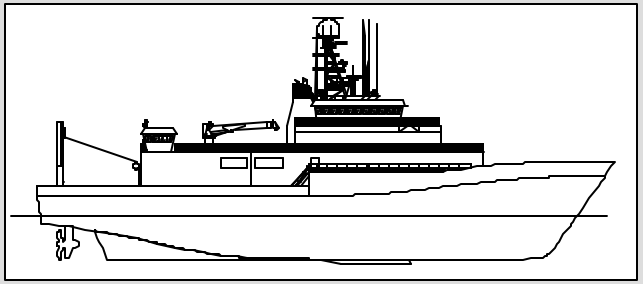
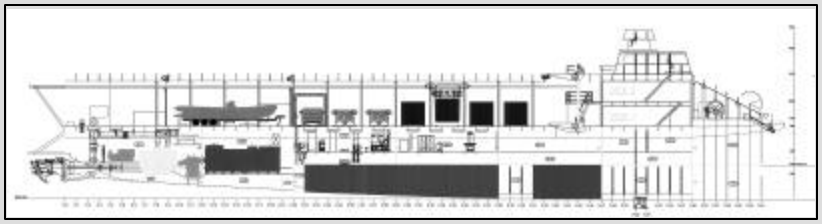
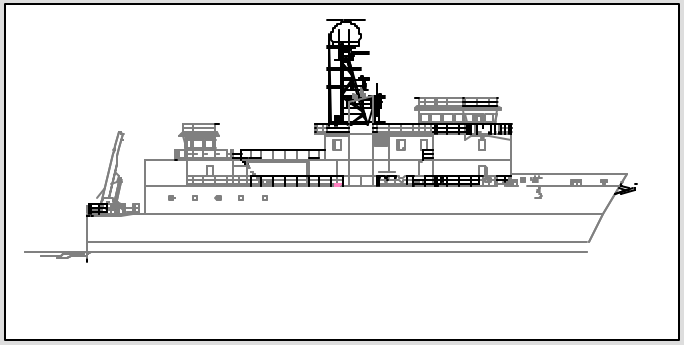
OCEAN Class AGOR
Concept Definition Task







2nd Web Meeting

27 April 2004

Status of OCEAN Class Concept Design Effort

Meeting Date	Monohull	SWATH	X Craft
02-Apr-04	Initial Concept Design - Hull Form - Arrangement - Seakeeping - Propulsion		Initial Concept Design - Hull Form - Arrangement - Propulsion
27-Apr-04	Revised Concept Design - Arrangement Revised to Reflect Comments - PH Location sketch - fwd vs. midship - Fuel endurance calc revised	Initial Concept Design - Hull Form - Arrangement - Propulsion	Revised Concept Design - Z Drive Variant - Waterjet Variant
In Progress	Cost Analysis - Const & Op	Seakeeping Analysis Refinement of Concept Design	Seakeeping Analysis Refinement of Concept Design
To Do	Further refinement of design	Cost Analysis - Const & Op Further refinement of design	Cost Analysis - Const & Op Further refinement of design

OCEAN Class AGOR

Concept Definition

Concept Design Capabilities

	<----------SMRs---------->		<----------OCEAN Class AGOR Variants---------->				
	Minimum	***Desired***	***Monohull***	***SWATH (AGOR 26)***	***X Craft AGOR***	**AGOR 23/24 Class**	**AGOR 14/15 Class**
Seakeeping:							
Seakeeping performance	SS6	SS6	SS6	SS6 Best Hdg	tbd		
Ship Dimensions:							
Length between perp, ft			210	172	240		
Beam, ft			46	88	72		
Depth to Main Deck, ft			24.9	38	tbd		
Draft, ft		19	16.9	25	14.6		
Finished Deck Ht (ft)	7.5	8	8		tbd		
Displacement, long tons			2500	2542	2310		
Propulsion:							
Plant type	Integrated Diesel Electric	Integrated Diesel Electric	Integrated Diesel Electric	Integrated Diesel Electric	Integrated Diesel Electric		
# Screws			2	2	2		
Total SHP			4,000	4,000	6000		
Speed, sustained		12	11	15	tbd		
Speed, maximum		14-15	15	15.5	15		
Speed, survey		12	12	12	tbd		
Towing Requirement	10000@6, 25000@4	10000@6, 25000@4	10000@6, 25000@4	10000#	tbd		
Endurance Requirement	8000 nm @ opt spd, 20 days transit, 20 days station	10800 nm @ 12 kts, 20 days transit, 20 days station, or 30 days survey	10800 nm @ 12 kts, 20 days transit, 20 days station, or 30 days survey	10,000 nm at 11 kts	tbd		
Bow Thruster	Yes	Yes	900 HP	1100 HP	tbd		

OCEAN Class AGOR

Concept Definition

Concept Design Capabilities

	<----------SMRs---------->		<----------OCEAN Class AGOR Variants---------->				
	Minimum	*Desired*	*Monohull*	*SWATH*	*X Craft AGOR*	*AGOR 23/24 Class*	*AGOR 14/15 Class*
Accommodations:							
Crew		USCG	21 est.	21 est.	21 est.	21	21
Scientists	20	25+	25+	25	25		
Total		43	43	46	46		
Certifications:							
ABS	Yes	Yes	Yes	Yes	Yes		
USCG	Subchap U	Subchap U	Subchap U	Subchap U	Subchap U		
Ice Class	A0	A0	A0	D0	tbd		
Space and Payload:							
Total Lab Space, sq ft	1,800	2,000	2,000	2,000	2,100		
Main Lab	1,000	1000+	1,200		tbd		
Wet Lab	400	400+	415	330	tbd		
Computer Lab	300	300+	300	830	tbd		
Climate Contrl'd Work Area	100	100+	115	No	tbd		
Refrigerator/Freezer Space	100	100	100	No	tbd		
Number of Labs	4	4	4		tbd		
Electronics Repair Shop	Yes	Yes	Yes	Yes	tbd		
IT Equipment Space	No	Yes	Yes	Yes	tbd		
IT Storage	Yes	Yes	Yes	Yes	tbd		
ISO Vans	2	2	2	2	tbd		
Vans (Non ISO, 500ft ttl)		2	2	2	tbd		
Working Deck Space, sq ft	2,000	2,000	2,000	2,000	2,050		
Clear Working Deck, sq ft	1,500	1,500	1,500	1,500	tbd		
Clear Rail Deck, sq ft	80' x 8'	80' x 8'	80' x 8'	Transverse	tbd		
Mission storage, cu ft		5,000	5,000	15,000	tbd		
Mission payload, long tons	100	200	200	100	tbd		
High Bay	Yes	Yes	Yes	Yes	tbd		

OCEAN Class AGOR

Concept Definition

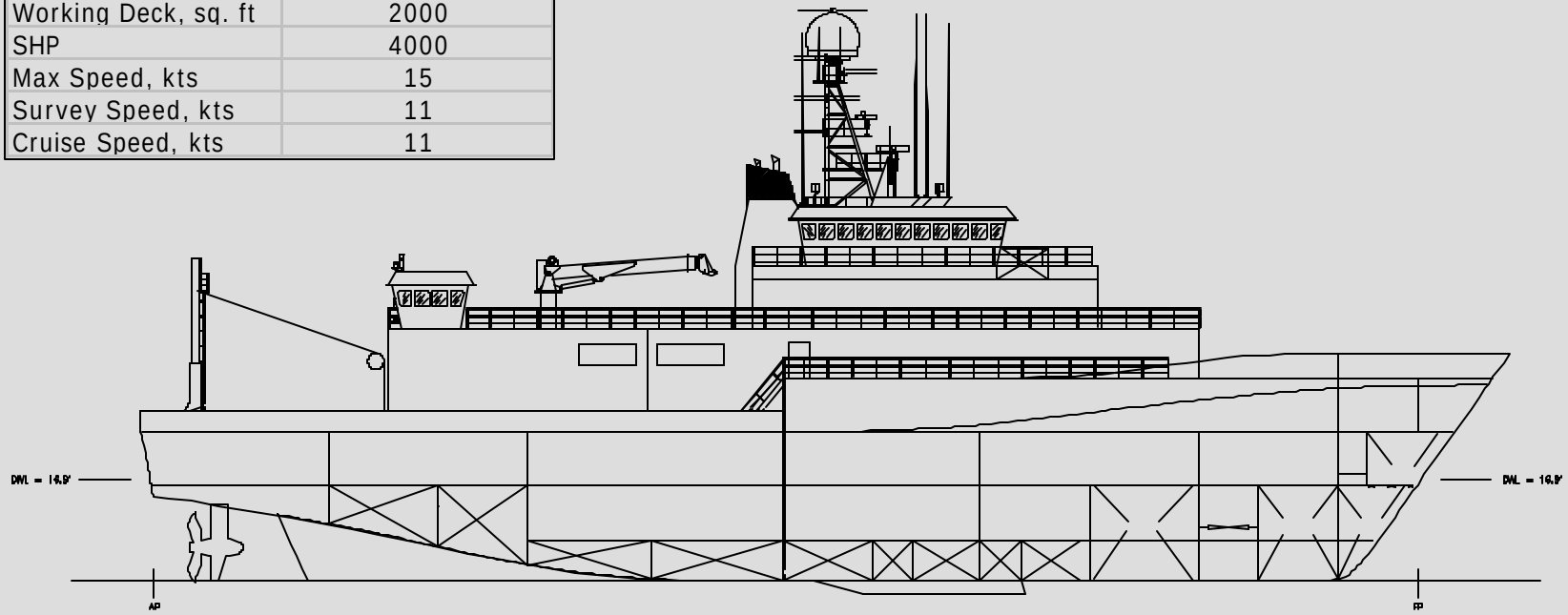
Concept Design Capabilities

	<----------SMRs---------->		<----------OCEAN Class AGOR Variants---------->				
	Minimum	***Desired***	***Monohull***	***SWATH***	***X Craft AGOR***	***AGOR 23/24 Class***	***AGOR 14/15 Class***
Mission Electronics Systems:							
Dynamic Positioning	Yes	Yes	Yes	Yes	Yes		
Deep multibeam	1 deg	1 deg	1 deg	(1x2 deg)	(1x2 deg)		
Shallow multibeam	data to 50m	data to 50m	Yes	Yes	Yes		
Single beam echosounder	12kHz	12kHz	12kHz	12kHz	12kHz		
Subbottom profiler	2-8kHz	2-8kHz	2-8kHz	Yes	Yes		
ADCP	38,75,150kHz	38,75,150kHz	38,75,150kHz	38,75,150kHz	38,75,150kHz		
Acoustic positioning	Yes	Yes	Yes	Yes	Yes		
Handling Systems:							
Stern U frame	30000# 15'Hx25'Vx12'O	30000# 15'Hx25'Vx12'O	30000# 15'Hx25'Vx12'O	30000# 18'Hx25'Vx12'O	30000# 18'Hx25'Vx12'O		
Towing crane				Yes	Yes		
Boom cranes	10000# @12'	20000# @20'	20000# @20'	20000# @20'	20000# @20'		
Traction winch	1	1	1	1	1		
Hydrographic winch	2	2	2	2	2		
Scientific Workboat	25'-30' LOA	25'-30' LOA	Yes	Yes	Yes		
Inflatable Work Boat	1 (16')	1 (16')	1 (16')	Yes	Yes		

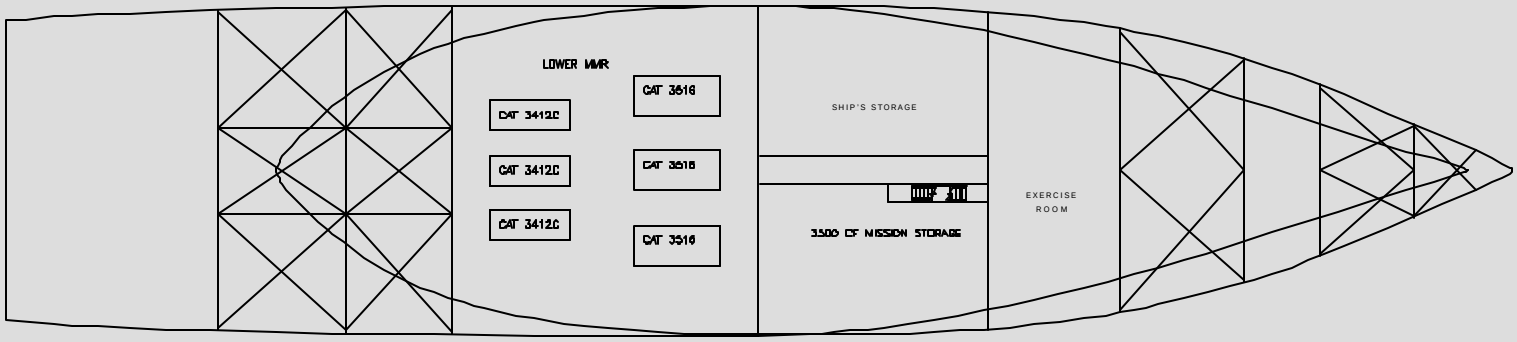
	MAXIMUM MONOHULL
LOA,ft	227
LWL, ft	210
Beam WL, ft	46
Max Beam, ft	46
Draft, ft	16.9
Displacement, LT	2500
Scientists	25
Crew	21 est.
Lab Area, sq. ft	2075
Working Deck, sq. ft	2000
SHP	4000
Max Speed, kts	15
Survey Speed, kts	11
Cruise Speed, kts	11

Maximum Monohull Concept

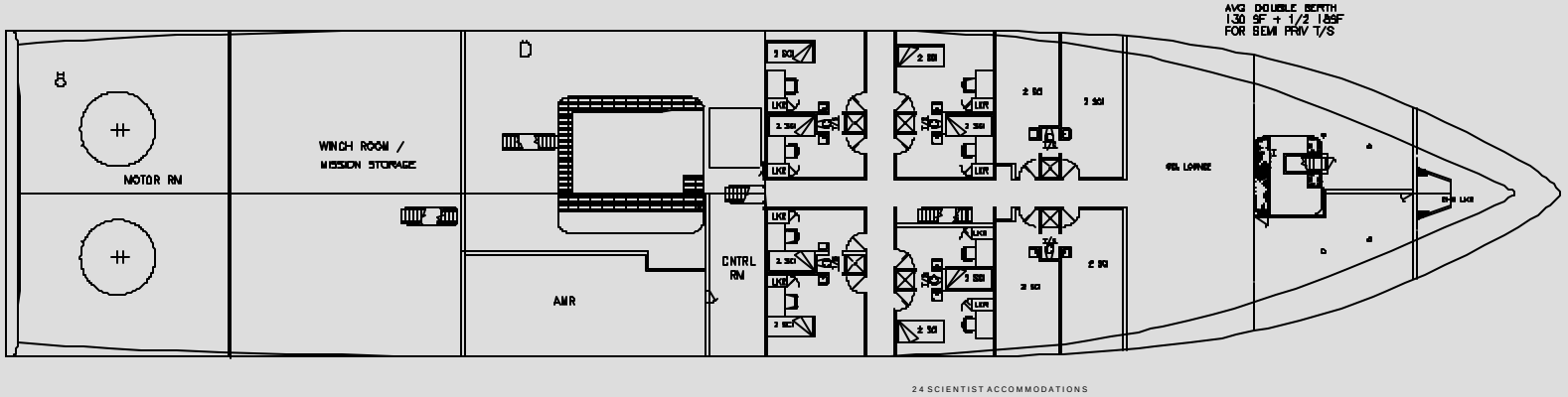
- Revised Arrangements



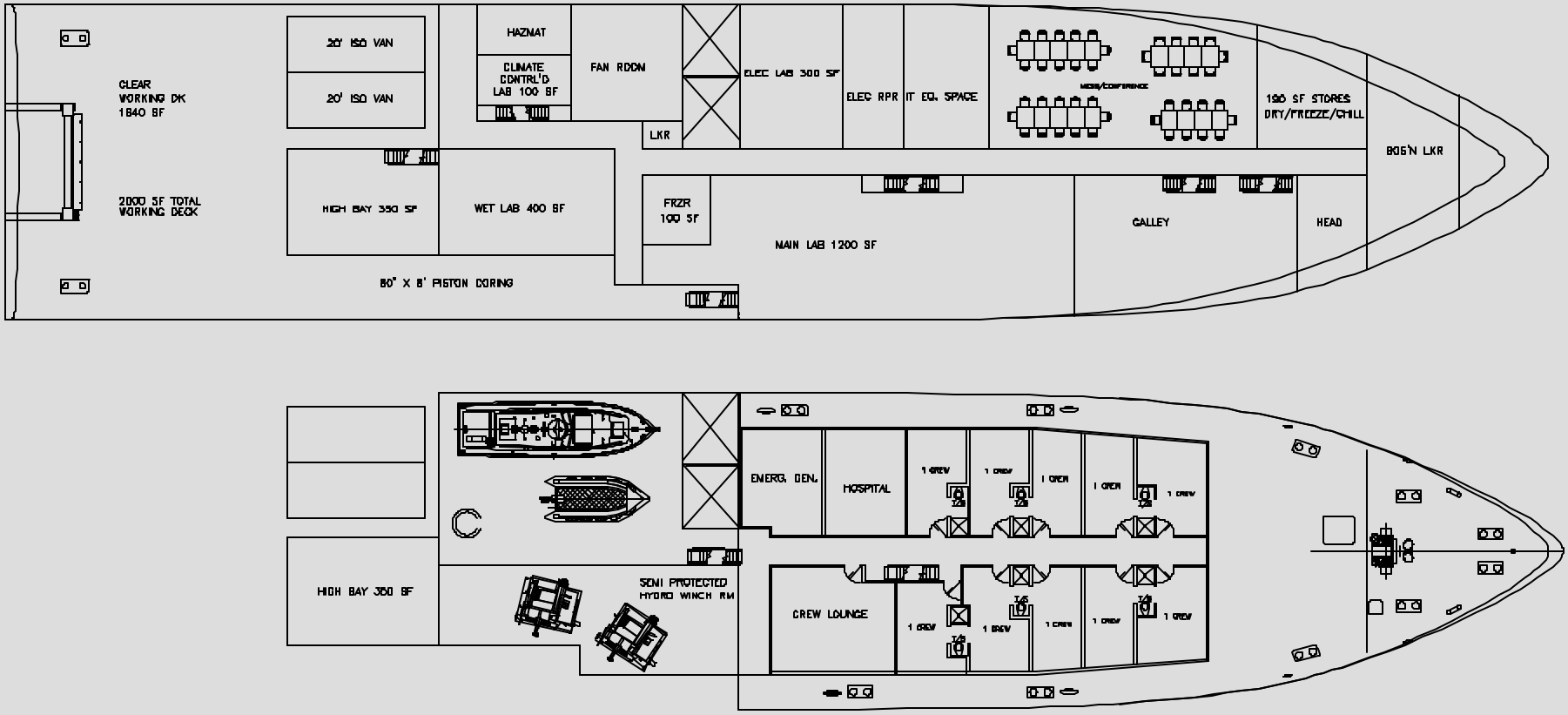
1st Platform & Tanktop



Notes: Integrated Electric Plant; 6 Gens Enhances Ability to Meet Varying Loads While Adequately Loading Gens, However May Want to Decrease # To Ease Maintenance

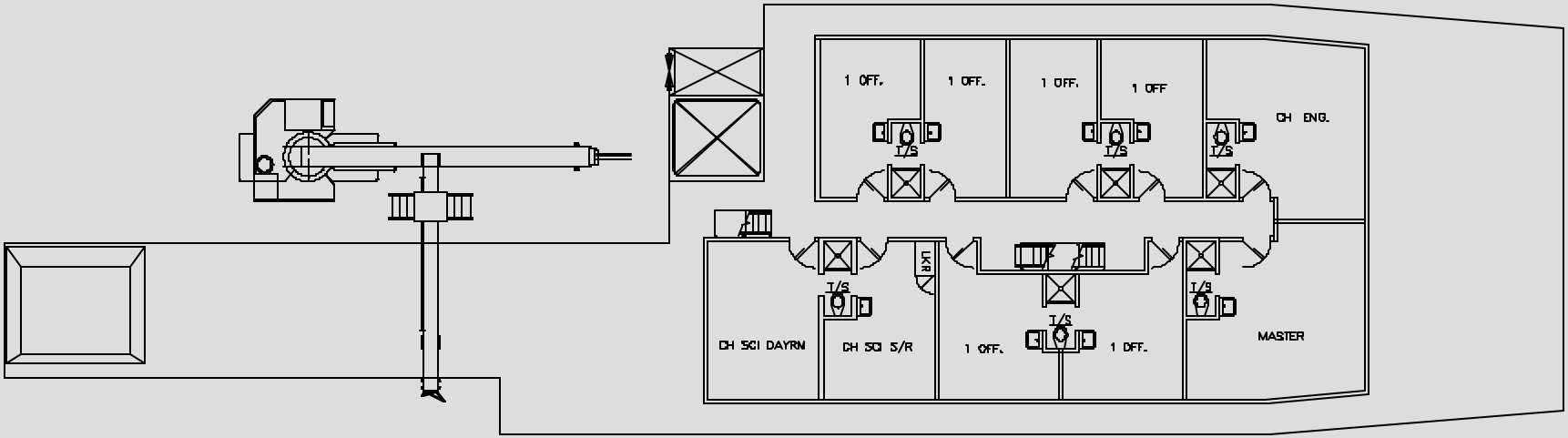


01 & Main Deck



Note: Crew Berthed in Singles IAW SMRs.

02 Deck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1 OFF.
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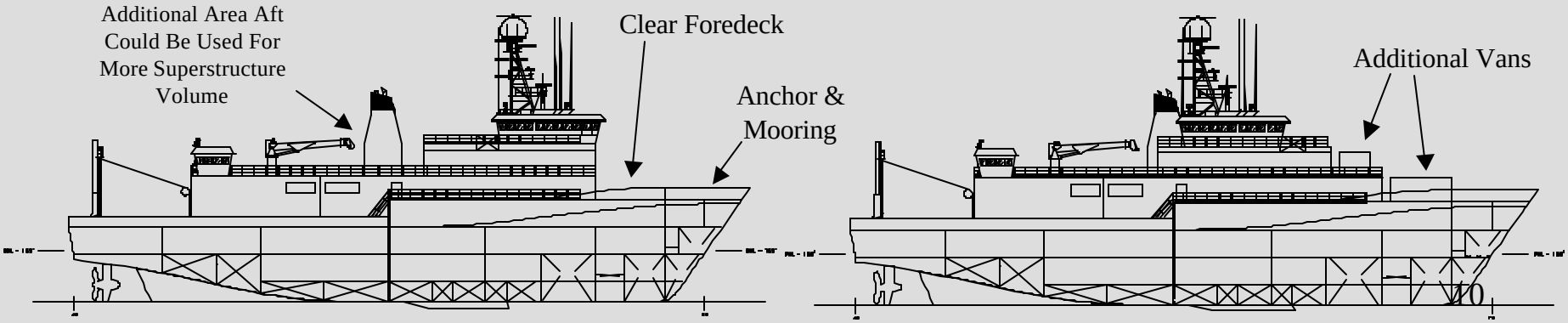
MASTER

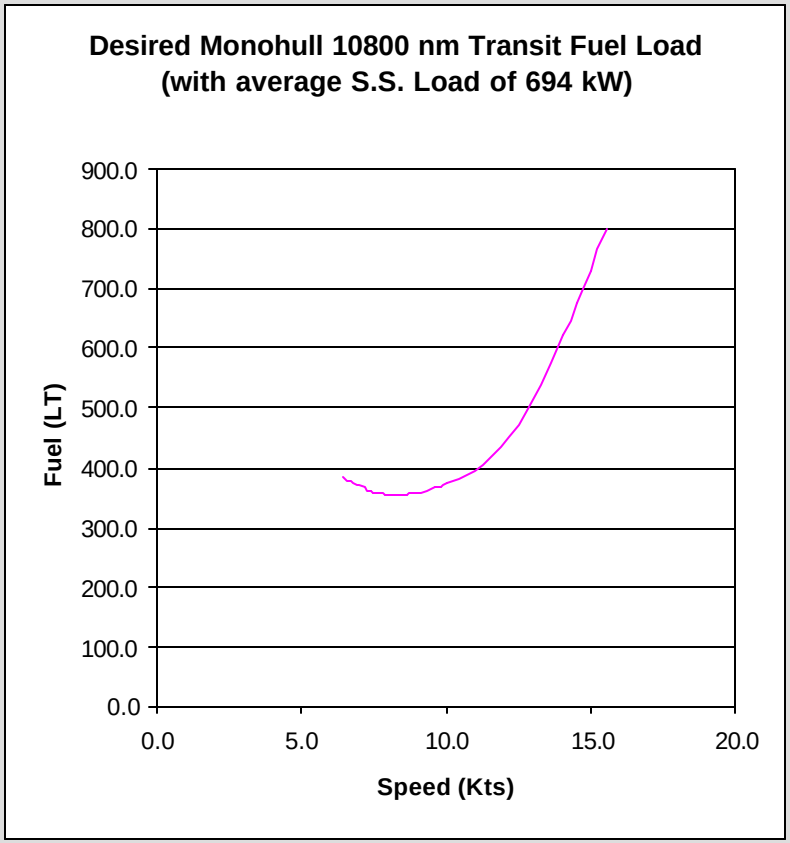
Pilothouse Location - Midship or Forward ?

- SMRs specify clear foredeck area for towers, booms and cranes
- Forward PH Location:
  - Improved Forward View for Bridge Watch
  - Larger Area Aft for Vans, Misc. Gear, Reachable With Heavy Cranes
  - Could Use Add'l Area For Expanded Superstructure and Shorten Ship Slightly
  - Poor View From Bridge To Working Deck
- Amidships PH Location:
  - Improved Astern View During Science Ops
  - Van and Gear Stowage Broken into Two Smaller Areas



Revised Mission Fuel Load Estimates

- Transit, 20 Days @ 12 Knots & 20 Days on Station
  - 330 LT of Fuel
- Survey, 30 Days @ 12 Knots
  - 536 LT of Fuel
- Survey, 30 Days @ 11 Knots
  - 291 LT of Fuel
- Transit, 10800 nm @ 11 Knots
  - 395 LT of Fuel



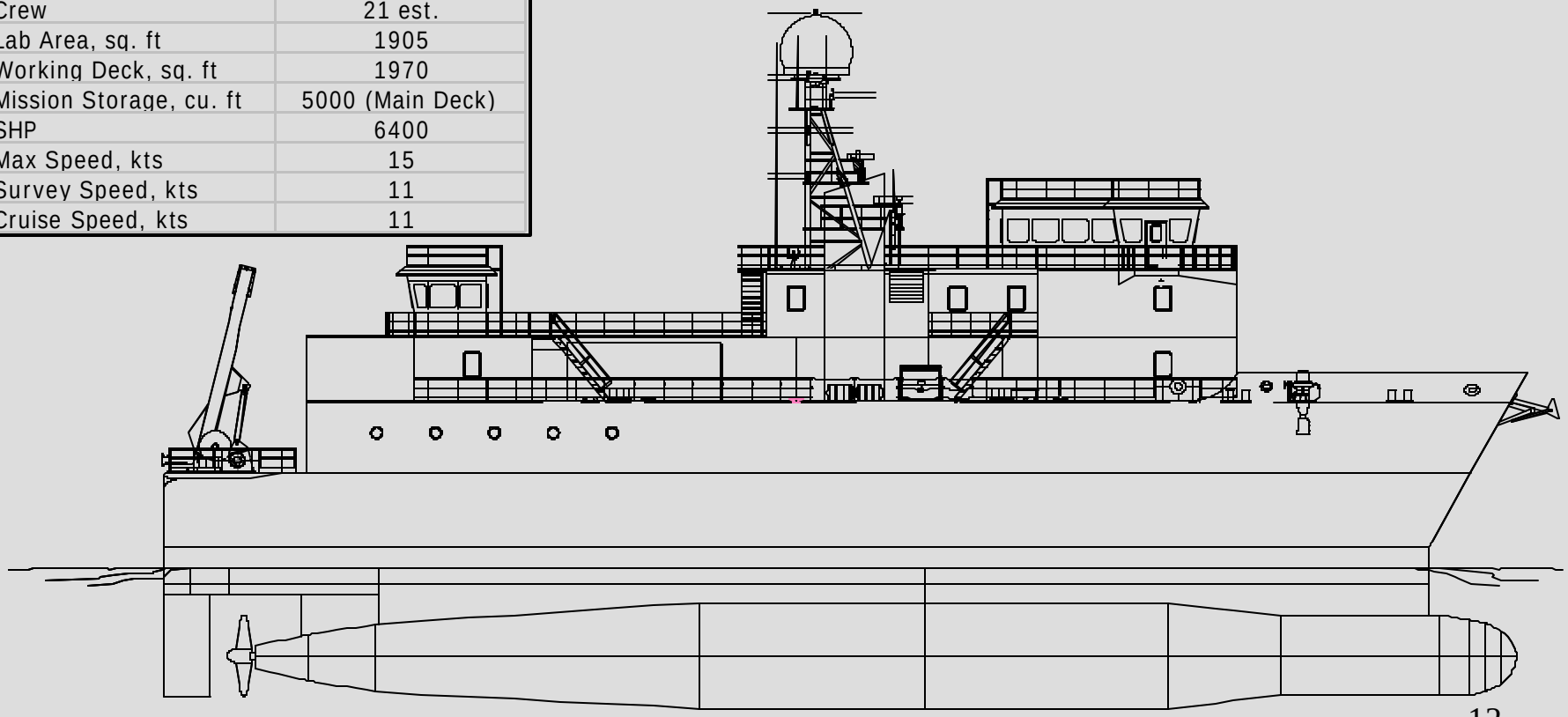
OCEAN Class AGOR

Concept Definition

Maximum SMR SWATH

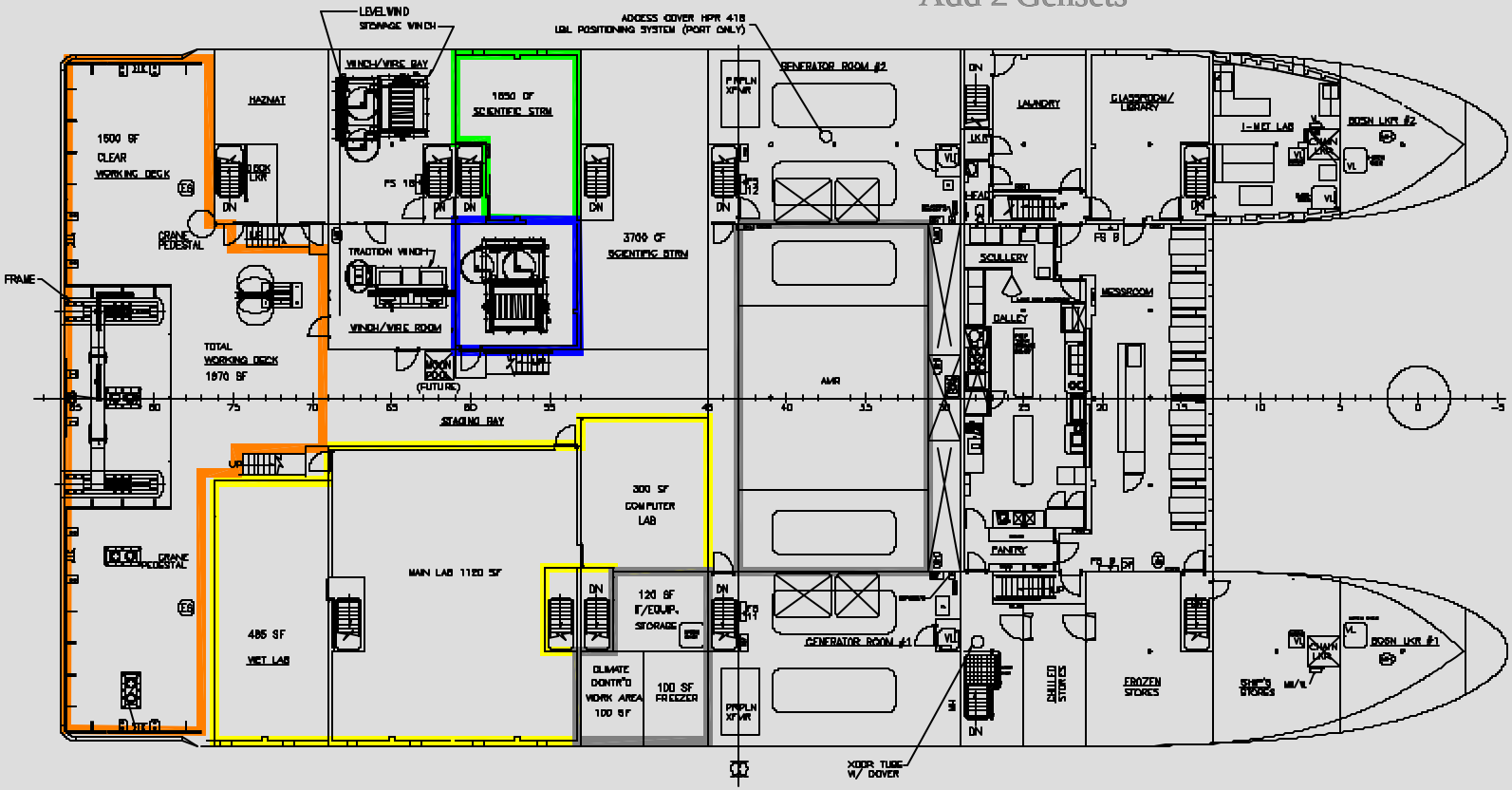
	Maximum SWATH
LOA,ft	186
LWL, ft	172
Beam WL, ft	88
Max Beam, ft	88
Draft, ft	25
Displacement, LT	2750
Scientists	26
Crew	21 est.
Lab Area, sq. ft	1905
Working Deck, sq. ft	1970
Mission Storage, cu. ft	5000 (Main Deck)
SHP	6400
Max Speed, kts	15
Survey Speed, kts	11
Cruise Speed, kts	11

Maximum SMR SWATH Concept



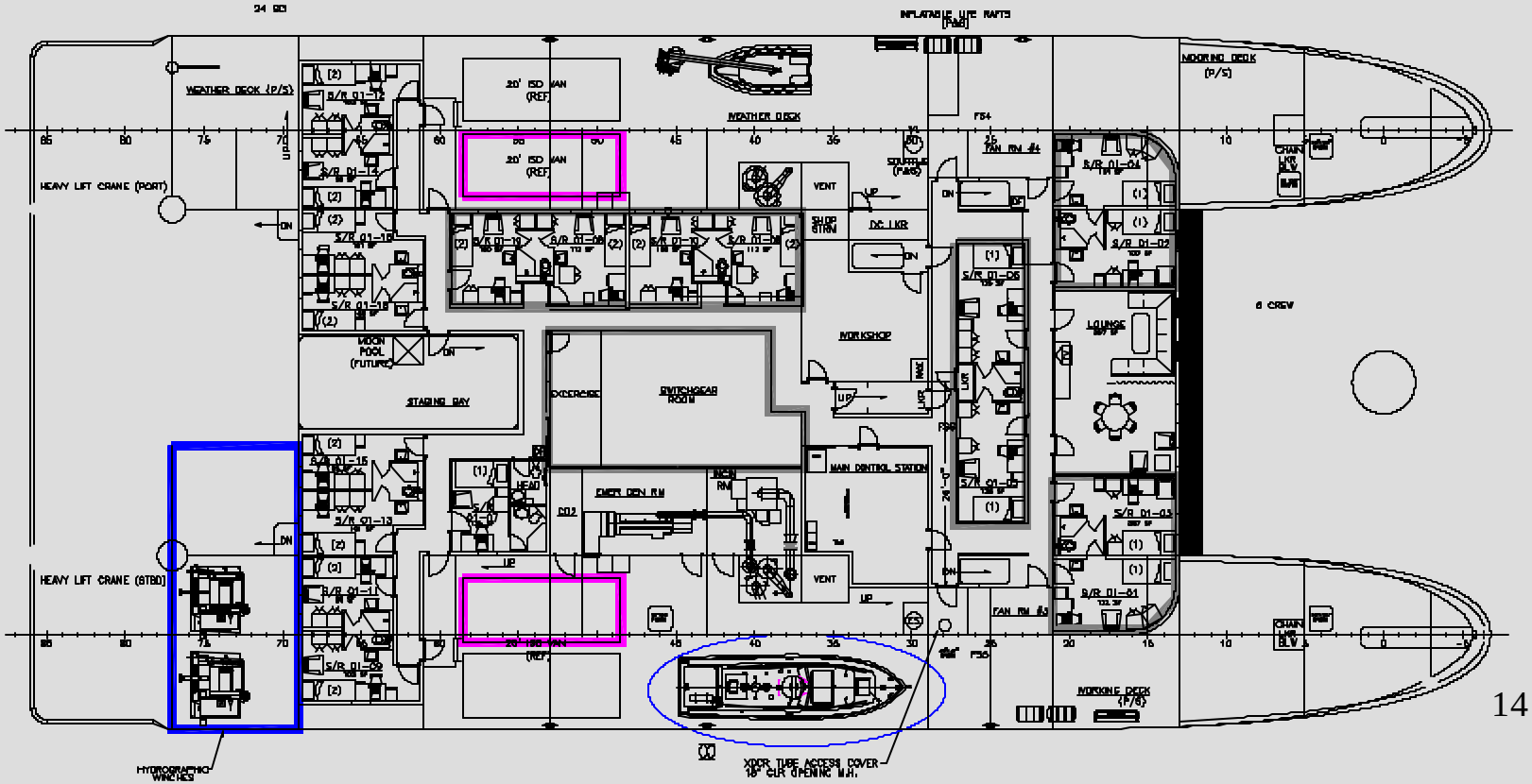
MAIN DECK - mods to KM to meet SMRs

- Increased length of clear working deck 1.5’
- Added Freezer & Climate Controlled Space
- Relocated Computer Lab & IT Eq. Space
- Rearranged lab area on Starboard side
- Added Winch Storage Drum
- Relocated Mission Storage
- Add 2 Gensets



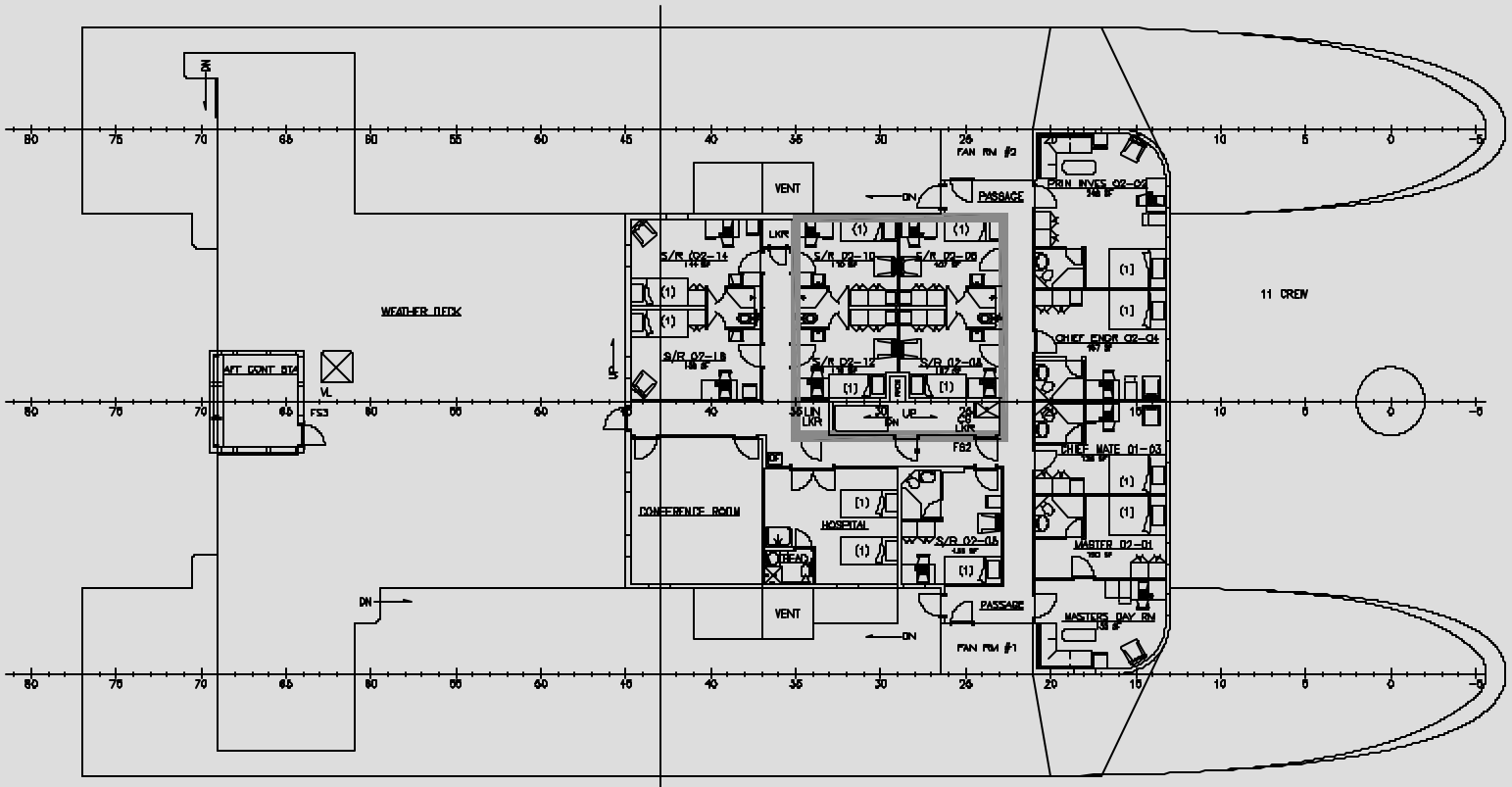
01 DECK - mods to KM to meet SMRs

- Added Hydro winch and enclosed
- Added ISO vans
- Add berthing spaces
- Convert 2-man berthing to 1-man for crew forward
- Relocate Exercise Rm and unassigned spaces
- Relocate Switchgear Room
- Add 30’ Workboat



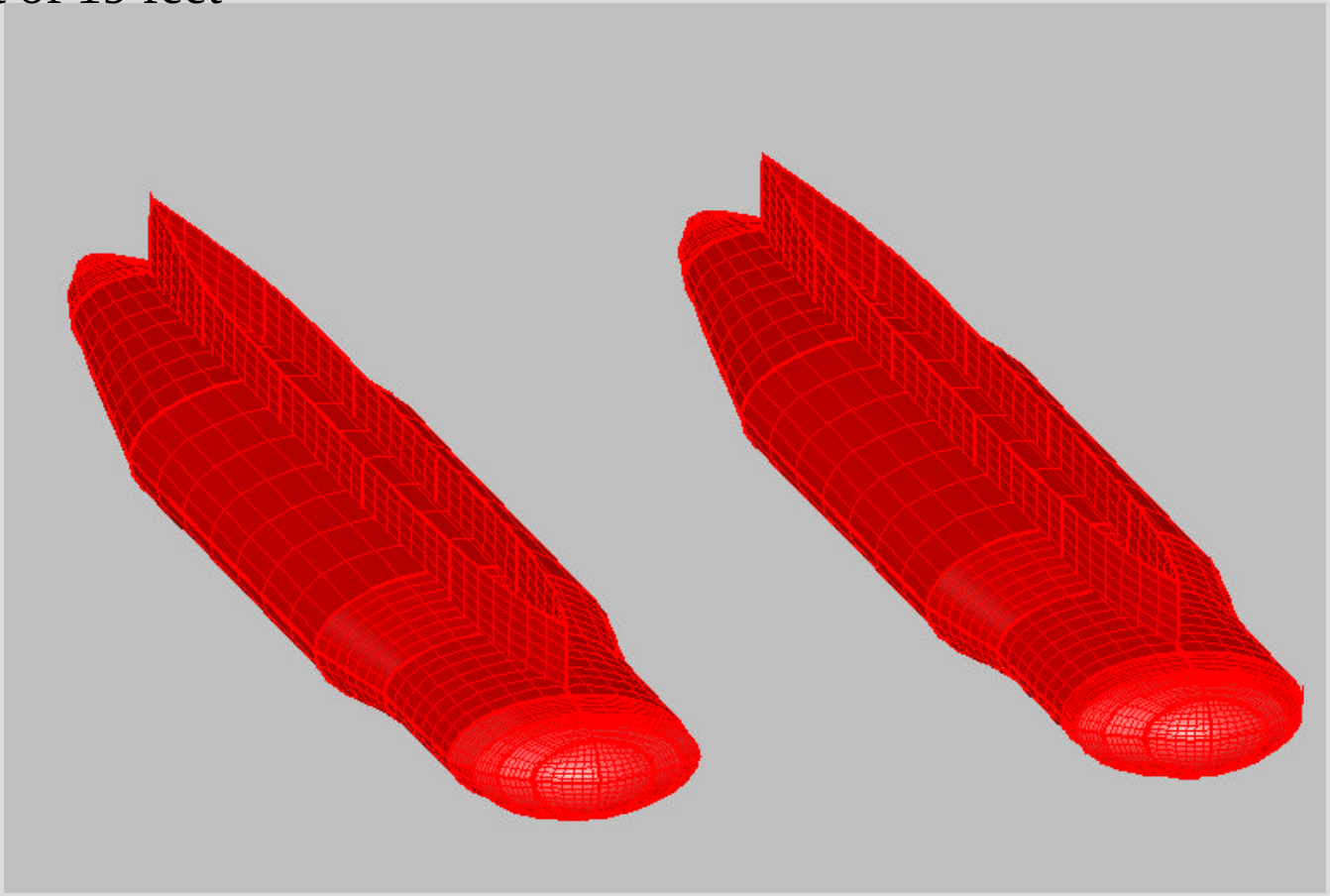
02 DECK - mods to KM to meet SMRs

- Convert 2-man to 1-man berthing for crew

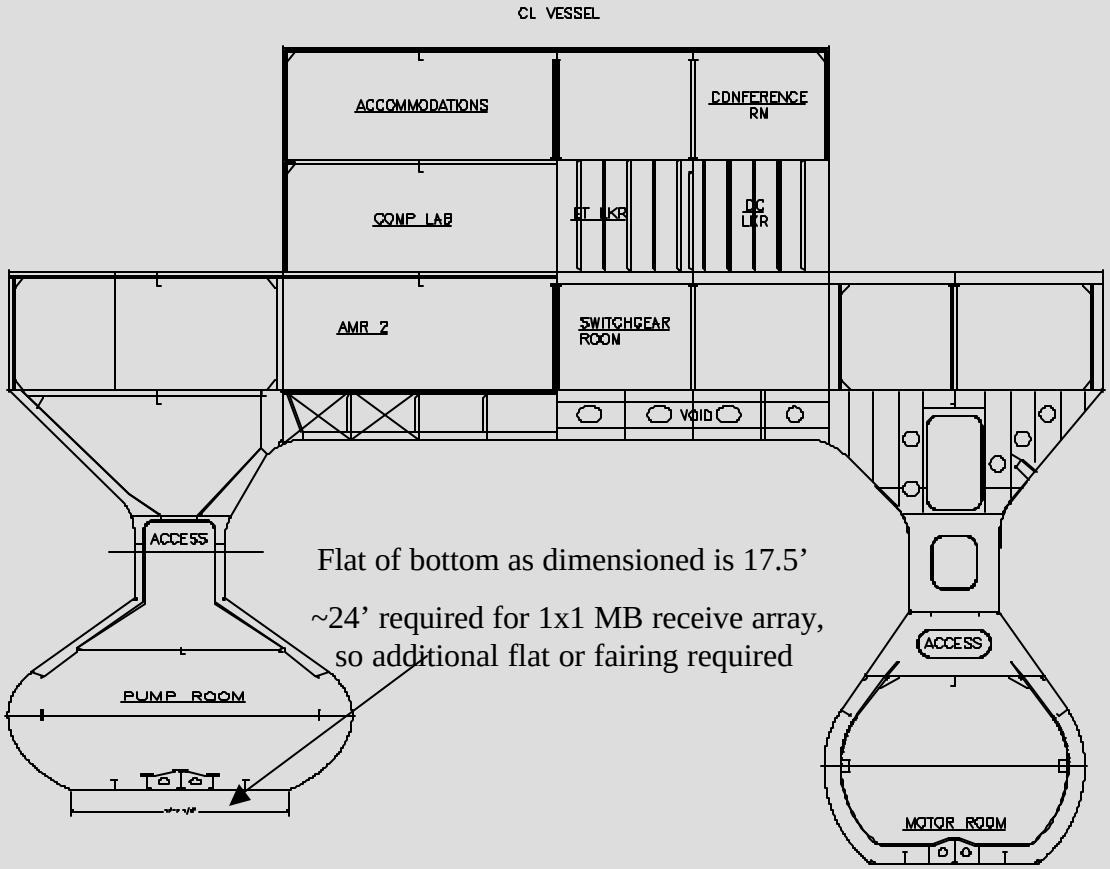


Maximum SWATH Hullform

Lower hulls must be “flattened” in order to provide adequate buoyancy, sufficient hull submersion, AND meet the desired SMR draft of 19 feet



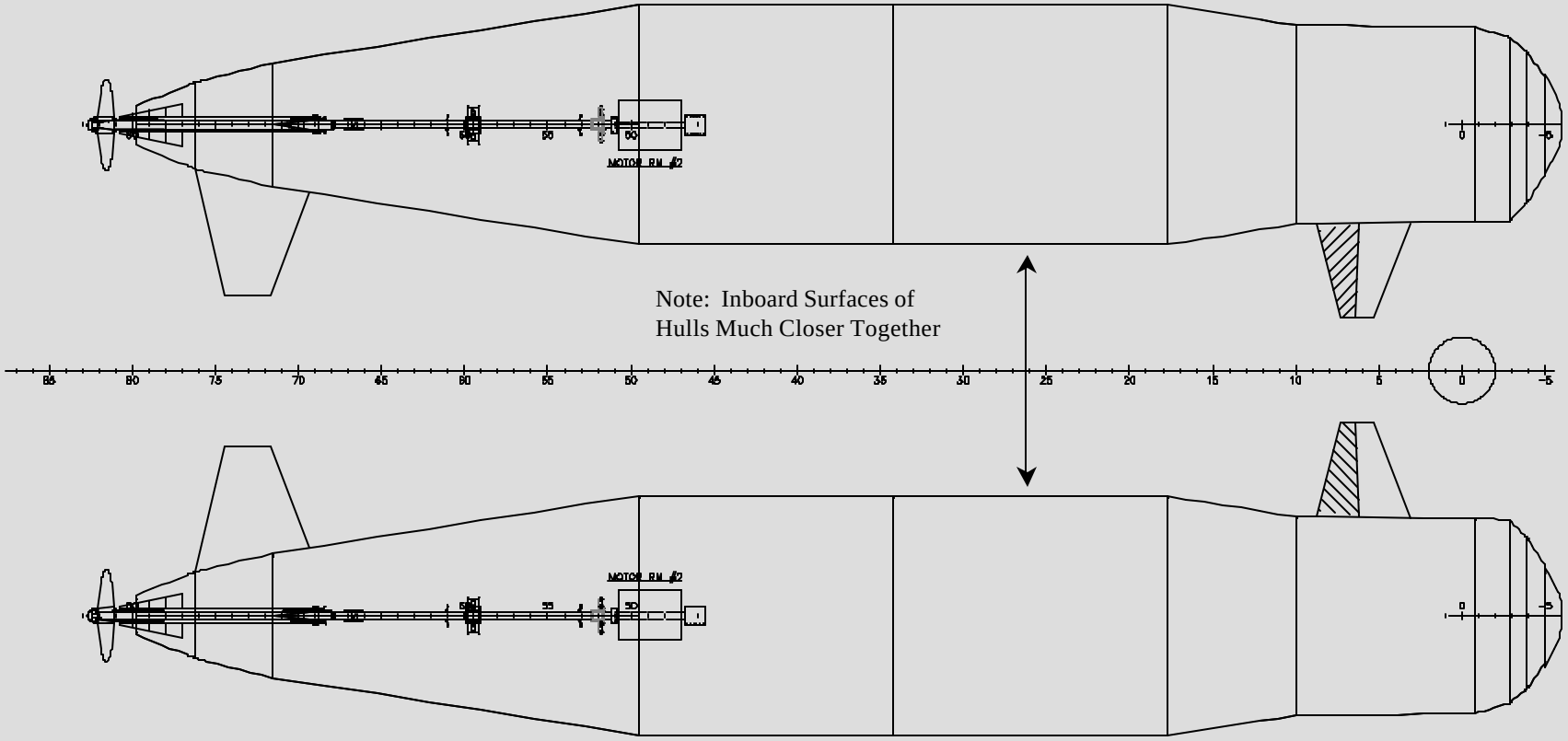
MIDSHIP SECTION COMPARISON



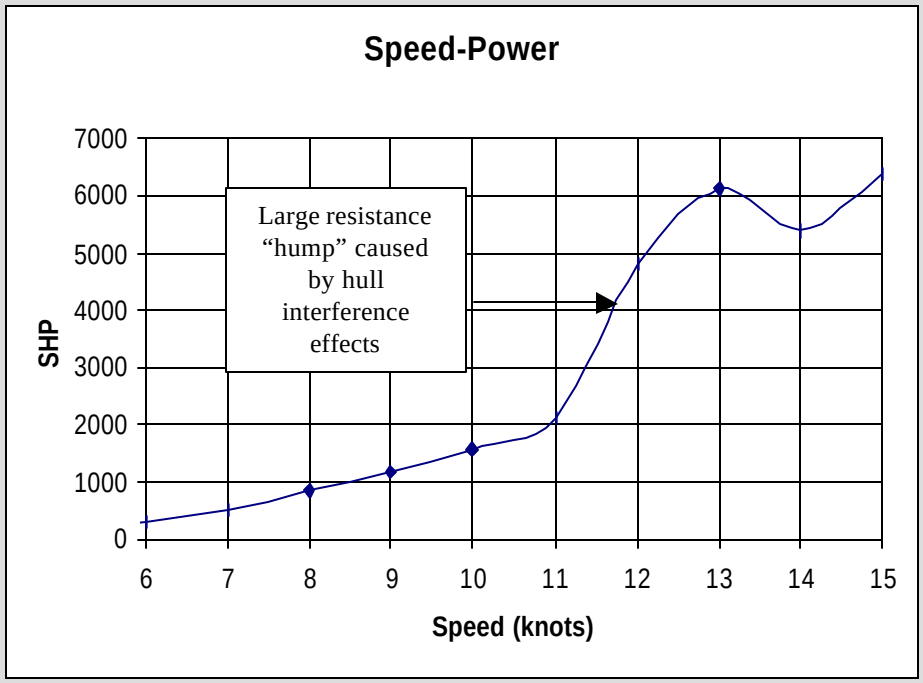
Desired : 19' Draft

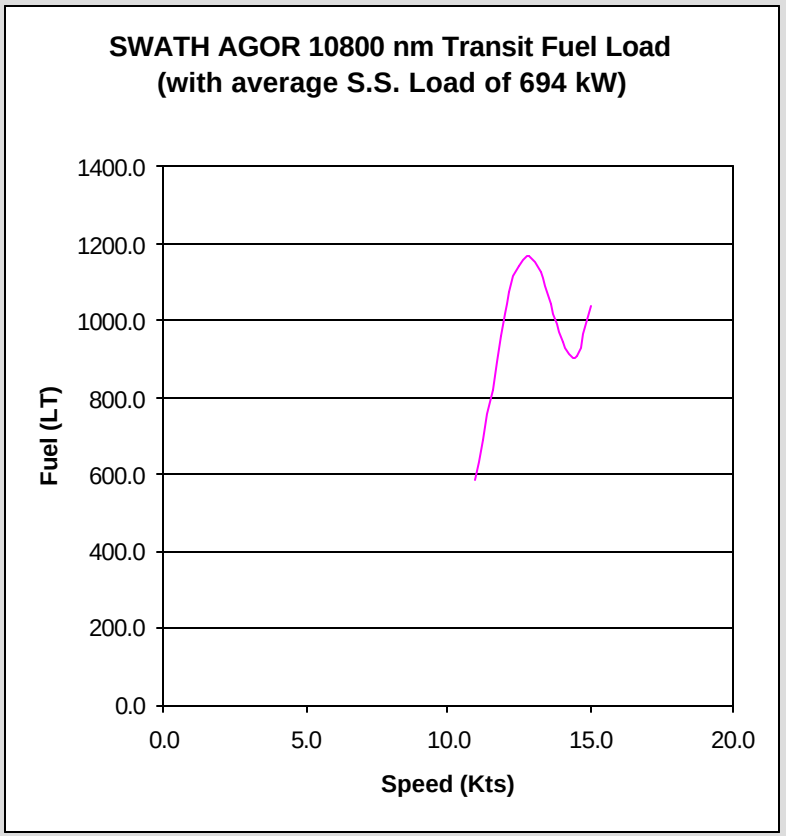
AGOR 26 : 25' Draft

Planform - 19 Foot Draft SWATH



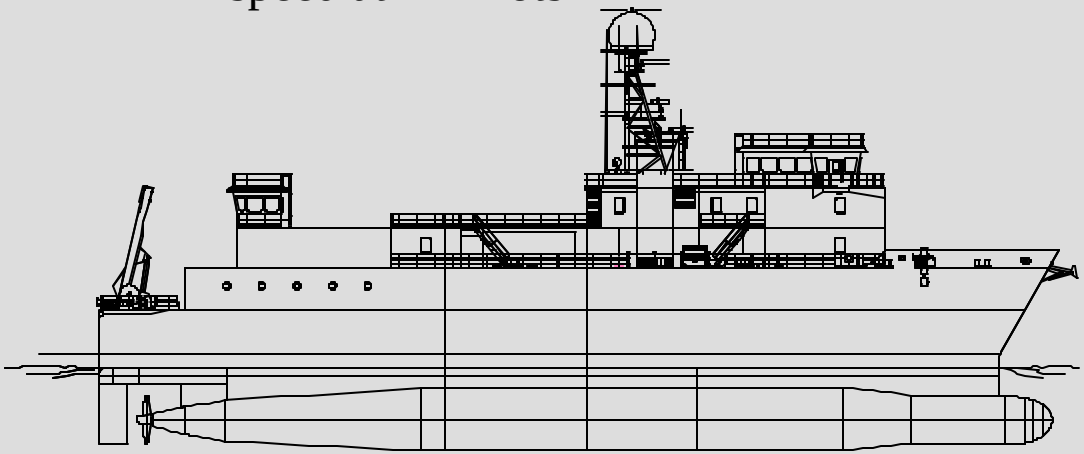
19 Foot Draft SWATH

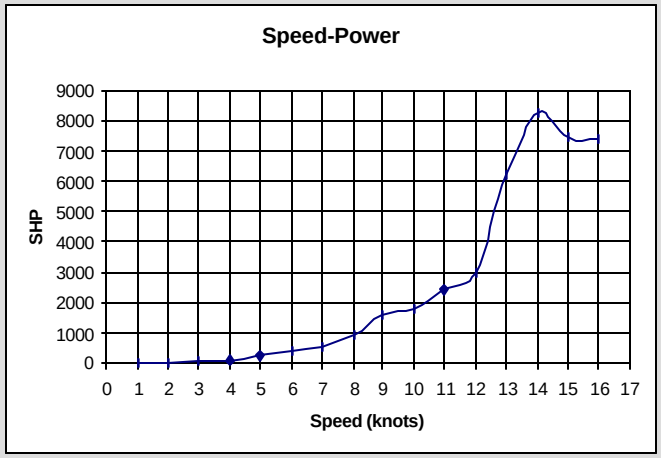




Propulsion - Maximum SWATH

- With 19 Foot Draft Hull Form, To make 12 knot survey speed more feasible:
  - Hulls would need to be lengthened 32 ft (pushes resistance hump to right)
  - 3 additional 910 kW gensets (7 total) would be required to get over hump speed at 14 knots





- Conclusion: 19 Foot Draft Not Feasible

OCEAN Class AGOR

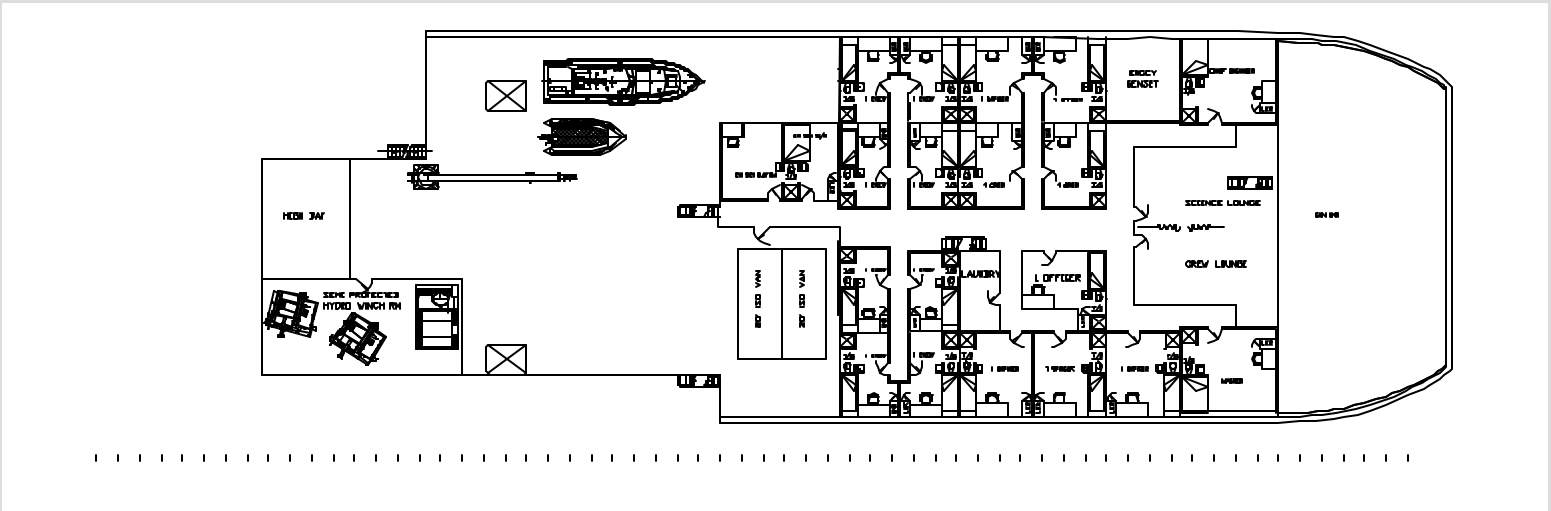
Concept Definition

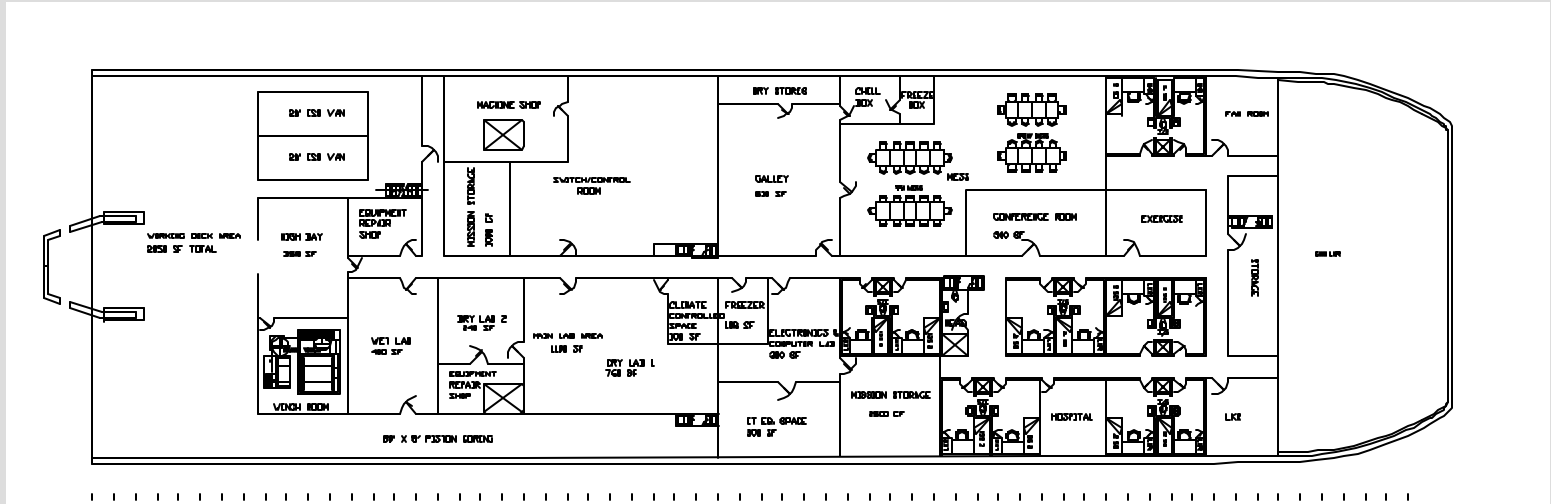
X-CRAFT Variants

	X-Craft AGOR, High Speed	X-Craft AGOR, Low Speed
Length Waterline, ft	*240*	*240*
Beam, Overall, ft	*72*	*72*
Beam, Waterline, ft	*23.5*	*21.75*
Draft, ft	*16.7*	*15.45*
Displacement, Lton	*2800*	*2400*
Max. Speed, knots	*40*	*15*
Propulsion	*Gas Turbines & Diesels*	*Diesel Electric, Integrated*
	2 x 25 MW, 2 x 4 MW	*2 x Caterpillar 3412C, 4 x 3508B*
	4 x KaMeWa 125SII Waterjets	*2 x Schottel SRP2020 Steerable Thrusters*
Range	*10,800 nm @12 knots*	*10,800 nm @12 knots*
Payload, Lton	*150*	*200*
Crew	*21 + 25 Scientists*	*21 + 25 Scientists*
SHP	*76,000hp@40 knots*	*4,590hp@15 knots*
Working Deck Area	*2,050 sq. ft*	*2,050 sq. ft*
Lab Area	*2,108 sq. ft*	*2,108 sq. ft*

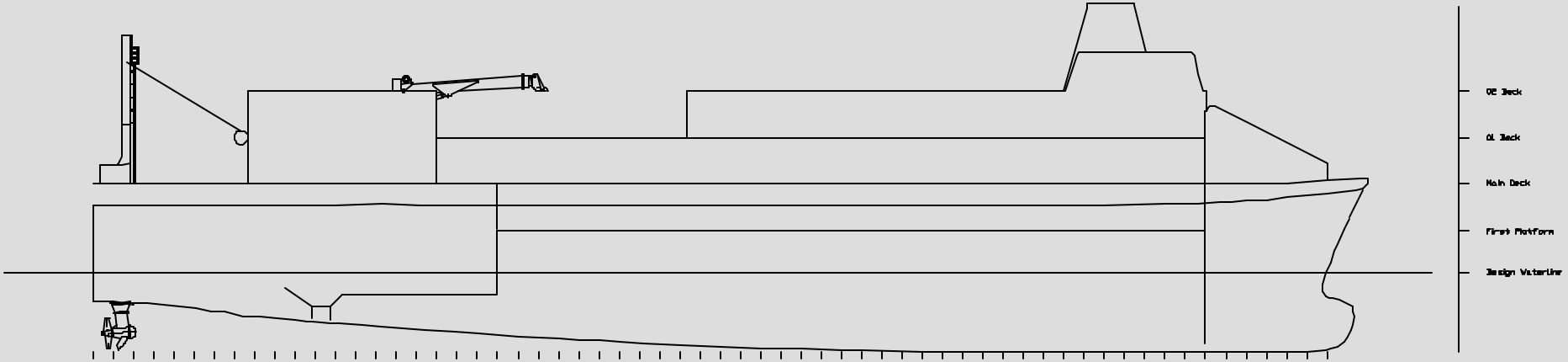
OCEAN Class AGOR
Concept Definition

X-CRAFT

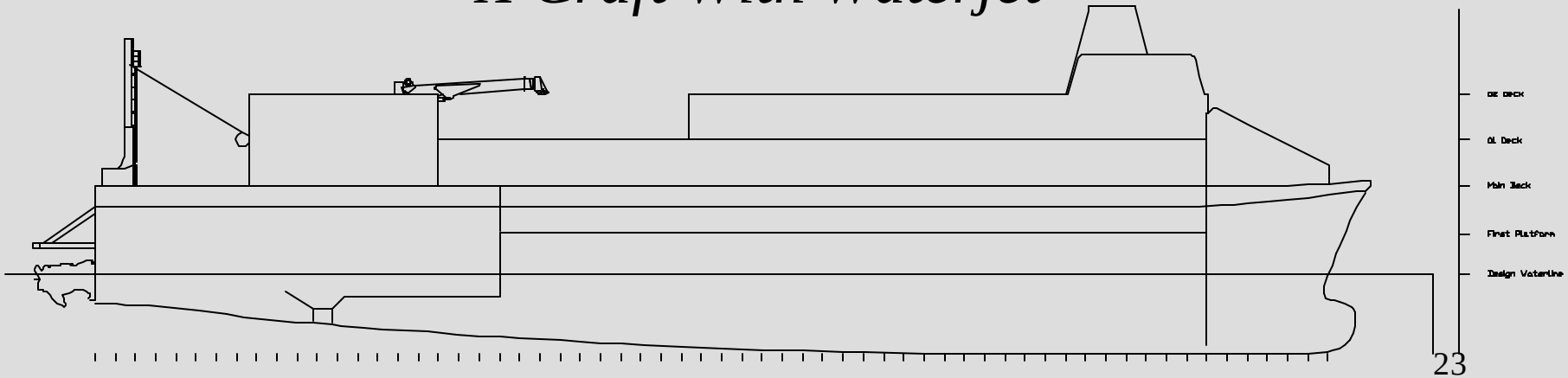




X Craft With Z Drive



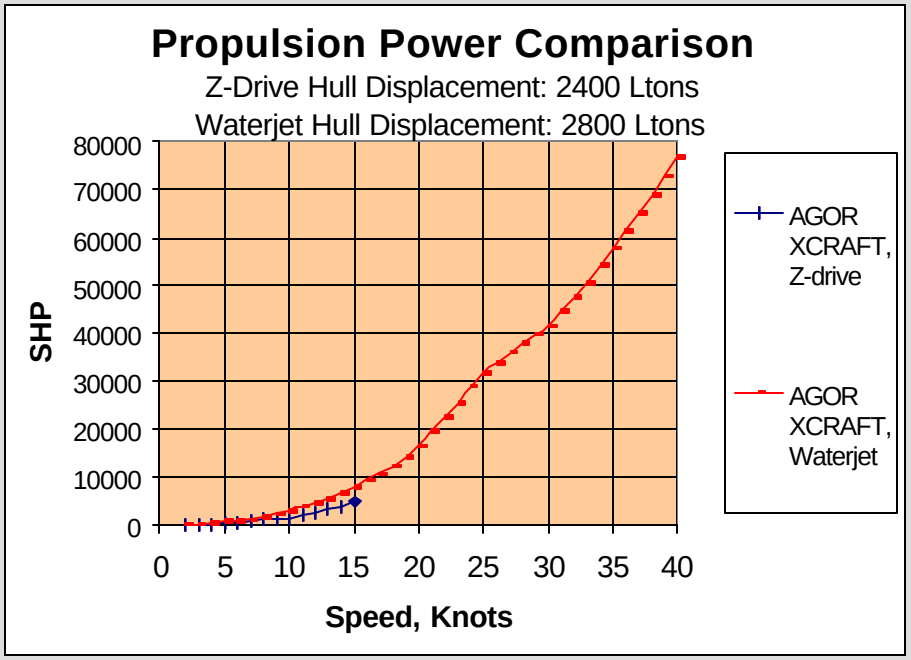
X Craft With Waterjet

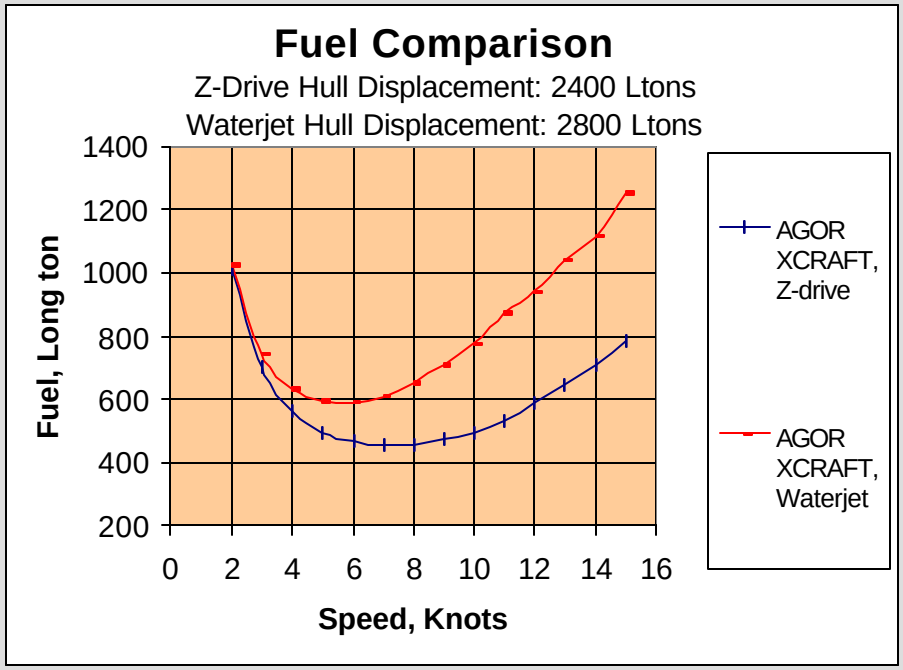


Propulsion – X-Craft

- *Main Propulsion System*
  - *Integrated Diesel Electric System*
    - *2 Caterpillar 3412C Gensets and 4 3508B Gensets. 2 x 590 ekw + 4 x 910 ekw@60 Hz*
  - *or Geared Turbine plus Diesel System*
    - *2 GE LM2500 2 x 25 MW, 2 MTU 16V 595 2 x 4 MW*
- *Propulsion System*
  - *Z-drive*
    - *2 x 1750 kw, 1000 rpm DC motors*
    - *2 x Schottel SRP2020. 2950 hp @1000 RPM*
  - *or Waterjet*
    - *4 x 14000 kw KaMeWa 125SII*
- *Dynamic Positioning System*
  - *Bow Thruster*
    - *2 x Elliott White Gill*

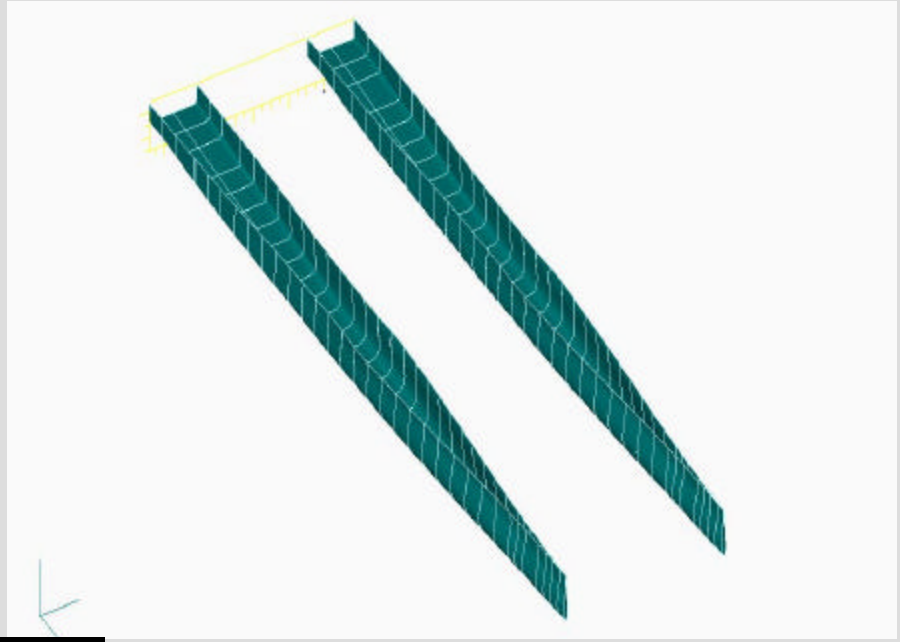
Resistance and Fuel Consumption

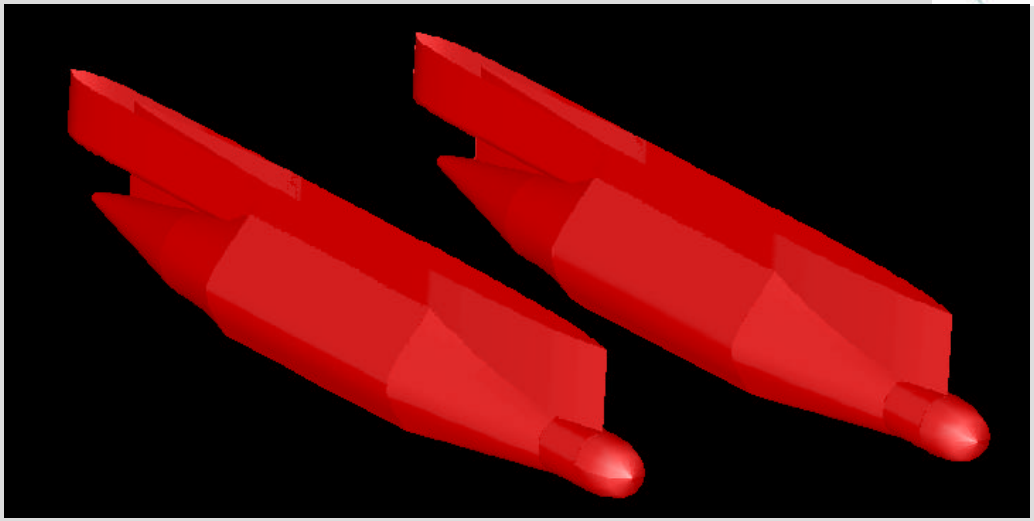




Comparison of X Craft and SWATH Hulls

X Craft AGOR Hull





SWATH AGOR Hull

X-Craft AGOR Variant

- *Propulsion System*
  - The available waterjets perform poorly at the normally required operating speeds (<15 knots)
  - The waterjet propulsive efficiency is about 0.3 to 0.35 at 12 knots vs. 0.6 for a propeller. More than 300 tons of fuel difference at the 10,800 nm range.
  - Acoustics - No known acoustic data available for waterjets, sonar performance is unknown
  - Hull form designed for speed; Could reduce stern beam and submerged transom area for low speed improvement

- *Structures*
  - Aluminum structural weight 20 to 30 % less than steel
  - Areas that need to be addressed:
    - Protection from impact - working deck, transom, side shell
    - Working deck bolt down grid
    - Mounting structure for heavy lift cranes and frames
  - For slower speed X craft might consider steel structure or steel hull with aluminum superstructure

OCEAN Class AGOR Concept Definition

Fuel Operating Cost Calculation

Maximum SMR Monohull

	Cruise	Transit				Towing/Survey			On Station		Total Days	Avg Daily Fuel Cost	Cruise Fuel Cost	Yearly Fuel & Lube Cost
		Speed	Days	NM	$/day fuel	Speed	Days	$/day fuel	Days	$/day fuel				
1	2D,3D High Res Sonar	12	2	576		5	30		2		34	$0	$0	FOY =
2	Piston Coring	12	4	1,152					20		24	$0	$0	300
3	Observatory Servicing	12	1	288		10	7		6		14	$0	$0	days
4	Current Meter Moorings, etc.	12	3	864		8	10		14		27	$0	$0	
5	Bio & Physical Survey	14	1	336		12	2		7		10	$0	$0	
6	Deployment of Moorings	10	20	4,800		10	1		4		25	$0	$0	
7	LaGrangian Float Studies	12	8	2,304		10	27				35	$0	$0	
8	Open Ocean Bio/Chem Int.	12	2	576		6	26				28	$0	$0	
9	Laying Cable for Observ.	12	5	1,440		5	5		10		20	$0	$0	
10	Moving Ship Tomography	12	15	4,320					15		30			
			61				108		78		247	$0		

Maximum SMR SWATH

	Cruise	Transit				Towing/Survey			On Station		Total Days	Avg Daily Fuel Cost	Cruise Fuel Cost	Yearly Fuel & Lube Cost
		Speed	Days	NM	$/day fuel	Speed	Days	$/day fuel	Days	$/day fuel				
1	2D,3D High Res Sonar	12	2	576		5	30		2		34	$0	$0	FOY =
2	Piston Coring	12	4	1,152					20		24	$0	$0	300
3	Observatory Servicing	12	1	288		10	7		6		14	$0	$0	days
4	Current Meter Moorings, etc.	12	3	864		8	10		14		27	$0	$0	
5	Bio & Physical Survey	14	1	336		12	2		7		10	$0	$0	
6	Deployment of Moorings	12	20	5,760		10	1		4		25	$0	$0	
7	LaGrangian Float Studies	12	8	2,304		10	27				35	$0	$0	
8	Open Ocean Bio/Chem Int.	12	2	576		6	26				28	$0	$0	
9	Laying Cable for Observ.	12	5	1,440		5	5		10		20	$0	$0	
10	Moving Ship Tomography	12	15	4,320					15		30			
			61				108		78		247	$0		

Maximum SMR X Craft - Low Speed Variant

	Cruise	Transit				Towing/Survey			On Station		Total Days	Avg Daily Fuel Cost	Cruise Fuel Cost	Yearly Fuel & Lube Cost
		Speed	Days	NM	$/day fuel	Speed	Days	$/day fuel	Days	$/day fuel				
1	2D,3D High Res Sonar	12	2	576		5	30		2		34	$0	$0	FOY =
2	Piston Coring	12	4	1,152					20		24	$0	$0	300
3	Observatory Servicing	12	1	288		10	7		6		14	$0	$0	days
4	Current Meter Moorings, etc.	12	3	864		8	10		14		27	$0	$0	
5	Bio & Physical Survey	14	1	336		12	2		7		10	$0	$0	
6	Deployment of Moorings	12	20	5,760		10	1		4		25	$0	$0	
7	LaGrangian Float Studies	12	8	2,304		10	27				35	$0	$0	
8	Open Ocean Bio/Chem Int.	12	2	576		6	26				28	$0	$0	
9	Laying Cable for Observ.	12	5	1,440		5	5		10		20	$0	$0	
10	Moving Ship Tomography	12	15	4,320					15		30			
			61				108		78		247	$0		

Maximum SMR X Craft - High Speed Variant

	Cruise	Transit				Towing/Survey			On Station		Total Days	Avg Daily Fuel Cost	Cruise Fuel Cost	Yearly Fuel & Lube Cost
		Speed	Days	NM	$ fuel	Speed	Days	$/day fuel	Days	$/day fuel				
1	2D,3D High Res Sonar	40	0.6	576	$0	5	30		2		32.6	$0	$0	FOY =
2	Piston Coring	40	1.2	1,152	$0				20		21.2	$0	$0	300
3	Observatory Servicing	40	0.3	288	$0	10	7		6		13.3	$0	$0	days
4	Current Meter Moorings, etc.	40	0.9	864	$0	8	10		14		24.9	$0	$0	
5	Bio & Physical Survey	40	0.35	336	$0	12	2		7		9.35	$0	$0	
6	Deployment of Moorings	40	6	5,760	$0	10	1		4		11	$0	$0	
7	LaGrangian Float Studies	40	2.4	2,304	$0	10	27				29.4	$0	$0	
8	Open Ocean Bio/Chem Int.	40	0.6	576	$0	6	26				26.6	$0	$0	
9	Laying Cable for Observ.	40	1.5	1,440	$0	5	5		10		16.5	$0	$0	
10	Moving Ship Tomography	40	4.5	4,320	$0				15		19.5	$0	$0	
			18.35				108		78		204.35	$0		

Calcs TBD

Operating Cost Calculation

	Avg Expenses Global Class 98/99 $ (from ONR)	Global Class Escalated to '04$	Ratio By	Max SMR Monohull	Max SMR SWATH	X Craft, Low Speed	X Craft, High Speed
Year $	1998.5	2004					
Payroll							
Salaries, ship	$1,729,043	$2,034,279	Crew Size				
Salaries, shore	$247,965	$291,739	Unity				
Payroll Subtotal	**$1,977,007**	**$2,326,018**					
Maintenance							
Repairs & Maintenance	$283,377	$333,403	Vessel Displ [1]				
Major Overhaul	$333,199	$392,020	Vessel Displ [2]				
Maint Subtotal	**$616,576**	**$725,423**					
Other Costs							
Fuel, lube	$562,800	$662,153	Calculated				
Food	$95,177	$111,979	Complement				
Insurance	$66,984	$78,809	Vessel Displ				
Stores	$215,998	$254,129	Complement				
Travel	$100,143	$117,822	Crew Size				
Shore Facility	$105,872	$124,562	Vessel Displ				
Misc	$167,894	$197,533	Vessel Displ				
Indirect Costs	$460,975	$542,352	Vessel Displ				
Other Subtotal	**$1,775,843**	**$2,089,340**					
Total Ship Cost	**$4,369,426**	**$5,140,781**					
Operating Days	272.75	272					
Day Rate (200 days)	**$16,019.89**	**$18,899.93**					
Tech Support Costs	$4,000	$4,706	Unity				
Total per day Cost	$20,020	$23,606					

Calcs TBD