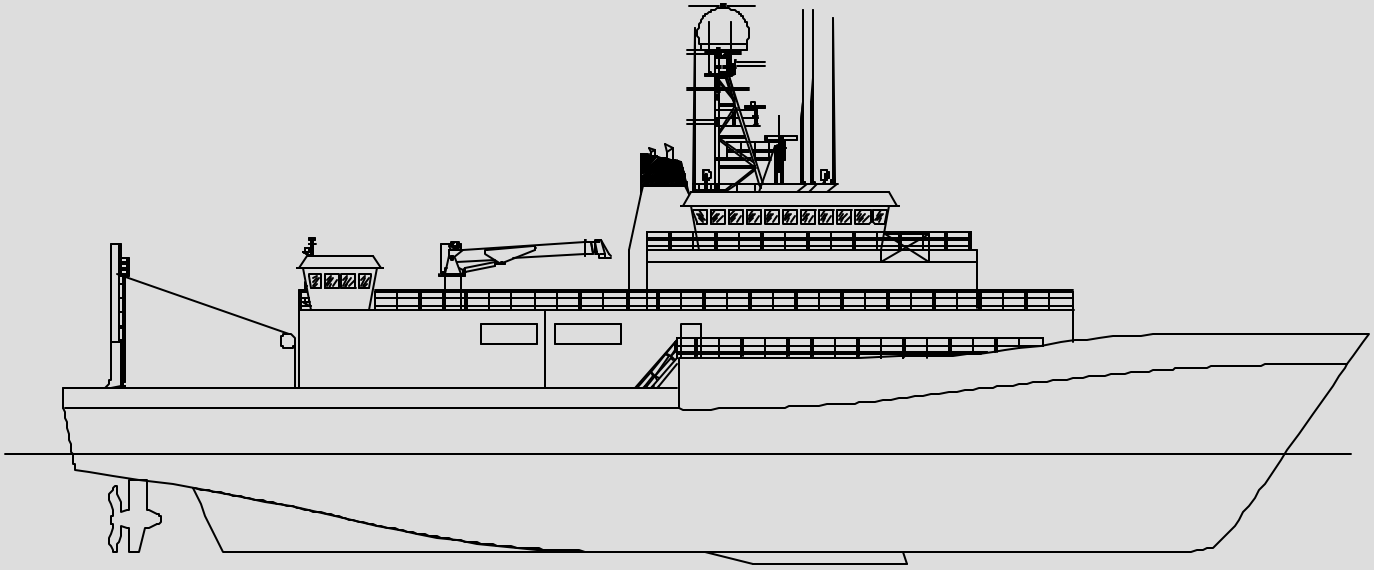
OCEAN Class AGOR
Concept Definition Task



Interim Review

2 April 2004

OCEAN Class AGOR

Concept Definition

Concept Design Capabilities

	UNOLS OCEAN Class	UNOLS OCEAN Class	UNOLS Ocean Class Monohull	AGOR 26 SWATH
Summary:	*Minimum SMRs*	*Desired SMRs*	*Desired*	
Seakeeping requirement	**SS6**	**SS6**	**SS6**	SS6 Best Hdg
Ship Dimensions:				
Length between perp, ft			210	172
Beam, ft			46	88
Depth to Main Deck, ft			24.9	38
Draft, ft		**19**	16.9	25
Finished Deck Ht (ft)	**7.5**	**8**	**8**	
Displacement, long tons			2500	2542
Propulsion:				
Plant type	Integrated Diesel Electric	Integrated Diesel Electric	Integrated Diesel Electric	Integrated Diesel Electric
# Screws			2	2
Total SHP			4,000	4,000
Speed, sustained		**12**	11	15
Speed, maximum		**14-15**	15	15.5
Speed, survey		12	12	12
Towing Requirement	**10000@6, 25000@4**	**10000@6, 25000@4**	**10000@6, 25000@4**	10000#
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
Bow Thruster	**Yes**	**Yes**	900 HP	1100 HP

Bold Text Indicates SMR

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Concept Design Capabilities

	UNOLS OCEAN Class	UNOLS OCEAN Class	UNOLS Ocean Class Monohull	AGOR 26 SWATH
Summary:	*Minimum SMRs*	*Desired SMRs*	*Desired*	
Accommodations:				
Crew		18	18	17
Scientists	**20**	**25+**	**25+**	**31**
Total		43	43	48
Certifications:				
ABS	**Yes**	**Yes**	Yes	Yes
USCG	Subchap U	Subchap U	Subchap U	Subchap U
Ice Class	**A0**	**A0**		D0
Space and Payload:				
Total Lab Space, sq ft	**1,800**	**2,000**	**2,000**	2,762
Main Lab	**1,000**	**1000+**	1,200	
Wet Lab	**400**	**400+**	415	330
Computer Lab	**300**	**300+**	300	830
Climate Contrl'd Work Area	**100**	**100+**	115	No
Refrigerator/Freezer Space	**100**	**100**	**100**	No
Number of Labs	**4**	**4**	**4**	8
Electronics Repair Shop	**Yes**	**Yes**	**Yes**	No
IT Equipment Space	**No**	**Yes**	**Yes**	No
IT Storage	**Yes**	**Yes**	**Yes**	Yes
ISO Vans	**2**	**2**	**2**	2
Vans (Non ISO, 500ft ttl)		**2**	**2**	0
Working Deck Space, sq ft	**2,000**	**2,000**	**2,000**	2,200
Clear Working Deck, sq ft	**1,500**	**1,500**	**1,500**	1,360
Clear Rail Deck, sq ft	**80' x 8'**	**80' x 8'**	**80' x 8'**	No
Mission storage, cu ft		**5,000**	**5,000**	15,000
Mission payload, long tons	**100**	**200**	**200**	100
High Bay	**Yes**	**Yes**	**Yes**	Yes

Bold Text Indicates SMR

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Concept Definition

Concept Design Capabilities

	UNOLS OCEAN Class	*UNOLS OCEAN Class*	*UNOLS Ocean Class Monohull*	*AGOR 26 SWATH*
Summary:	*Minimum SMRs*	*Desired SMRs*	*Desired*	
Mission Electronics Systems:				
Dynamic Positioning	**Yes**	**Yes**	**Yes**	Yes
Deep multibeam	**1 deg**	**1 deg**	**1 deg**	(1x2 deg)
Shallow multibeam				Yes
Single beam echosounder	**12kHz**	**12kHz**	**12kHz**	12,38,200kHz
Subbottom profiler	**2-8kHz**	**2-8kHz**	**2-8kHz**	Yes
ADCP	**38,75,150kHz**	**38,75,150kHz**	**38,75,150kHz**	125kHz
Acoustic positioning				Yes
Handling Systems:				
Stern U frame	**30000# 15'Hx25'Vx12'O**	**30000# 15'Hx25'Vx12'O**	**30000# 15'Hx25'Vx12'O**	**20000# 18'Hx25'Vx12'O**
Towing crane				Yes
Boom cranes	**10000# @12'**	**20000# @20'**	**20000# @20'**	20000# @30'
Traction winch	**1**	**1**	**1**	Yes
Hydrographic winch	**2**	**2**	**2**	1
Scientific Workboat	**25'-30' LOA**	**25'-30' LOA**	**(1) 30' LOA**	No
Inflatable Work Boat	**1 (16')**	**1 (16')**	**1 (16')**	Yes

Bold Text Indicates SMR

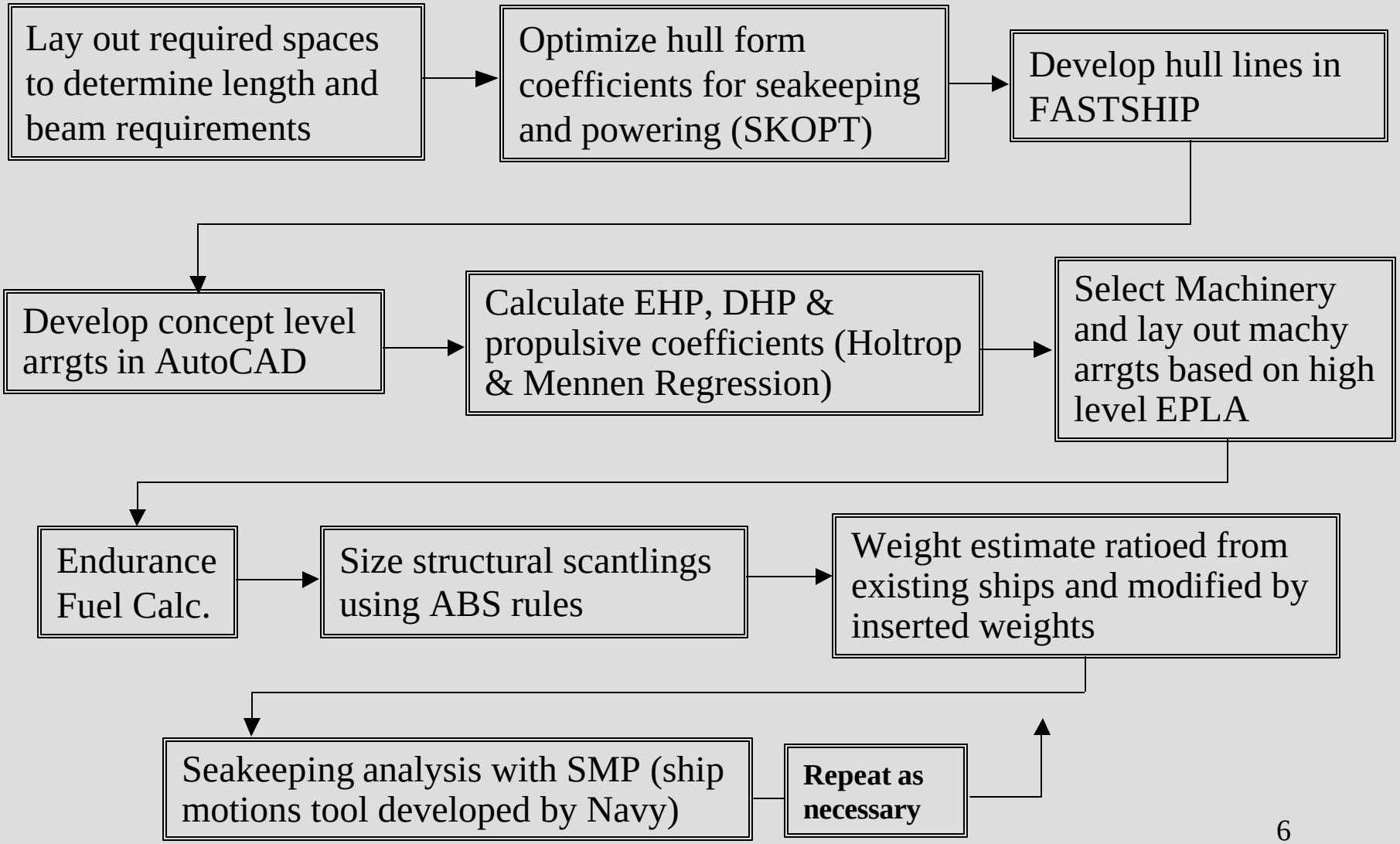
Concept Design Process

- Develop 3 Desired (objective) ship concepts that meets the desired SMRs
  - Monohull
  - SWATH
  - X-Craft Variant
- Determine changes to designs to meet minimum SMRs
- Determine feasibility of $50M cost cap

OCEAN Class AGOR

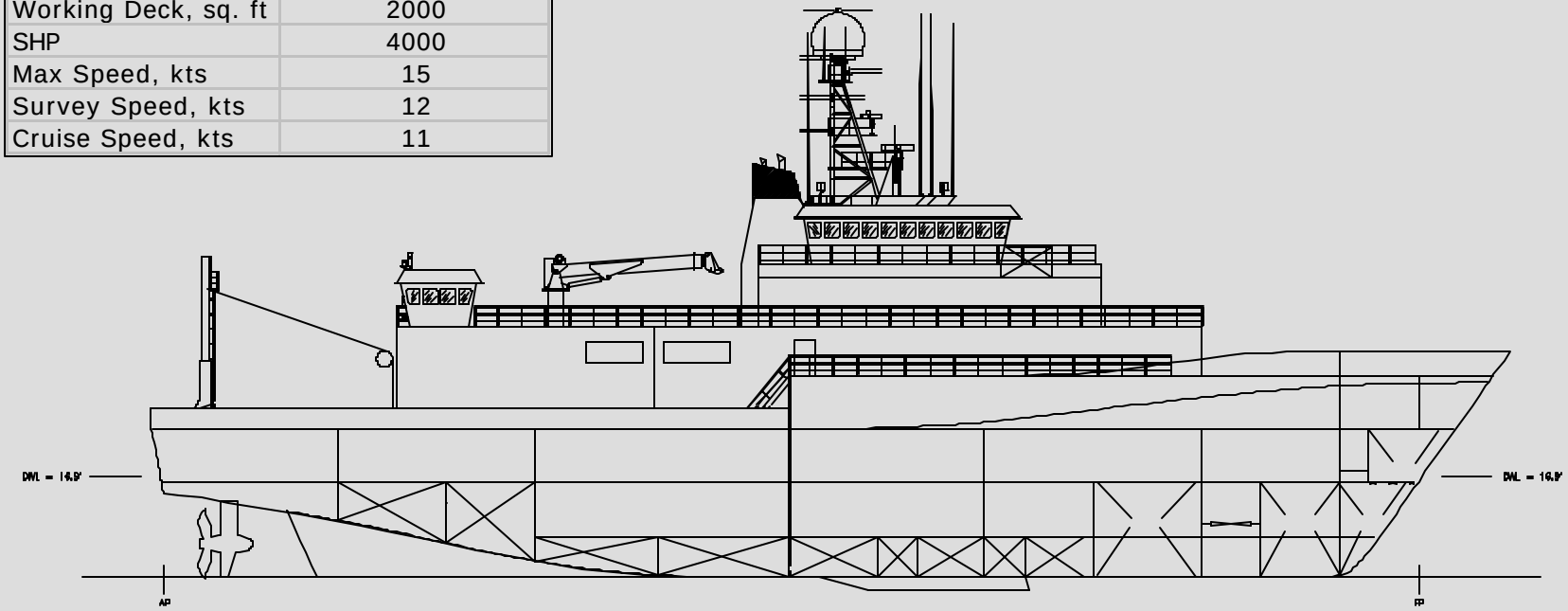
Concept Definition

Concept Design Process

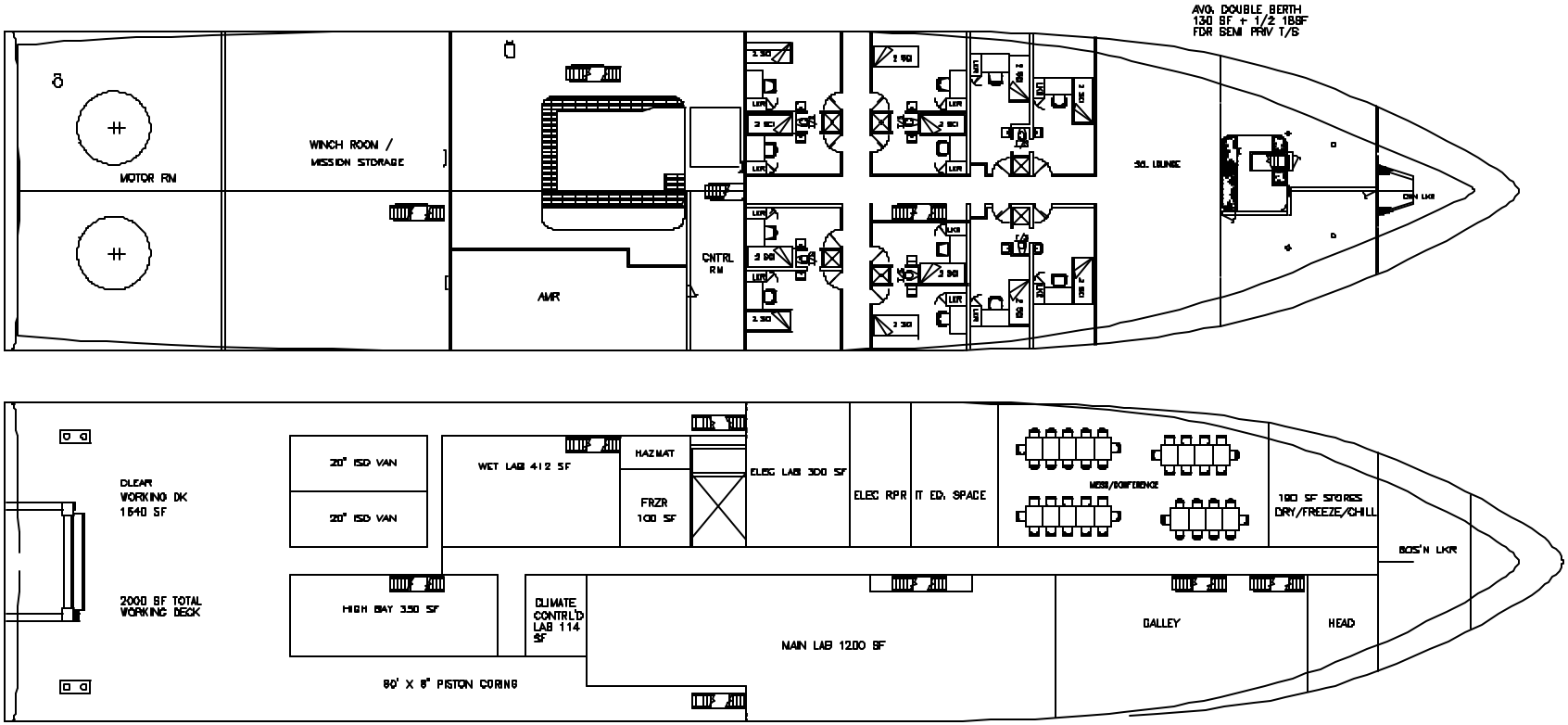


	DESIRED MONOHULL
LOA,ft	227
LWL, ft	210
Beam WL, ft	46
Max Beam, ft	46
Draft, ft	16.9
Displacement, LT	2500
Scientists	25
Crew	18
Lab Area, sq. ft	2075
Working Deck, sq. ft	2000
SHP	4000
Max Speed, kts	15
Survey Speed, kts	12
Cruise Speed, kts	11

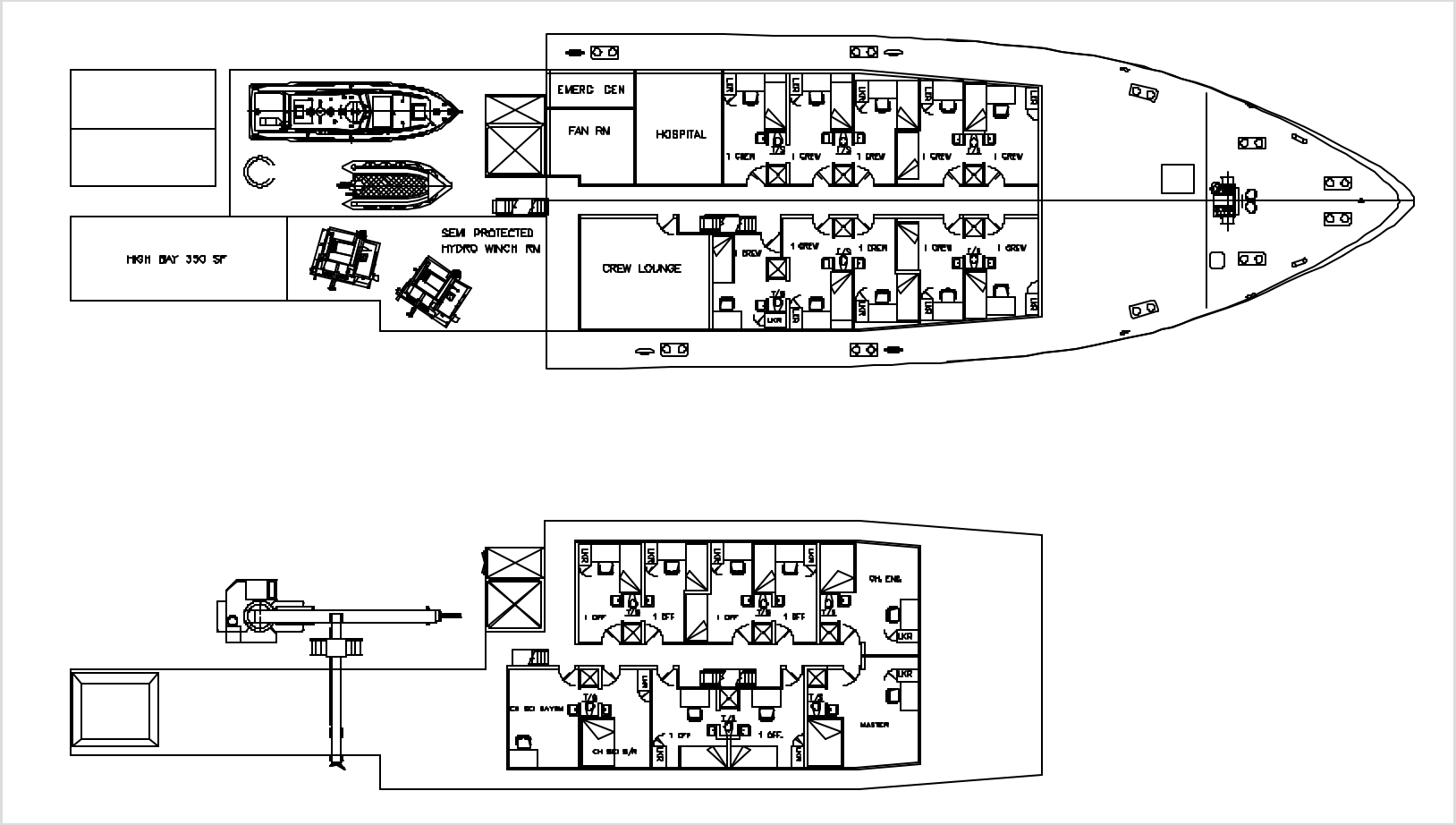
Desired Monohull Concept



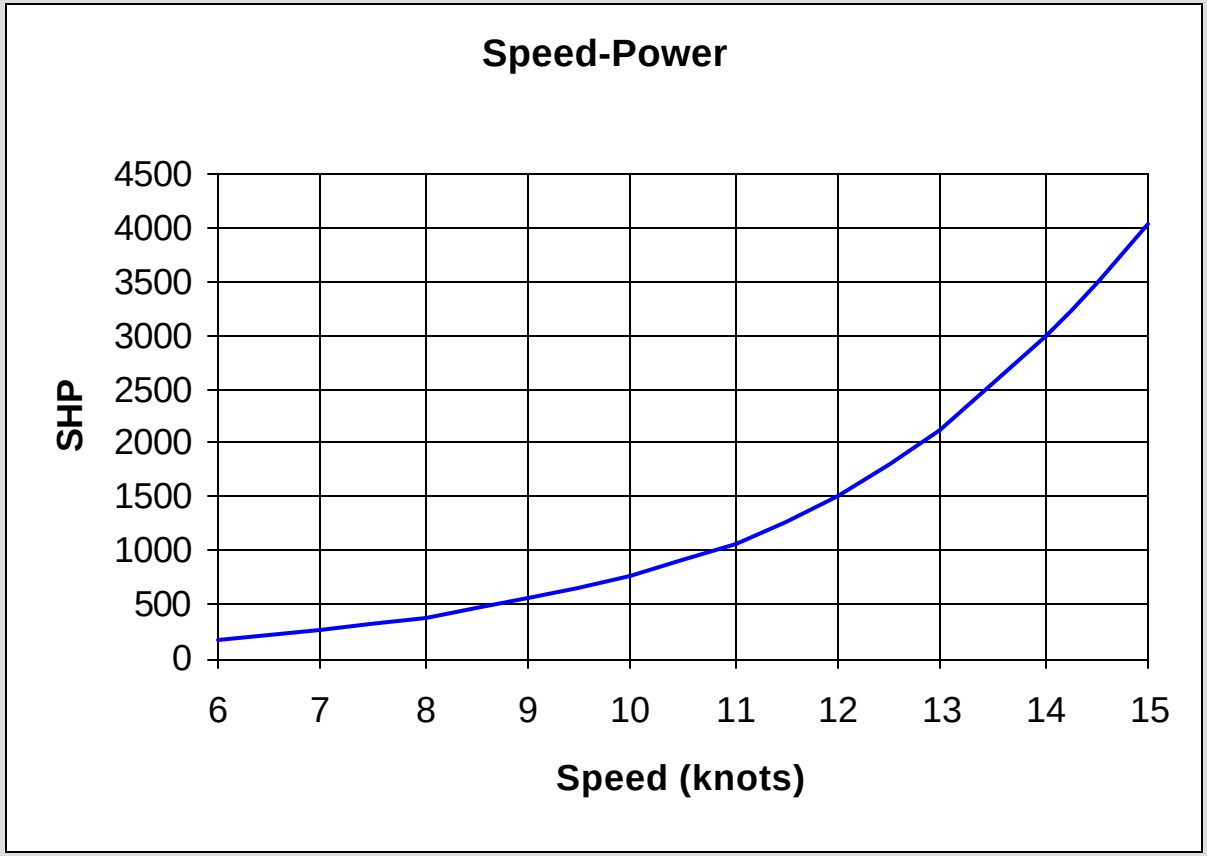
MAIN DECK & 1ST PLATFORM



01 & 02 DECK


EMERG GEN
FAN RM
HOSPITAL
HIGH BAY 350 SF
SEMI PROTECTED
HYDRO WINCH RM
CREW LOUNGE

Powering Estimates



Propulsion - Monohull

❖ Main Propulsion System

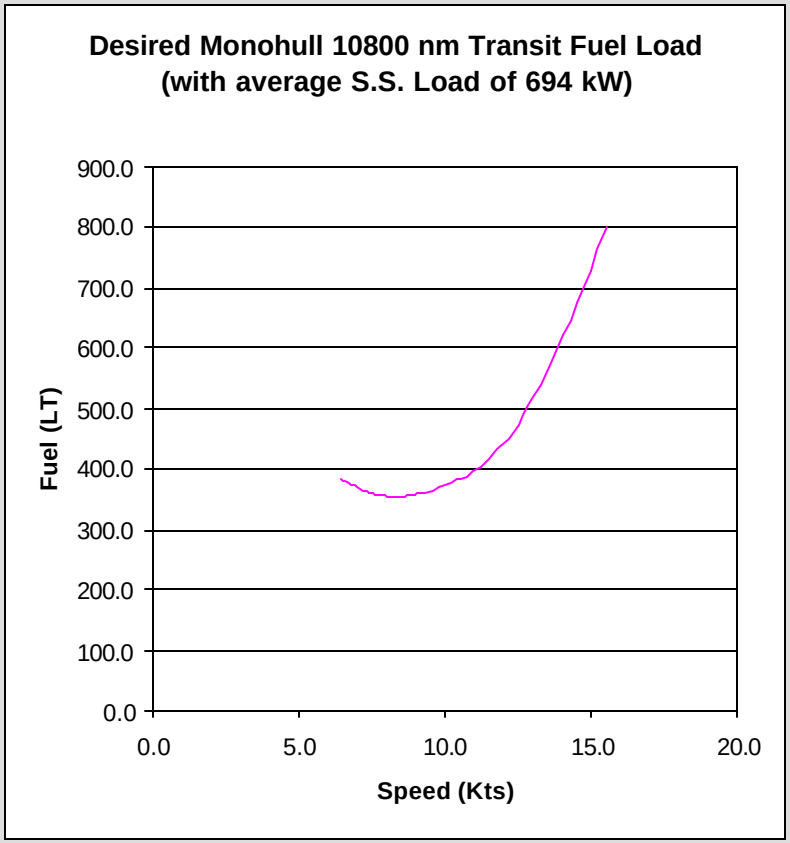
- Integrated Diesel Electric System
  - 3 x 1195 bkW, Caterpillar 3516 Propulsion Gensets
  - 3 Caterpillar 3412C Ship Service Gensets
    - 2 x 350 ekW, 50 Hz @ 1500 rpm for 700 ekW + standby
- Propulsion Motor and Propeller Unit
  - 2 x 1500 kw, 1000 rpm DC motors
  - 2 x steerable fixed pitch Z-drive. 2 x 2850 max kW @ 1000 rpm. Propeller diameter = 11.5 feet.

❖ Dynamic Positioning System

- Bow Thruster
  - 1 x Elliott White Gill T3S-40, 686 kW

Mission Fuel Load Estimates

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



OCEAN Class AGOR

Concept Definition

Seakeeping - Table of Operabilities

						Short-Crested	Long-Crested
Region	**Season**	**Perf.**	**Mission**	**Sea State**	**SMR**	**Desired**	**Desired**
North Atlantic	Annual	SPI-1	All	Spectrum	75% Winter	83%	76%
Pacific NW	Annual	SPI-1	All	Spectrum	75% Winter	85%	77%
North Atlantic	Winter	PTO	On Station	SS4	100%	100%	100%
North Atlantic	Winter	PTO	On Station	SS5	80%	95%	83%
North Atlantic	Winter	PTO	On Station	SS6	50%	53%	34%
North Atlantic	Winter	PTO	Transit	SS4	100%	100%	100%
North Atlantic	Winter	PTO	Transit	SS5	80%	94%	81%
North Atlantic	Winter	PTO	Transit	SS6	50%	55%	37%
Pacific NW	Winter	PTO	On Station	SS4	100%	100%	100%
Pacific NW	Winter	PTO	On Station	SS5	80%	95%	83%
Pacific NW	Winter	PTO	On Station	SS6	50%	81%	63%
Pacific NW	Winter	PTO	Transit	SS4	100%	100%	100%
Pacific NW	Winter	PTO	Transit	SS5	80%	94%	81%
Pacific NW	Winter	PTO	Transit	SS6	50%	81%	63%

Notes:

1) PTO = Percent time operability in a given sea state; SPI-1 = Seakeeping performance index (probability weighted across sea spectru

2) PTO analysis accounts for probability of significant wave heights for specific regions in Winter (January-March)

3) SPI-1 analysis assumes most probable modal wave periods for N. Atlantic and N. Pacific (Bales)

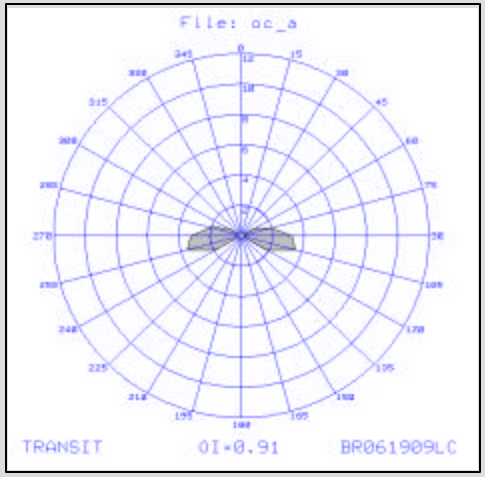
Seakeeping - Effect of Anti Roll Tank on Monohull Motions

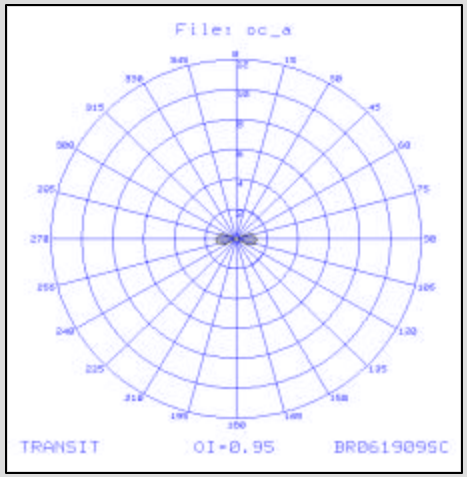
Transit, MID SS4, Tm=9s

Long-Crested Seas

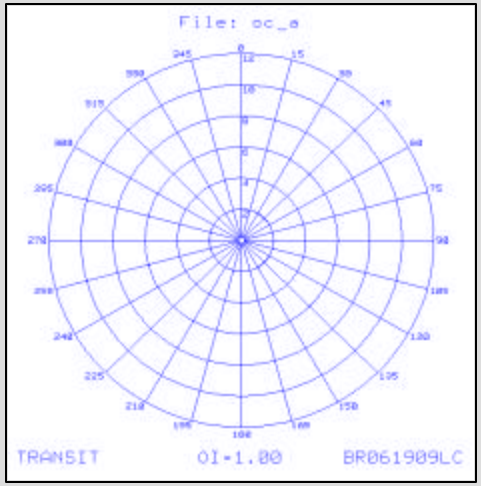
Short-Crested Seas

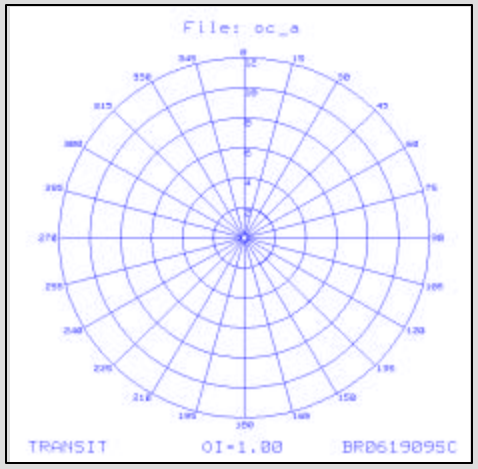
Without Anti Roll Tank





With Anti Roll Tank

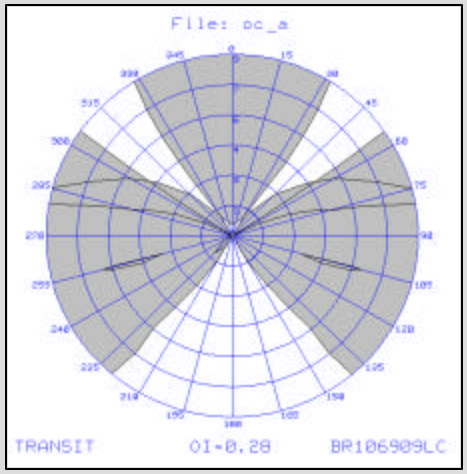
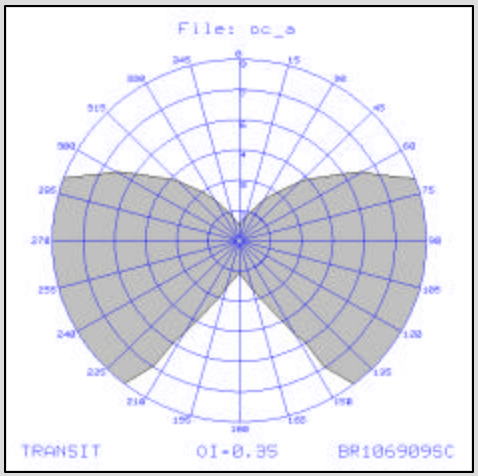
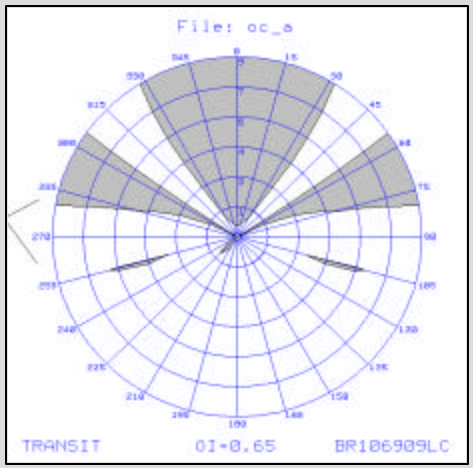
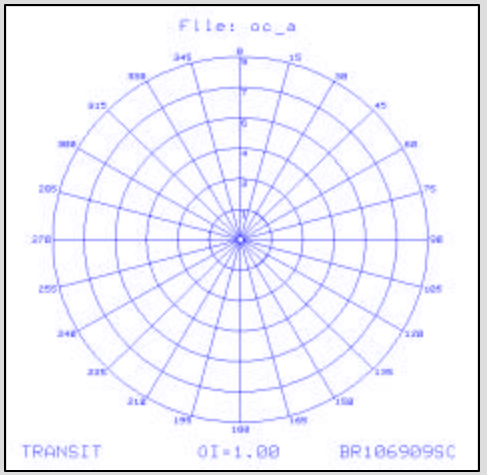




Shaded Areas Exceed Motion Criteria

Seakeeping - Effect of Anti Roll Tank on Monohull Motions

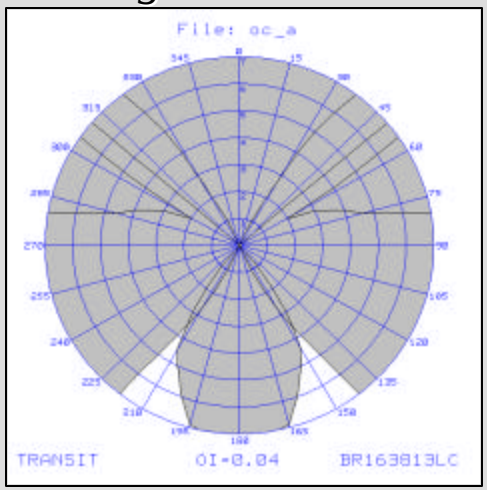
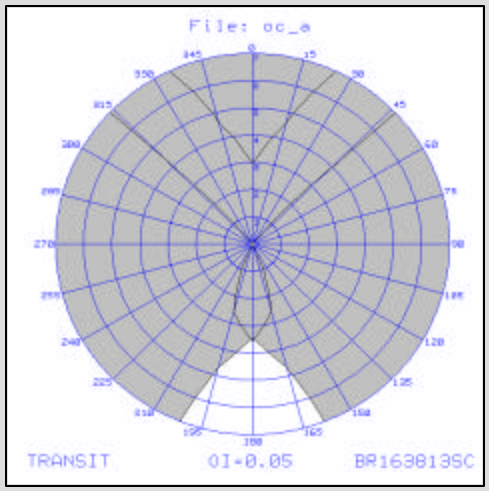
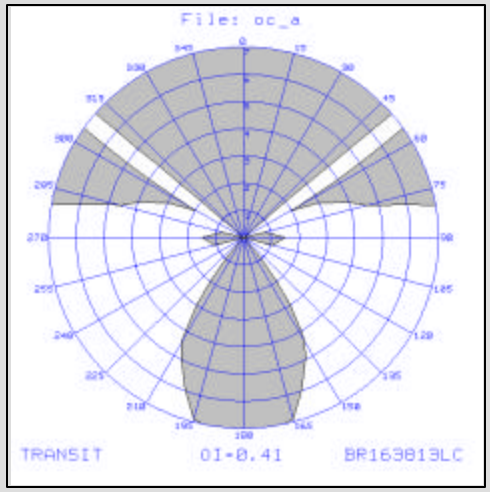
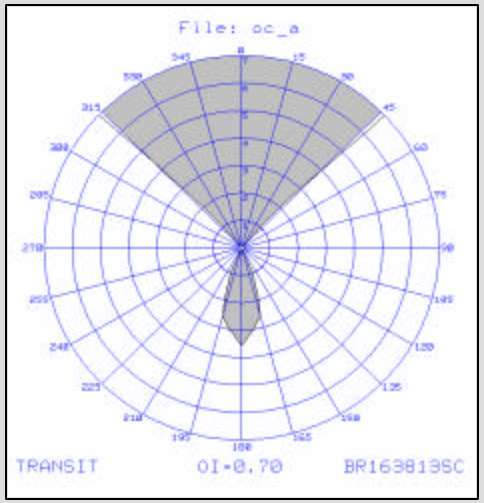
Transit, MID SS5, Tm=9s

	Long-Crested Seas	*Short-Crested Seas*
Without Anti Roll Tank		
With Anti Roll Tank		

Shaded Areas Exceed Motion Criteria

Seakeeping - Effect of Anti Roll Tank on Monohull Motions

Transit, MID SS6, Tm=13s

	Long-Crested Seas	*Short-Crested Seas*
Without Anti Roll Tank		
With Anti Roll Tank		

Shaded Areas Exceed Motion Criteria

Concept Design Variants

X-Craft

Main Characteristics

	ONR X-Craft	X-Craft AGOR
Length Waterline, ft	*240*	*240*
Beam, Overall, ft	*72*	*72*
Beam, Waterline, ft	*16.6*	*20.5*
Draft, ft	*11.8*	*14.6*
Displacement, Lton	*1400*	*2150*
Speed, knots	*>50*	*12*
Propulsion	*Gas Turbines & Diesels*	*Diesel Electric, Integrated*
	2 x 25 MW, 2 x 4 MW	*6 x Caterpillar 3412C*
Range	*4,000 nm @20 knots*	*10,800 nm @12 knots*
Payload, Lton	*150*	*200*
Crew	*25*	*18 + 25 Scientists*
SHP	*72,000hp@50 knots*	*2,800hp@12 knots*
Working Deck Area		*2,050 sq. ft*
Lab Area		*2,108 sq. ft*

AGOR Variant

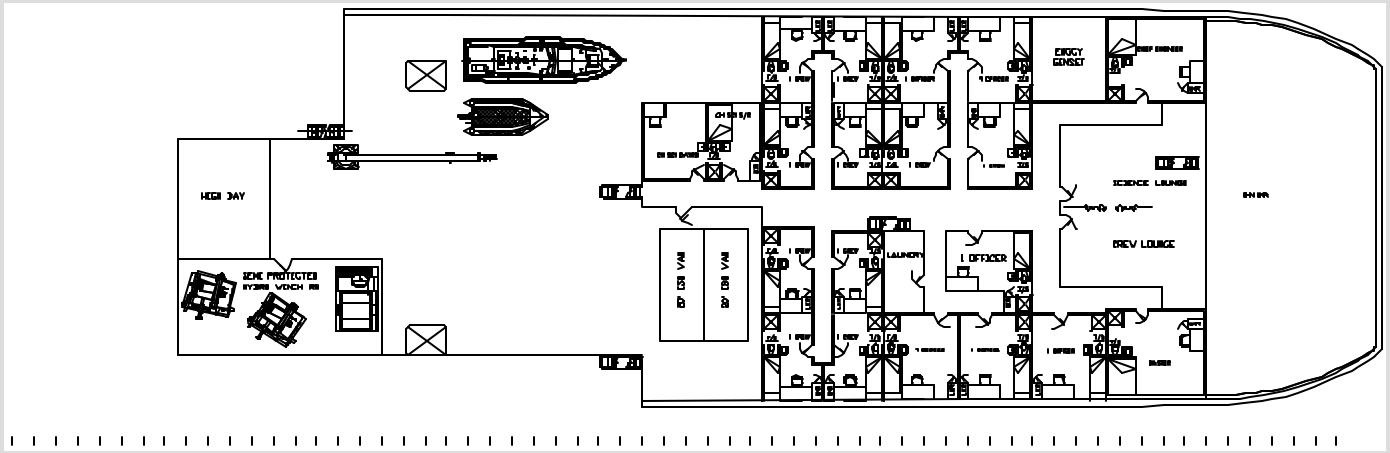
- *Displacement*
  - Based on the Ocean AGOR SMR, the UNOLS X-Craft is estimated to have a displacement of 2,150 Lton, compared to the 1,400 Lton ONR X-Craft.
  - To gain the required additional displacement, one option is to linearly scale two side hull cross sections under wetdeck and keep the ship length and hull above wetdeck unchanged.
- *General Arrangement*
  - The mission bay deck of the ONR X-Craft will be the main deck of the UNOLS X-Craft.
  - Remove the heavy flight deck of the ONR X-Craft.
  - Add an 01 deck over the main deck.
  - More than enough space available based on the existing main dimensions. Therefore, the length and beam of the ONR X-Craft were kept unchanged.
- *Hull Form*
  - No change of the ship length.
  - Geosim in the body section under the main wet deck with a linear ratio of 1.239.

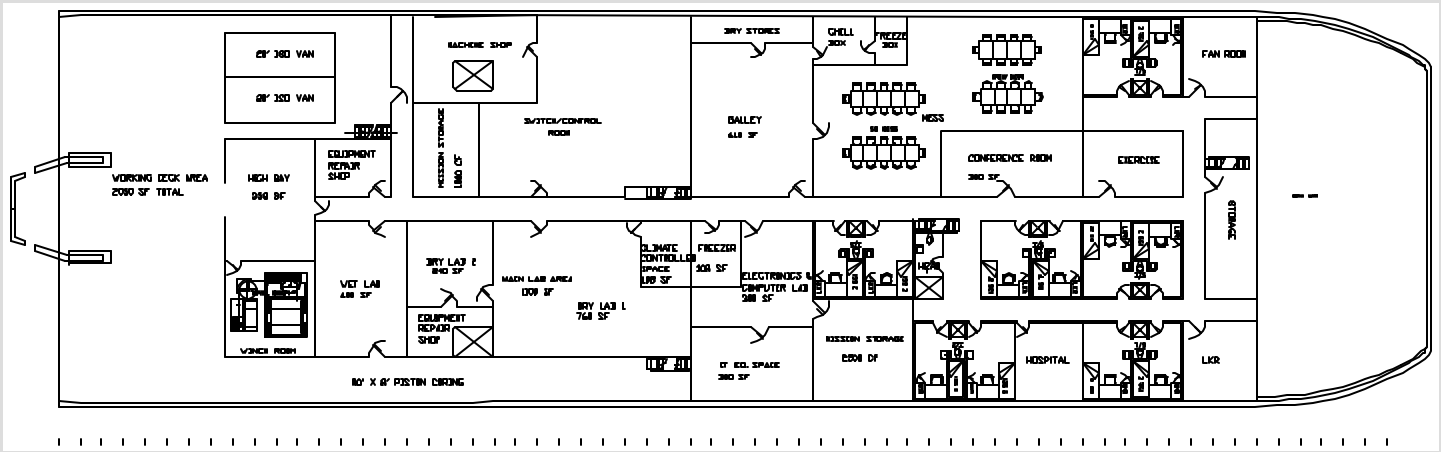
AGOR Variant

- Since the operation speeds are significantly lower, it is believed that at least the stern shape needs to be changed to optimize the low speed resistance of the Ocean AGOR.

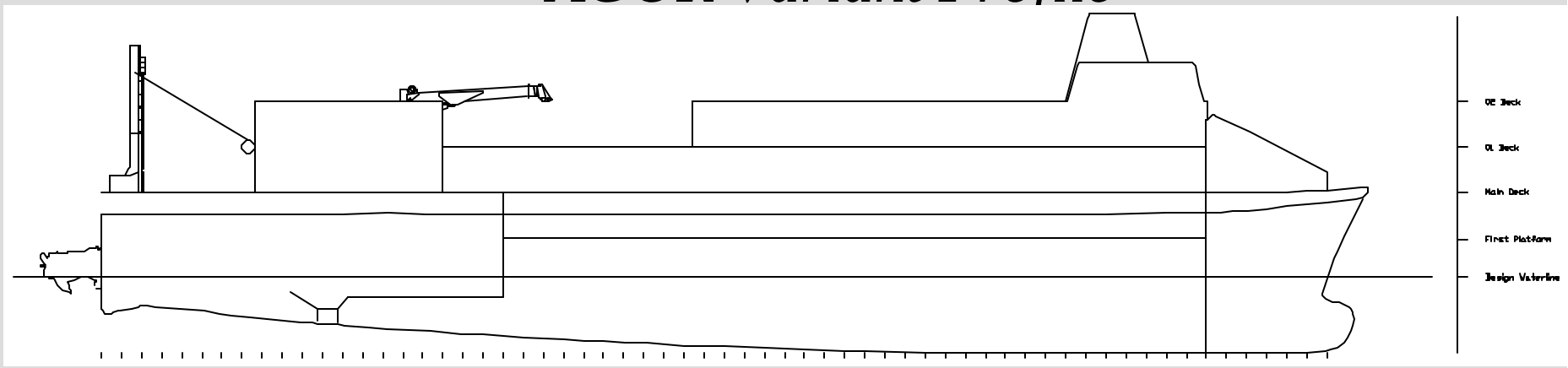
- *Structures*
  - Aluminum structure.
  - The hull shall be designed to ABS 90 meter Rules or SWATH Guide.
  - Design speed difference will change scantlings.
  - The deck structures will be designed according to the SMR loading requirements.
  - Current Flight Deck shall be replaced by a much lighter deck structure.
- *Propulsion System*
  - The gas turbines shall be removed
  - The gear diesel prime movers will be replaced by integrated diesel-electric systems.
  - There is no need for 4 waterjets for the much lower speed requirement. Two water jets may be installed instead.
  - Low speed water jets should be investigated to provide higher propulsion efficiency at 12 knots, such as the Traktor Jet. The current KaMeWa high speed water jet performs poorly at low speeds.
  - Traditional propeller could be an optional propulsor with a higher efficiency.

Main & 01 Deck

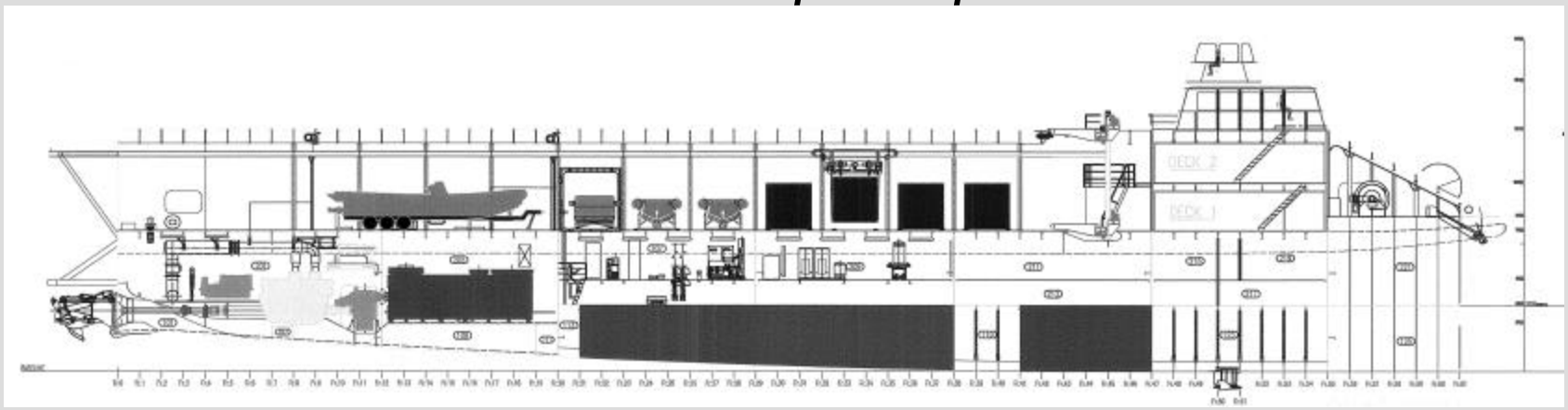

HIGH BAY
SCIENCE LOUNGE
REC LOUNGE
LAUNDRY
OFFICER


WORKING DECK AREA
HIGH BAY
EQUIPMENT REPAIR SHOP
MACHINE SHOP
SWITCH/CONTROL ROOM
DRY STORES
GALLEY
MESS
CONFERENCE ROOM
FAN ROOM
WET LAB
DRY LAB
MAIN LAB AREA
CLIMATE CONTROLLED SPACE
FREEZER
HOSPITAL
LKR

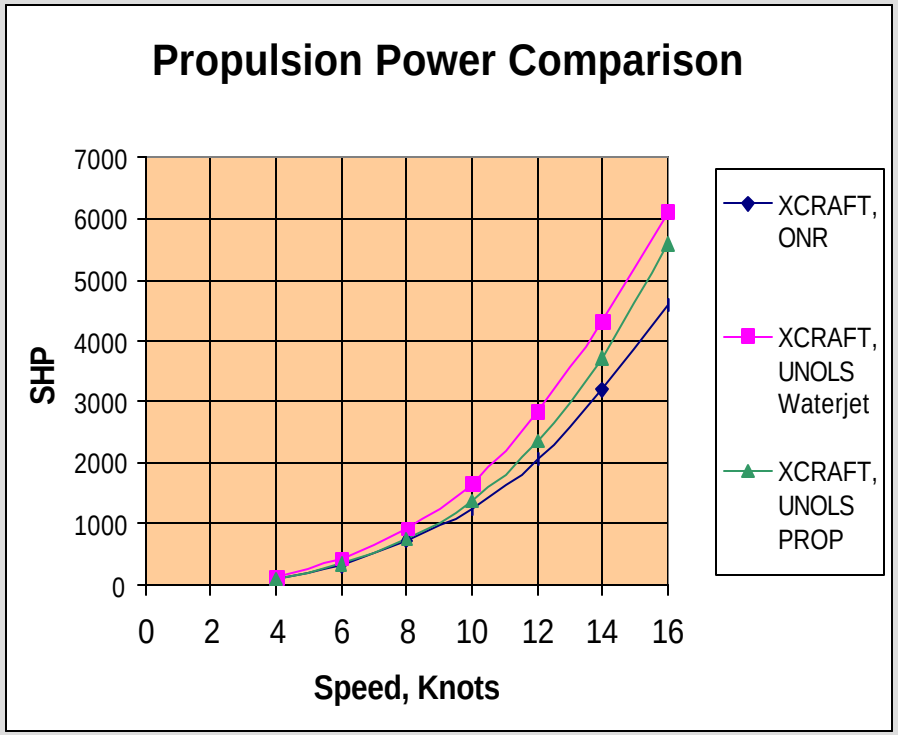
AGOR Variant Profile

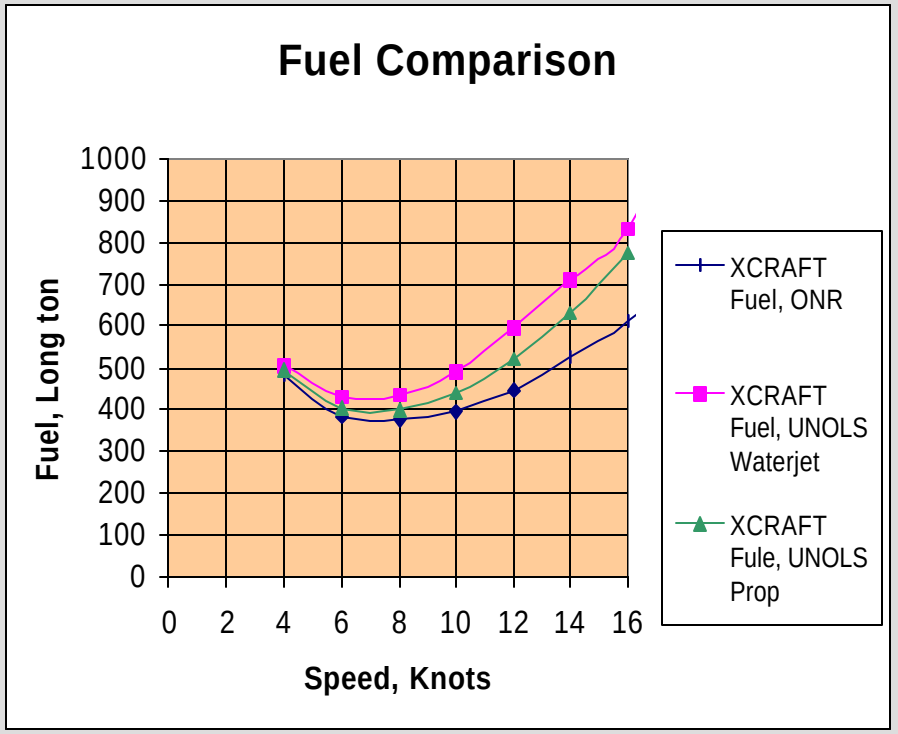


X-Craft Profile



Resistance and Fuel Consumption





Discussions of the AGOR X-Craft Variant

- *Hull Form*
  - Current hull form is for high speed and high propulsion power design.
  - Modification to the hull form may yield better performance at lower speed.
  - Stern shape change to accommodate the propulsion method change.
- *Propulsion System*
  - Availability of low speed waterjet. Most of the waterjets today are designed to operate at high speeds (>30 knots) and have low propulsive efficiencies (<0.45) at low speeds (<20 knots). Traktor Jet has large impeller diameter low speed water jets with higher efficiency (~ 0.5). But the model that can produce the required thrust is still in the prototype stage.
  - Shafted propeller with rake is an option. Propeller and required clearance need to be verified. Propeller efficiency typically 0.6 or better.
  - Z-drive. The unit is usually much heavier than a water jet or a shaft propeller.
  - SWATH type stern with propellers at the end of the tail cones.

OCEAN Class AGOR

Concept Definition

Work Remaining

- *Incorporate Comments*
- *Refine X-Craft Concept Designs & Analysis*
- *Develop SWATH AGOR Concepts*
- *Size Minimum SMR Concepts*
- *Investigate Technologies*
  - Portable Lab Vans
  - Overside Handling
  - Bubble Sweepdown