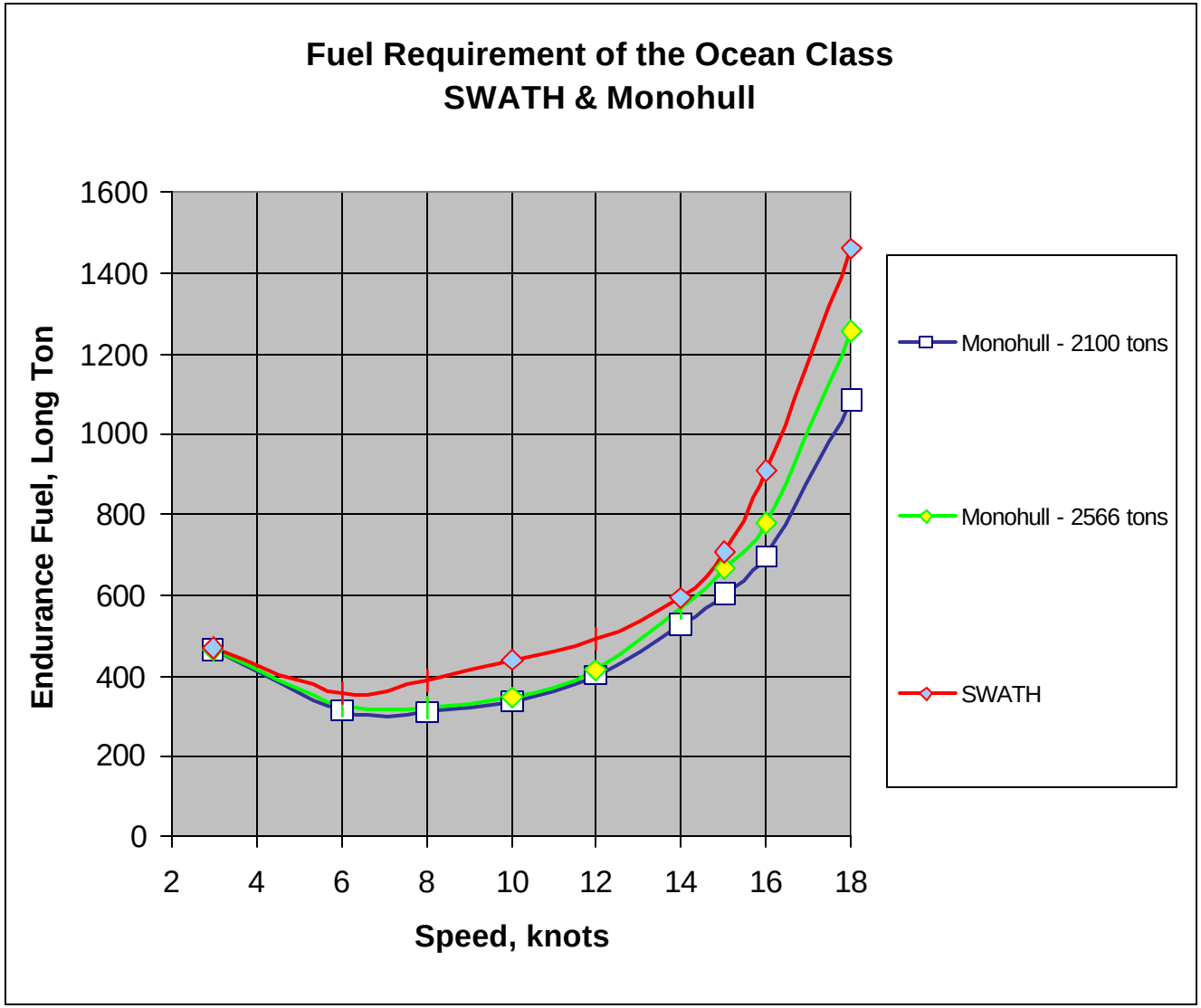
T-AGOR

Common Hull Oceanographic Ship Study



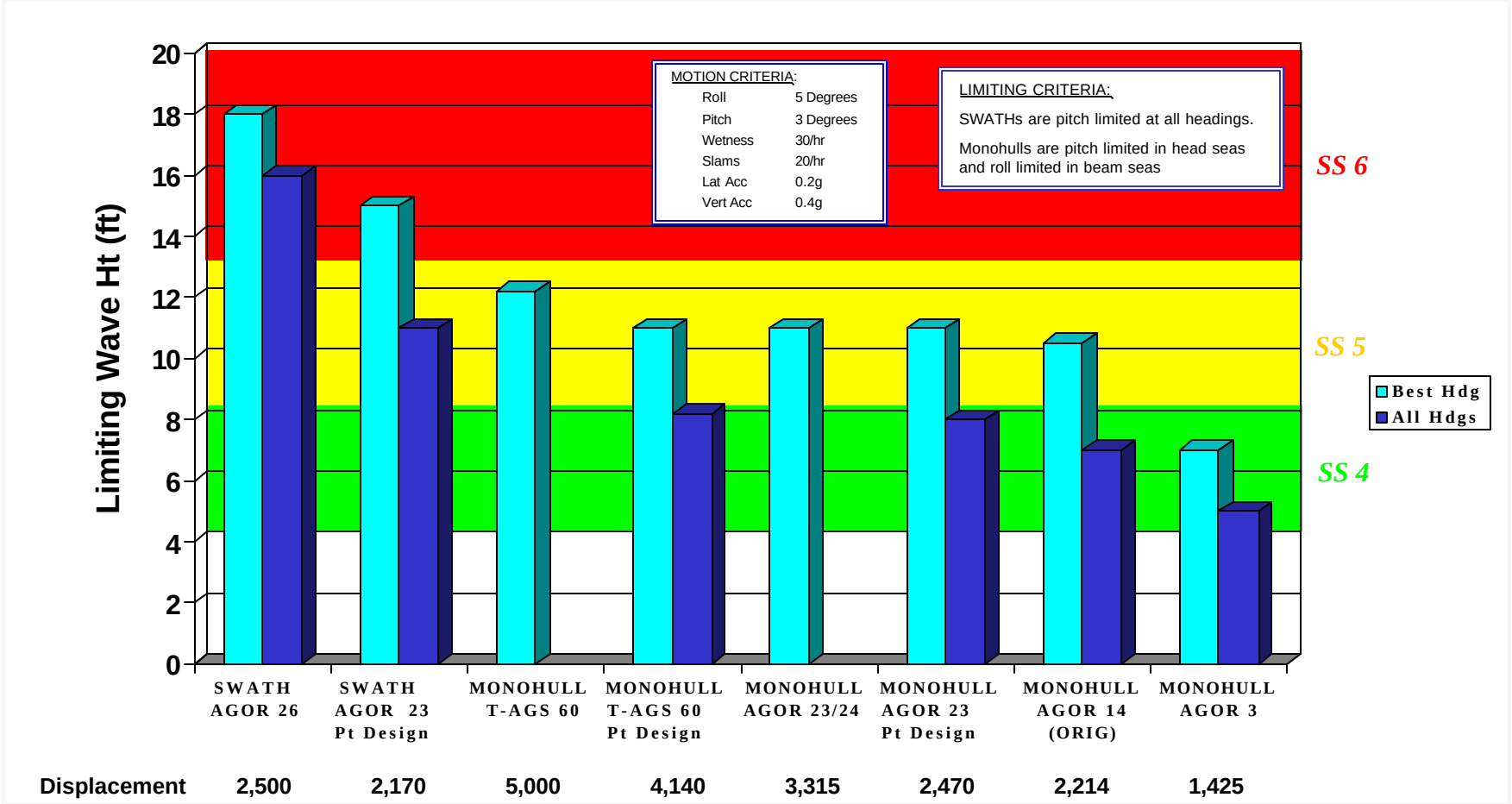
T-AGOR

Common Hull Oceanographic Ship Study



Common Hull Oceanographic Ship Study

Predicted Seakeeping Performance for Recent Oceanographic Ships - On Station Condition



Monohulls Adequate For Mid SS 5 - SWATH Required For SS 6

Common Hull Oceanographic Ship Study

		OCEAN	T-AGS 66	T-AGS(X)
Mono	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			
SWATH	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			
Cat	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			

		OCEAN	T-AGS 66	T-AGS(X)
Tri	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			
SLICE	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			
HSV	Seakeeping			
	Speed			
	Endurance			
	Draft			
	Payload			
	One Degree Multibeam			
	Moon Pool Handling			
	Overside Handling			

GREEN

•Can Meet Full Requirement With Little Difficulty

YELLOW

• Meeting Full Requirement May Be Challenging

RED

• Meeting Full Requirement Will Be Very Difficult

Acoustic Performance Considerations

- Bubble Sweepdown:
  - SWATH AGOR 26 Has No Apparent Bubble Problems Because of Hull Shape and Deep Draft
  - Recent Monohulls (T-AGS 60/63, AGOR 24) Have Bubble Interference With Sonar Performance
  - New Design AGOR and T-AGS Monohulls Will Require Careful Hull Design and/or Sonar Wing or Bubble Diverting Fence To Maximize Sonar Performance
- Machinery Sonar Self Noise
  - Desire For Improvement in OCEAN Class Over AGOR 23/24 Class
  - May Require More Extensive/Better Resilient Mounting, Greater Sonar-Machinery Separation, Quieter Machinery, Damping Tile
- Propeller Self Noise
  - Need Well-Designed, Quiet Propellers to Maximize Sonar Performance
  - SWATH Especially Sensitive to Propeller Noise Because of Cross Hull Path

Observations and Conclusions

- Minor Commonality of Desired Capabilities Exists Among AGORs and T-AGS
  - Handling Systems and Hull Mounted Sensors
- Significant Differences In Capabilities Exist:
  - Speed - Max, Sustained, and Survey
  - Number of Accommodations
  - Working Deck/Lab Areas (T-AGS is 2:1 over OCEAN)
  - Habitability Requirements (T-AGS Requires MSC)
  - Moon Pool
  - Helicopter Landing Capability
  - Mission Electronics and Communications Systems
- T-AGS(X) Platform Is 50% Longer and 2.5x Displacement Of OCEAN Platform
  - If Based On Common Hull, Resulting Platforms Would Not Be Well Optimized For Their Particular Operating Profiles
- Common Hull Platform For OCEAN Class and T-AGS 66, T-AGS(X) Not Feasible

Common Hull Oceanographic Ship Study

- Primary Design Drivers (Not in Particular Order)
  - SEAKEEPING
  - Speed
  - Number Of Accommodations
  - Labs/Working Deck
  - Endurance
  - Science Payload
  - One Degree Multibeam
  - Mission Storage Volume

Monohull and SWATH Appear To Be Most Promising Choices for OCEAN Class

» *Monohull*

- Generally Lower Cost and Risk
- More Economical Cruising; Higher Endurance Speed
- Seakeeping Performance Limited to Low to Mid Sea State 5
  - OCEAN Class Desires Operation Through Sea State 5 and into Sea State 6
- Wide Bottom For Locating 1x1 Degree Deep Multibeam Array
- Susceptible to Bubble Sweepdown

» *SWATH*

- Cost and Risk May Be Higher Than Monohull
- Powering and Endurance Fuel Higher Than Monohull
  - May Have to Accept Slower Cruising Speed and/or Less Range
- Seakeeping Performance Best - Mid Sea State 6 for OCEAN Size
  - OCEAN Class Desires Sea State 5 to 6; T-AGS(X) Desires SS 6
- Draft of 23 to 25 feet Substantially Exceeds Desired Limit of 17 feet
  - Possibly Consider Variable Draft Design, But Requires Significant Compromises
- Narrow Hulls Make It Difficult To Mount 8 Meter Wide 1 Degree Multibeam Array, But No Bubbles
  - May Require A Large Appendage
  - Look At Multibeams That Might Allow Halves of Rx Array To Be Separated
- Ship Weight Sensitivity Makes Ice Classing More Difficult

Other Hull Forms Don't Offer Benefits At OCEAN Class Speed

SLICE

- Powering Performance No Better Than SWATH
- Forward Engines and Propellers May Degrade Sonar Performance
- Prototype Is Small (180T); High Risk To Scale Concept To ~2300T

Catamaran

- Seakeeping Not As Good As SWATH
- Powering Not As Favorable As Monohull Or SWATH

Trimaran

- Narrow Working Deck Aft
- Speed/Power Benefits Come In At Higher Speeds

HSV

- Catamaran Variant Designed For High Speeds
- Fine Hulls Are Problem For Mounting Sonars
- Low Payload Capacity