



Anti Piracy Combatant

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Motivation

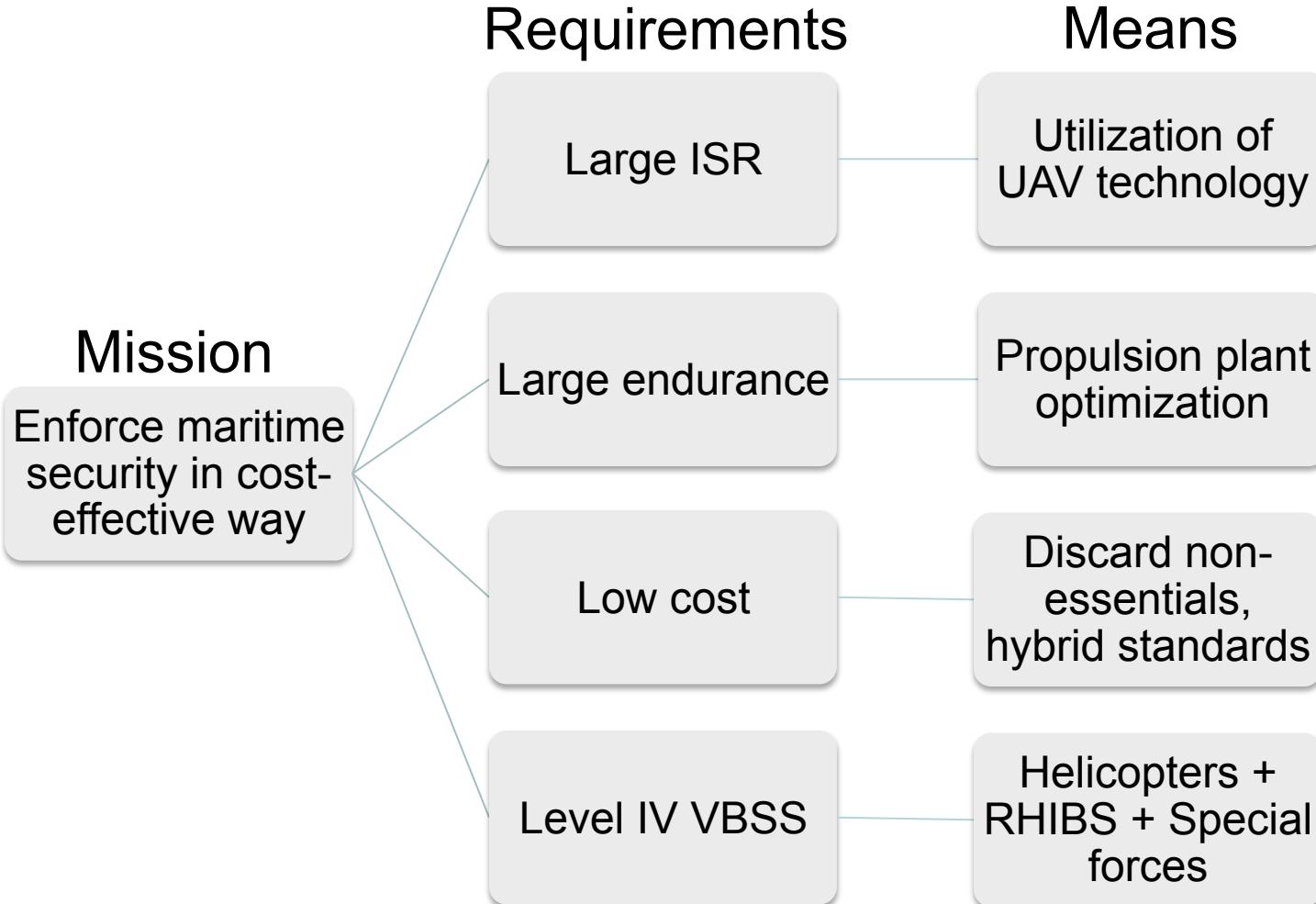
Piracy incidents report 2013-2014



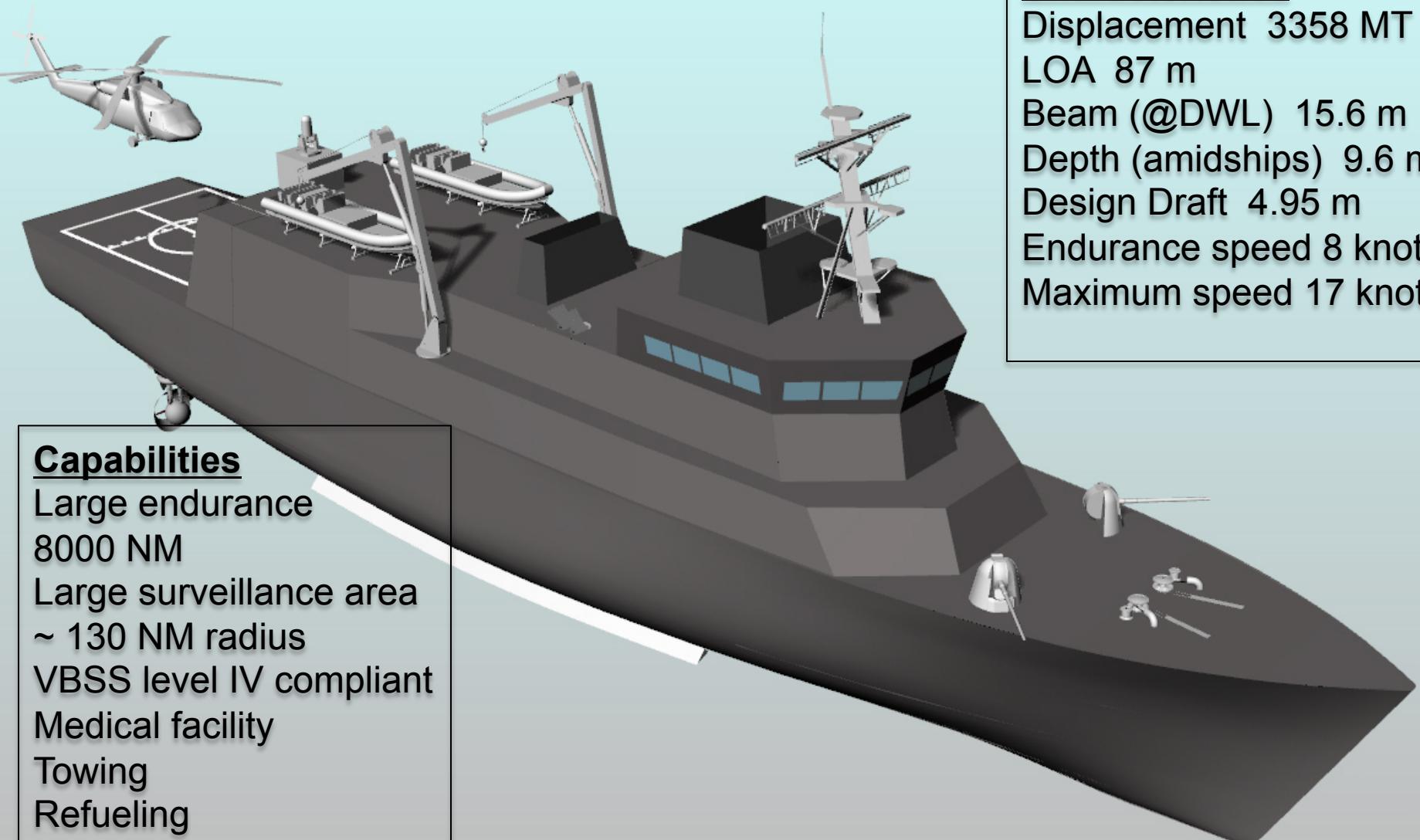
- Global maritime security is insufficient
- Threats are asymmetric and unpredictable
- Expensive warships are called to respond
- Response vessels may lack the necessary capabilities
- We can do better!



Design Requirements



Vessel Overview



Capabilities

Large endurance
8000 NM
Large surveillance area
~ 130 NM radius
VBSS level IV compliant
Medical facility
Towing
Refueling

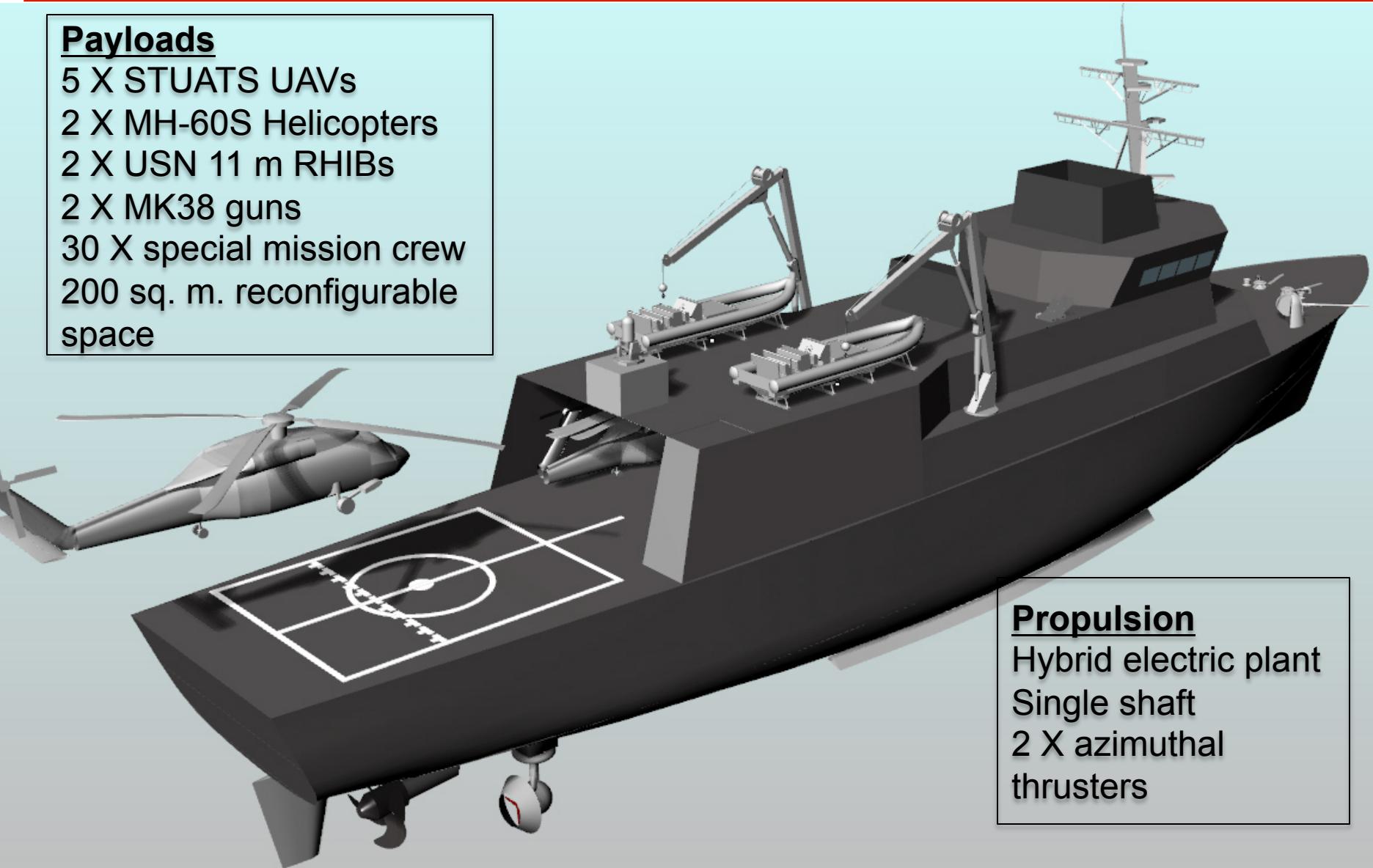
Characteristics

Displacement 3358 MT
LOA 87 m
Beam (@DWL) 15.6 m
Depth (amidships) 9.6 m
Design Draft 4.95 m
Endurance speed 8 knots
Maximum speed 17 knots

Vessel Overview

Payloads

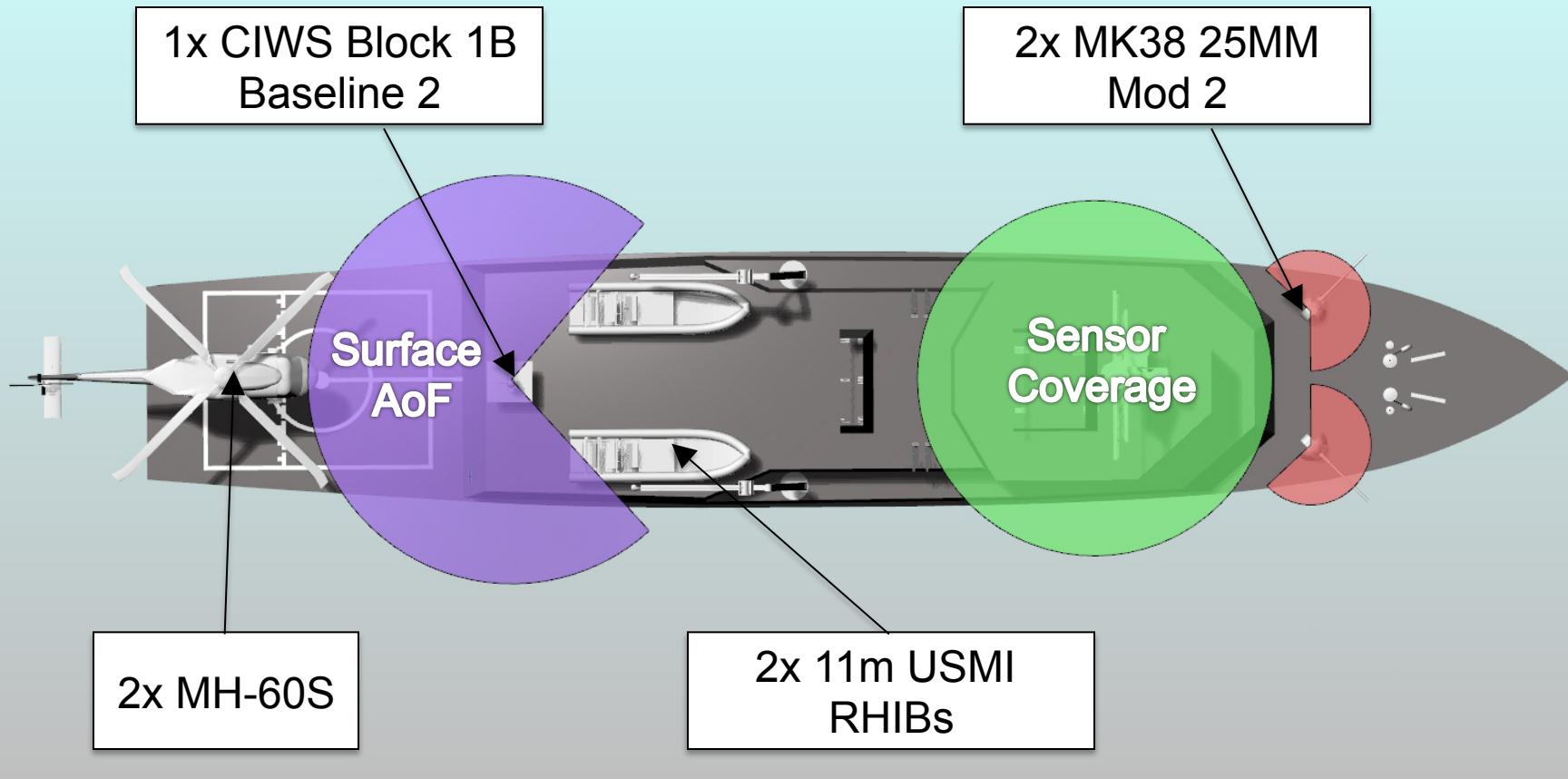
5 X STUATS UAVs
2 X MH-60S Helicopters
2 X USN 11 m RHIBs
2 X MK38 guns
30 X special mission crew
200 sq. m. reconfigurable space



Propulsion

Hybrid electric plant
Single shaft
2 X azimuthal
thrusters

Weapons



PERSISTENT ISR

- Principle APC Mission
 - 5 STUAS
 - 2 Datalink Systems
 - 1 RQ-21A in air at all times



Payload:

- Day/Night Full-Motion Video
- Infrared Marker
- Laser Range Finder
- Comms Relay Package
- AIS Receiver
- Total Weight: 25 lbs

Characteristics:

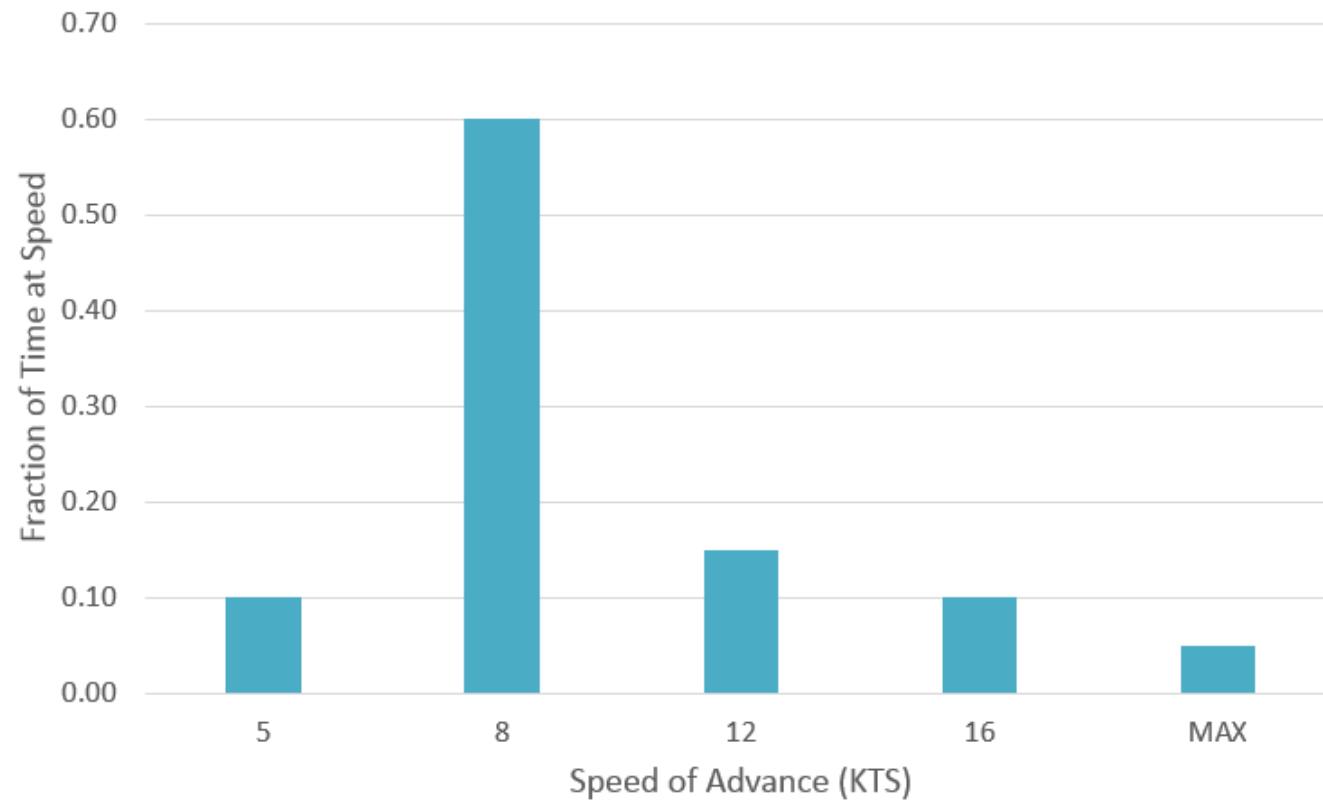
- Speed: 80 kts
- Ceiling: 15000 ft
- Min Range: 50 nm
- Wing Span: 16ft
- Length: 8ft
- Weight: 125 lbs

- **Surface Search Radar: SPS-67 & Furuno**
- **GPS**
- **Air Control:**
 - AN/SQQ-28 LAMPS III Shipboard System
 - 2x STUAS Data Communication Link Systems
 - TACAN / IFF
- **Chaff: MK36 MOD12 SRBOC**

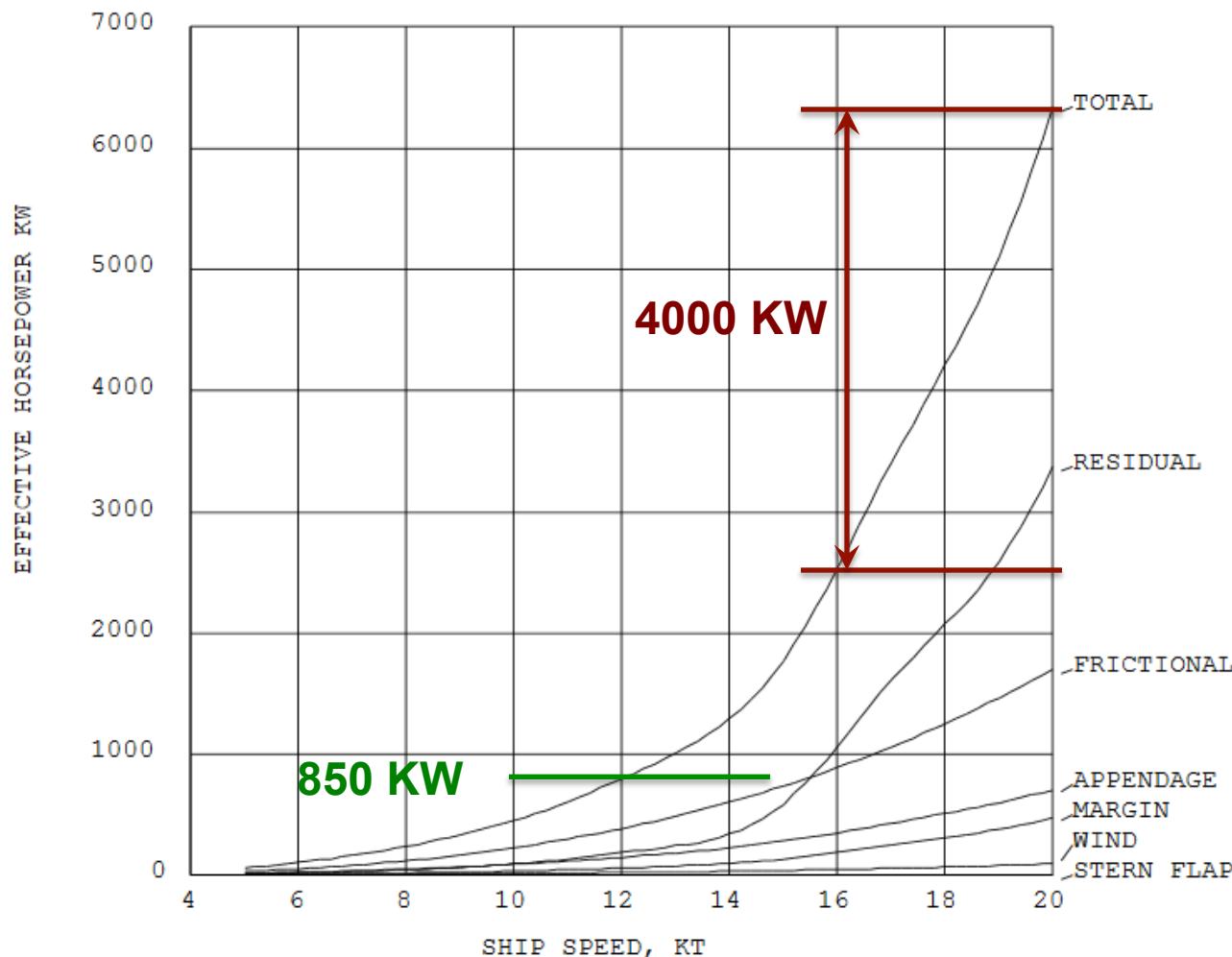
- **SATCOM/ LOS: 2x AN/WSG-3 UHF Transceivers**
- **SATCOM: 1x WSC-6 SHF Transceiver**
- **SATCOM: 1x INMARSAT(B) Transceiver**
- **VHF Bridge-to-Bridge**

Operational Profile

- **Max Speed: 17kts**

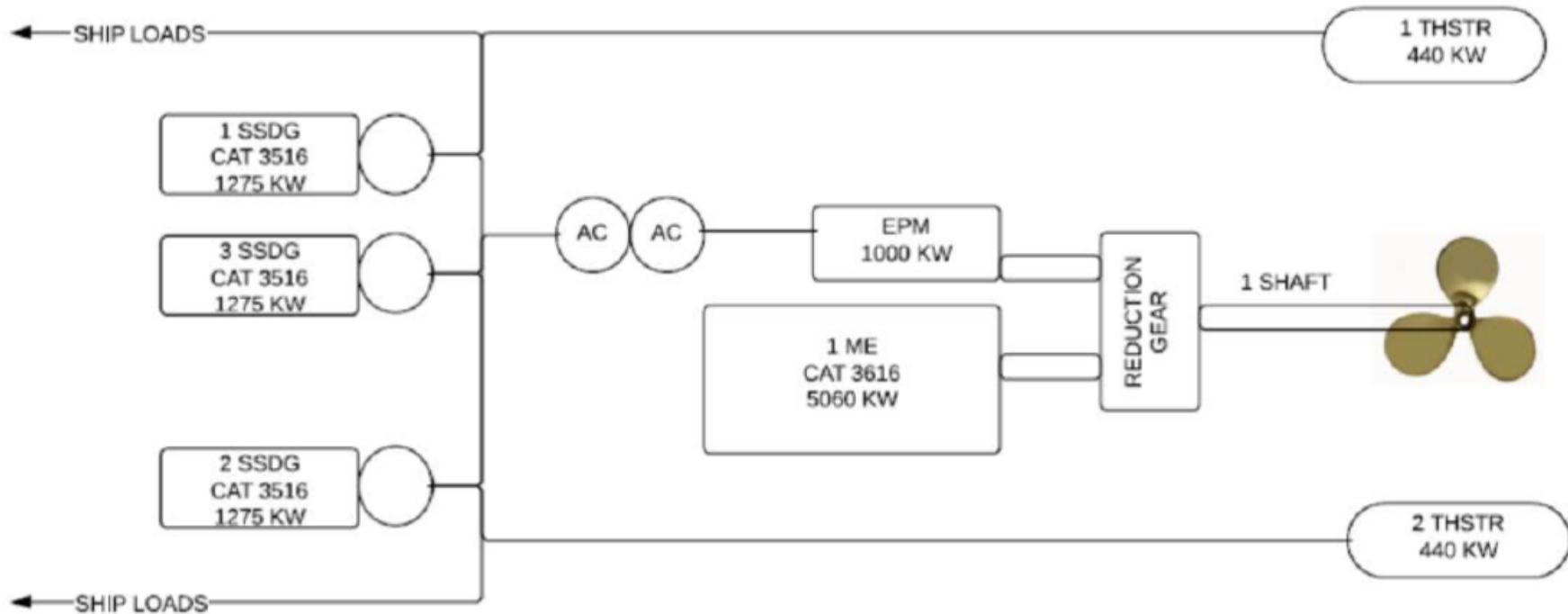


EHP vs. Speed



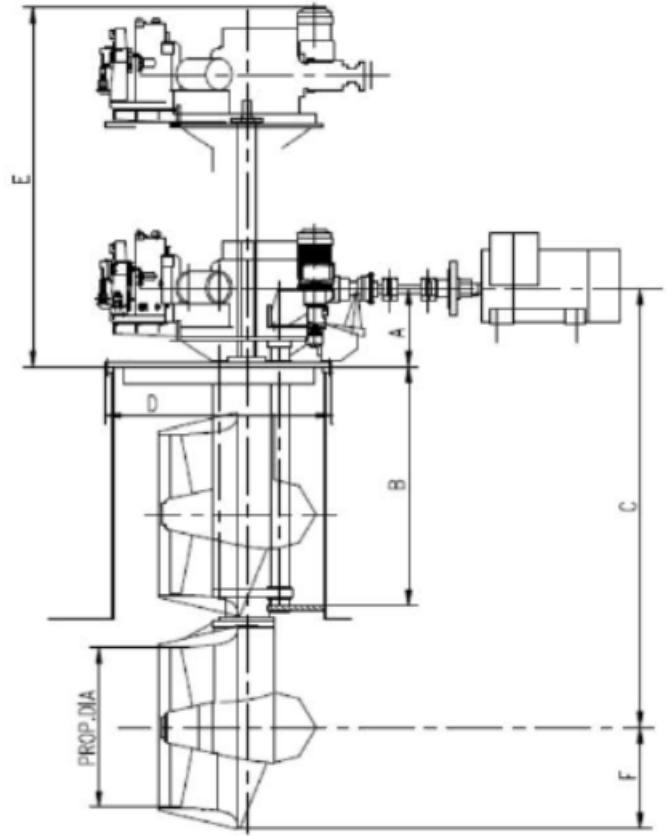
SPEED COSTS MONEY!

Engineering Plant

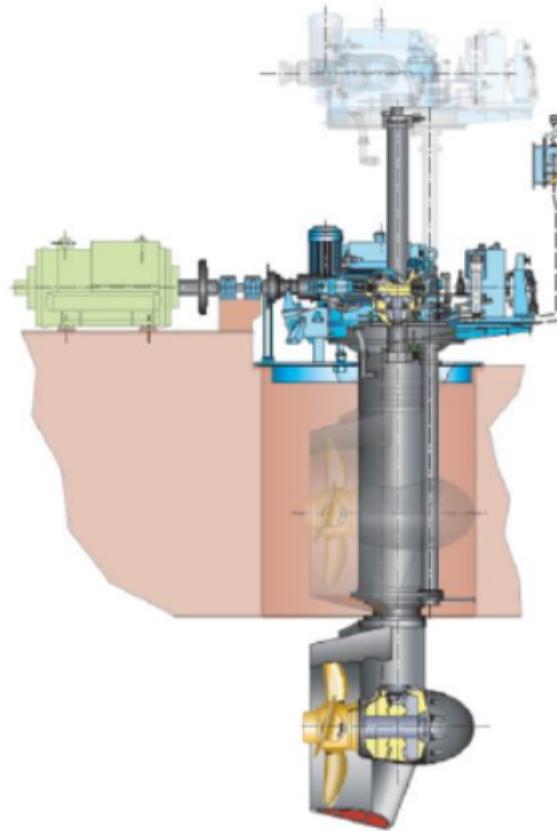


- 3 X 1275KW Diesel Gen Sets
- 1 X AC-AC Power Converter
- 1 X 1000KW EPM
- 1 X 5060KW Diesel Main Engine
- Single Shaft
- 2 X 440KW Retractable Thrusters

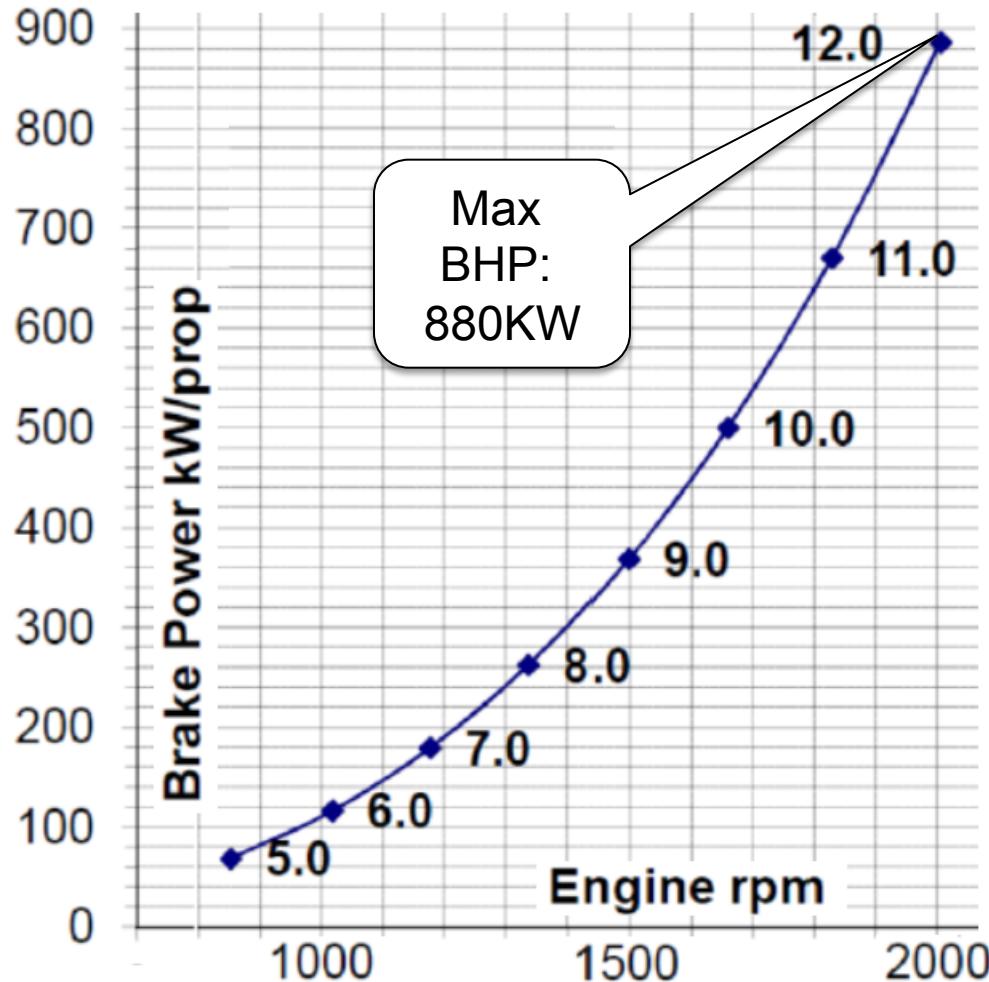
RR UL601FP



ROLLS-ROYCE UL601FP

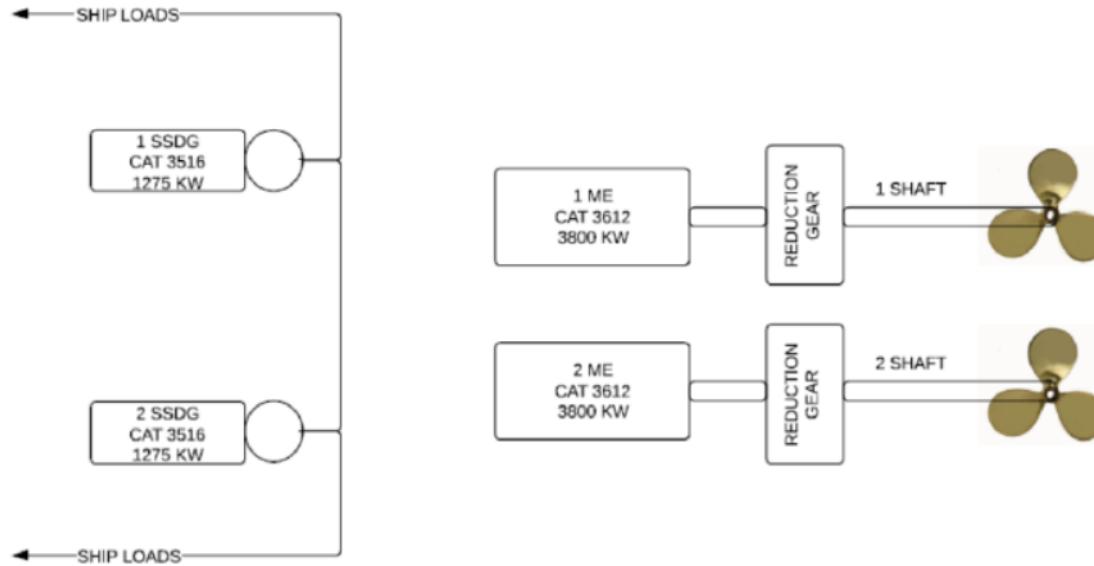


Thruster Performance



Projected Fuel Savings

- Compared to Conventional Electric / Propulsion Plant Configuration



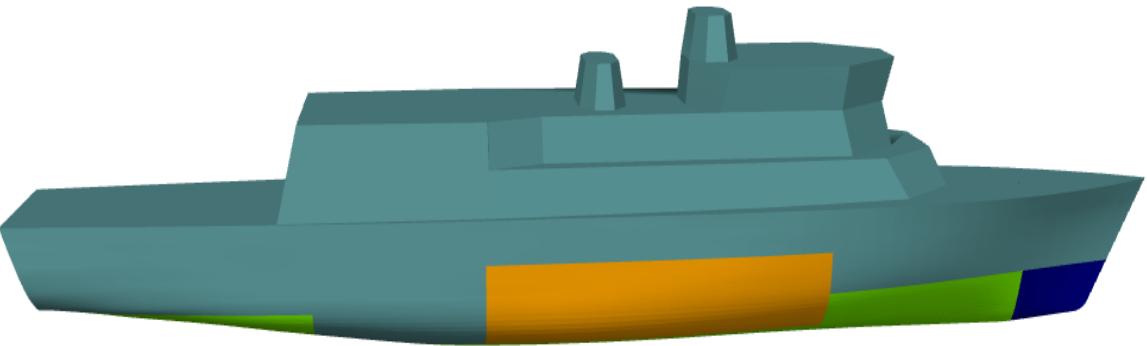
- Fuel Savings of >600k gals/yr w/ Hybrid Propulsion.
- If thrusters are used for main propulsion – more.

- **SAA Tool bridges the gap between a list of required areas and 2D drawings.**
- **Program operates in three stages:**
 - Volume allocations
 - Area allocations
 - Area layout
- **Demo during Poster Sessions**

Volume Allocation

Compartment Assignments		Area Allocation	Topology Arrangement
Volume: 756.9 / 882.5 m ³	Deckhouse Area: 967.7 / 1210.7 / 0.0 m ²	Total Arrangeable Area: 2765.1 / 2969.8 / 0.0 m ²	<input checked="" type="checkbox"/> Z View By Zones <input type="checkbox"/> Zone Editor
Operational Tankage Required/Assigned	Arrangeable Areas Required/Available/Assigned		

Compartment Viewport



Compartment Settings

Volume Assignment Totals			
SSCS Number	SSCS Description	Volume Assigned (m ³)	Volume (%)
1	MISSION SUPPORT	0.00	98.7 ^
1.3	AVIATION	0.00	98.7
1.38	AVIATION FUEL SYS	0.00	98.7
1.381	JP-5 SYSTEM	0.00	98.7
1.3813	AVIATION FUEL	0.00	98.7

Compartment Assignment

Compartment Name	Compartment Assignment	Deck Location	Zone
2-FPK-0	ARRANGEABLE	Deck 2	Zone 1
3-FPK-0	ARRANGEABLE	Deck 3	Zone 1
HB-FPK-0	VOID, NOT TANKAGE	Hull Bottom	Zone 1
2-8-0	ARRANGEABLE	Deck 2	Zone 1
3-8-0	ARRANGEABLE	Deck 3	Zone 1
4-8-0	OPERATIONAL TANKAGE	Deck 4	Zone 1
HB-8-0	OPERATIONAL TANKAGE	Hull Bottom	Zone 1
2-16-0	ARRANGEABLE	Deck 2	Zone 2
3-16-0	ARRANGEABLE	Deck 3	Zone 2
4-16-0	OPERATIONAL TANKAGE	Deck 4	Zone 2
HB-16-0	OPERATIONAL TANKAGE	Hull Bottom	Zone 2
2-25-0	ARRANGEABLE	Deck 2	Zone 2
4-25-0	MACHINERY	Deck 4	Zone 2
HB-25-0	OPERATIONAL TANKAGE	Hull Bottom	Zone 2
2-38-0	ARRANGEABLE	Deck 2	Zone 3
4-38-0	MACHINERY	Deck 4	Zone 3
HB-38-0	OPERATIONAL TANKAGE	Hull Bottom	Zone 3
2-50-0	ARRANGEABLE	Deck 2	Zone 3
3-50-0	ARRANGEABLE	Deck 3	Zone 3

Area Allocation

Compartment Assignments
Area Allocation
Topology Arrangement

Deckhouse Area: 967.7 / 1210.7 / 0.0 m²

Total Arrangeable Area: 2765.1 / 2969.8 / 145.0 m²

Arrangeable Areas Required/Available/Assigned

Run Genetic Algorithm

Run Simulated Annealer

Allocation Utility
0.010

Area Preferences

Compartment Location Affinity

SSCS Number	SSCS Description	Deck Location	Zone Location	Location(Z)	Ignore Assignment
1	MISSION SUPPORT	No Preference	No Preference		<input type="checkbox"/>
1.1	COMMAND,COMMUNICATION+SURV	No Preference	No Preference		<input type="checkbox"/>
1.11	EXTERIOR COMMUNICATIONS	No Preference	Zone 5		<input type="checkbox"/>
1.111	RADIO	No Preference	Zone 5		<input type="checkbox"/>
1.113	VISUAL COM	No Preference	Zone 5		<input type="checkbox"/>
1.13	COMMAND+CONTROL	No Preference	No Preference		<input type="checkbox"/>
1.131	COMBAT INFO CENTER	Deck 1	No Preference	0.50	<input type="checkbox"/>
1.132	CONNING STATIONS	Deck 03	Zone 5		<input type="checkbox"/>
1.13201	PILOT HOUSE	Deck 03	Zone 5		<input type="checkbox"/>
1.13202	CHART ROOM	Deck 03	Zone 5		<input type="checkbox"/>
1.14	COUNTERMEASURES	No Preference	Zone 5		<input type="checkbox"/>
1.141	ELECTRONIC	No Preference	Zone 5		<input type="checkbox"/>

Allocation Utility

Area Optimization

Load Heuristic Preferences

Utility Functions

Select Utility Function:

Total Area Allocation Module Utility

Utility Function:

Total Area Allocation Module Utility

Distribution Type:

Combination

Calculation of Utility Value:

Average Utility

For combination type utility functions, overall weighted average is computed by summing the weighted value of each composition function utility.

Utility Description:

Represents the total utility measure of the area allocation module, comprised of the sum of two utility functions: Compartment Utility and Space Utility

Allocations View

Area Assignment Totals

SSCS Number	SSCS Description	Deckhouse Area Assigned	Deckhouse Area Required	Total Area Assigned	Total Area Req
1	MISSION SUPPORT	0.00	606.42	145.00	877.54
1.1	COMMAND,COMMUNICATION+SURV	0.00	100.94	0.00	186.14
1.11	EXTERIOR COMMUNICATIONS	0.00	45.95	0.00	45.95
1.111	RADIO	0.00	40.00	0.00	40.00
1.113	VISUAL COM	0.00	5.95	0.00	5.95
1.13	COMMAND+CONTROL	0.00	48.49	0.00	108.50
1.131	COMBAT INFO CENTER	0.00	0.00	0.00	60.00
1.132	CONNING STATIONS	0.00	48.49	0.00	48.49
1.13201	PILOT HOUSE	0.00	41.53	0.00	41.53
1.13202	CHART ROOM	0.00	6.96	0.00	6.96
1.14	COUNTERMEASURES	0.00	6.50	0.00	6.50
1.141	ELECTRONIC	0.00	6.50	0.00	6.50
1.15	INTERIOR COMMUNICATIONS	0.00	0.00	0.00	25.20
1.2	WEAPONS	0.00	65.00	0.00	95.01
1.21	GUNS	0.00	0.00	0.00	30.00

Area Allocations By Compartment

Select a compartment to view: 2-25-0

Deck Location: Deck 2

Designated Zone: Zone 2

Total Compartment Area: 200.29

Assigned Area in Compartment: 145.00

Compartment Utilization: 72.40 %

New:

Existing:

SSCS Number	SSCS Description	Area Assigned
1.35306	AVIATION OFFICE	100.00
1.36106	BATTERY SHOP	45.00

Area Layout

Compartment Assignments Area Allocation Topology Arrangement

Deckhouse Area: 967.7 / 1210.7 m² Total Arrangeable Area: 2765.1 / 2969.8 m²

Lay Areas By Greedy Fill Lay Areas Select and Translate Point Select Polygon Select Pan Zoom Rect Camera Controls Selection Controls Draft Tools

Arrangeable Areas Required/Available

Topological Considerations

Autogenerate Passages Passage Templates

Select DC Deck: Deck 2

Select Passage Type: Double

Passageway Width(m): 2.00

Double Passageway Spread: 0.82

Generate Passageways

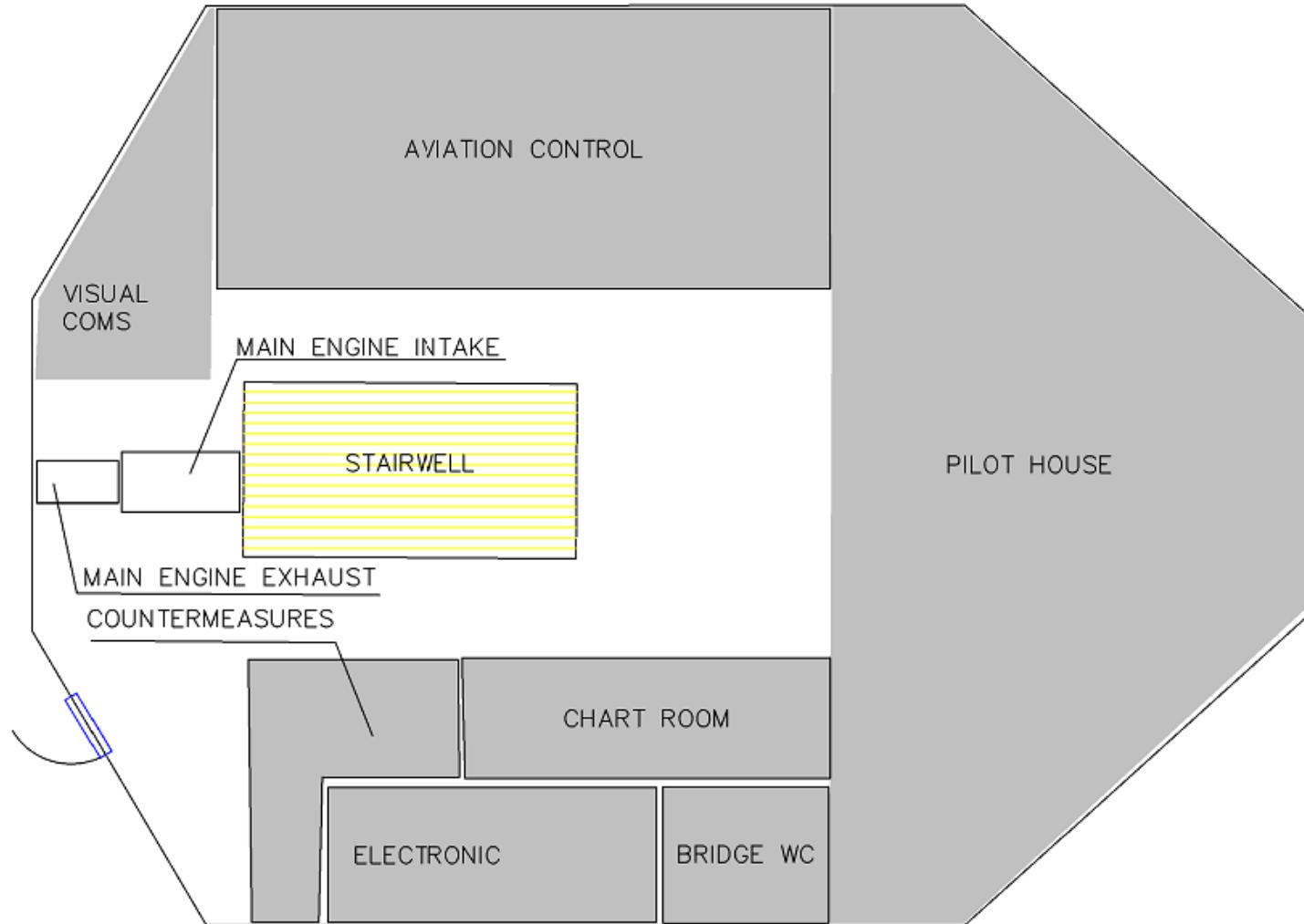
Current Compartment Area Allocated/Laid

SSCS Number	SSCS Description	Area Assigned	Area Laid	Label Visibility
1.35306	AVIATION OFFICE	100.00	0.00	<input type="checkbox"/>
1.36106	BATTERY SHOP	45.00	0.00	<input type="checkbox"/>
1.141	ELECTRONIC	0.00	11.87	<input checked="" type="checkbox"/>

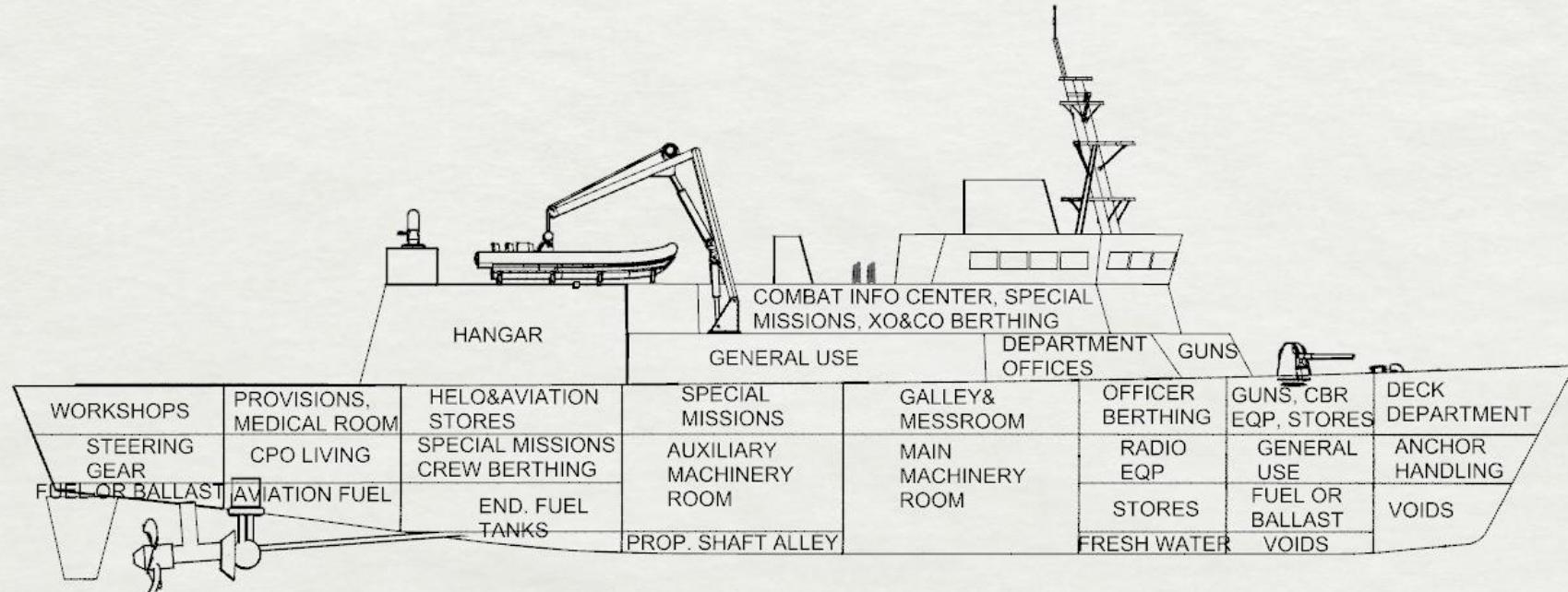
Deck View: Deck 2

SCALE: 12 (m) 0 5 10

Example Tool Output



Internal Deck View



Cost

- **Many design decisions were made to make the APC affordable:**
 - ABS building standards
 - Smaller hull size
 - Engineering Plant configuration
 - Armament
- **To estimate cost we used the MIT 2N auxiliary ship cost model**
 - Lead ship cost – 174 million (USD FY2014)
 - For comparison the USCG Offshore Patrol Cutter (OPC) costs 324 million (USD FY2012)

Conclusions

- **Affordable ship with ability set that provides for maritime security.**
 - Deterrence through persistent, sustained ISR
 - VBSS Level IV capable operations
- **Unique engineering plant solution that both minimizes fuel usage and operating costs.**
- **New arrangements tool capable of automating 2D preliminary arrangements**



QUESTIONS?