Design Innovations on Future Naval Cruisers

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Strategic Context



- Peer adversary navies growing faster than ours
- Slow ship construction
- Aging ships and naval support structure

Strategic Context

- Currently the U.S. Navy CSG defense is carried out by the Ticonderoga class cruisers

- However, ALL the ships in the class are planned to be decommissioned by 2029



Key Challenges and Considerations

- Lack of Next-Generation Cruiser CG(X) to carry out air defense

- Limited ability for ships to service at sea

- Need for long endurance vessels



[1]

Design Innovations

- AI Integration
- Drone Integration & Meteorological Tests
- Anti-Detection Measures
- VLS Capacity & Replenishment
- Directed Energy Weapons (DEW)

AI Integration

- Integration with sensor systems for better target distinction
- Data analysis & machine learning for predictive maintenance
- Decision making aid



[2]

Drone Integration & Meteorological Tests

- USVs – Enhancement of VLS capacity, swarm tactic capability
- UAVs – Scouting, meteorological testing
- UUVs – Underwater testing



[3]

Anti-Detection Measures

- Addition of resilient mounts to reduce machinery noise
- Anechoic Tiles to reduce radiated noise
- AI Integrated degaussing
- Slightly tumblehome radar-scattering superstructure design

VLS Capacity & Replenishment



[4]

- Increased VLS Capacity to allow for extended operations
- Integration of TRAM system to allow for underway replenishment

DEW Development

- High Energy Laser with Integrated Optical-Dazzler and Surveillance
- Limited only by ship power and cooling capabilities



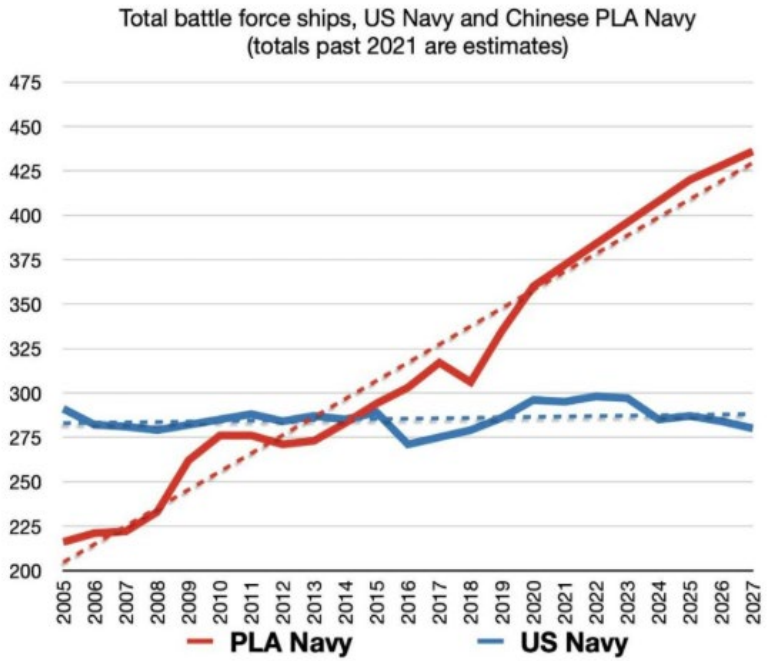
[5]

Economic Principals

- Focus of Quality over Quantity
- Servicing at Sea – Cost Cutting
- Nuclear? …for Cruisers
- Avoid Complex, Variable Factors - Keep it Simple

Quality over Quantity

- Less focus on total numbers
- Priority on mission requirements
- Number of ships being built vs retired are not equal; fleet size is expected to decrease yearly [7]



[6]

Servicing at Sea



[8]

- Focus on developing the merchant marine fleet
- Avoiding time spent in the dry docks and yards
- Range: 11,000 nmi
- Service Life: Three Decades

Nuclear Option



[9]

- Unlimited range through PWR
- Historical precedents with Virginia class cruisers
- Too costly to build, maintain and operate nuclear cruisers [10]

Keeping it Simple

- Developing new vessels do not have to be a start over, but working from predecessors
- Even simple and cheap projects can extend to costly problems, ex. both LCS class vessels [12]



[11]

Our Proposed CG(X) Design Approach

- Construction of a new AEGIS backed cruiser

- Capable of reloading VLS missiles underway at sea

- Ability to carry out CSG air defense

Comparative Analysis: Previous Ships

Class Ship	Years Built	Displacement (LT)	Length (ft)	Beam (ft)	L/B	Draft (ft)	B/T	Speed	Propulsion (hp)
Long Beach Class (CLGN)	1957–1961	15540	721.25	71.50	10.09	30.58	2.34	30	80,000
Bainbridge Class DLGN	1959-1962	9100	565.00	57.75	9.78	29.00	1.99	34	60000
Truxtun Class (DLGN)	1963-1967	8659	564.00	58.00	9.72	30.50	1.90	31	70000
California Class (CGN)	1970–1974	10600	587.00	61.00	9.62	31.50	1.94	30	60000
Virginia Class (CGN)	1972–1980	11666	586.00	63.00	9.30	32.00	1.97	3	60000
"Design Summary"	FUTURE	15727	588.00	62.00	9.48	29.00	2.14	35	162000
Kirov Class Battlecruiser	1974–1998	28000	827.00	94.00	8.80	30.00	3.13	32	140000
Strike Cruiser (CSGN)	NEVER BUILT	17284	709.58	76.50	9.28	22.33	3.43	3	120000
Ticonderoga Class (CG)	1980–1994	9600	567.00	55.00	10.31	34.00	1.62	32.5	~100000
Arleigh Burke Class (DDG)	1988-present	9700	509.50	66.00	7.72	31.00	2.13	30	105000
Next Generation Cruiser (CG(X))	NEVER BUILT								
Zumwalt Class (DDG)	2011-present	15656	610.00	80.70	7.56	27.60	2.92	30	105000
NexGen Destroyer (DDG(X))	2032 (planned)	13290							
Constellation Class (FFG(X))	2024-present	7291	496.00	65.00	7.63	N/A	N/A	26	~52200
Type 055 Destroyer	2014–present	12795	590.58	65.58	9.01	21.67	3.03	30	150000
Atago Class Destroyer	2004–2008	10,000	541.33	68.92	7.85	20.00	3.45	30	100000
Maya Class Destroyer	2017–2021	10250	557.75	68.92	8.09	21.00	3.28	30	68010
Sejong the Great Class Destroyer	Unknown	12000	557.75	70.25	7.94	20.50	3.43	30	100000
F126 Frigate	2023-present	10550	544.58	71.17	7.65	19.25	3.70	26	43000
Type 45 Destroyer	2003–2012	8500	500.00	69.58	7.19	24.25	2.87	32	27000

Parametrization

Initial Design:

- Block Coefficient: 0.599
- Midship Coefficient: 0.927
- Prismatic Coefficient: 0.654
- Waterplane Coefficient: 0.885
- DWL: 35 ft

Preliminary Design:

- Block Coefficient: 0.55
- Midship Coefficient: 0.89
- Prismatic Coefficient: 0.61
- Waterplane Coefficient: 0.80
- DWL: 562 ft

Design Overview: Particulars

- Displacement: 15,727 Long Tons
- Length Overall: 588 Feet
- Beam: 62 Feet
- Design Waterline: 562 Feet
- Midship Depth: 55 Feet
- Propulsion Output: 121 MW
- Hotel Output: 16 MW

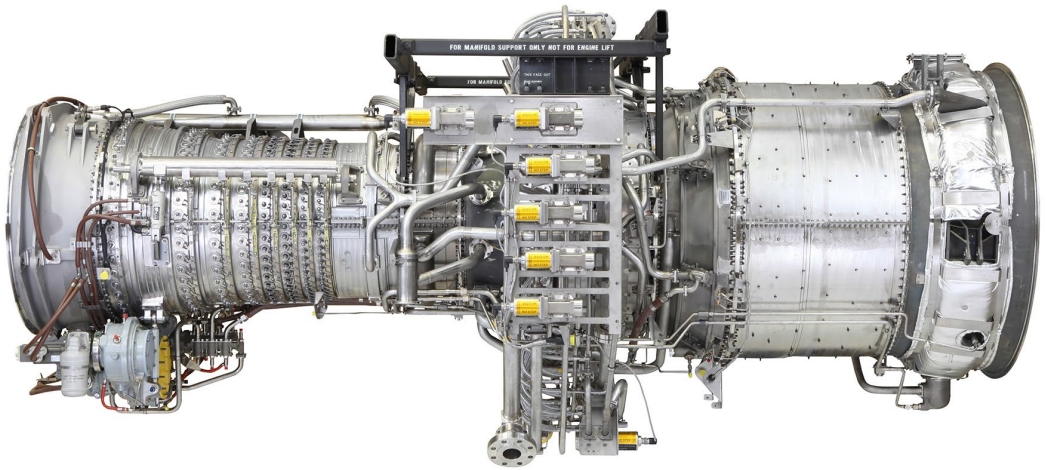
Design Overview: Features

- 6 AESA 3D Radar x4 (AESA)
- AN/SPQ-9B Surface Search/FC Radar (Spook Nine)
- AN/SPQ-9B FC Radar (Spook Nine)
- Mk-45 5" x 2 Lightweight Gun (Artillery)
- Mk-32 TL x2 (Torpedo Launcher)
- HELIOS LWS 120kW x2 (Close-In Weapon System)
- Mk-38 25mm MGS x2 (Machine Gun System)
- Mk-41 VLS Module x20 (VLS Missiles)

[13]

Turbines Used

- GE LM2500+ GT Propulsion x4
- Rolls Royce AG9160RF x4

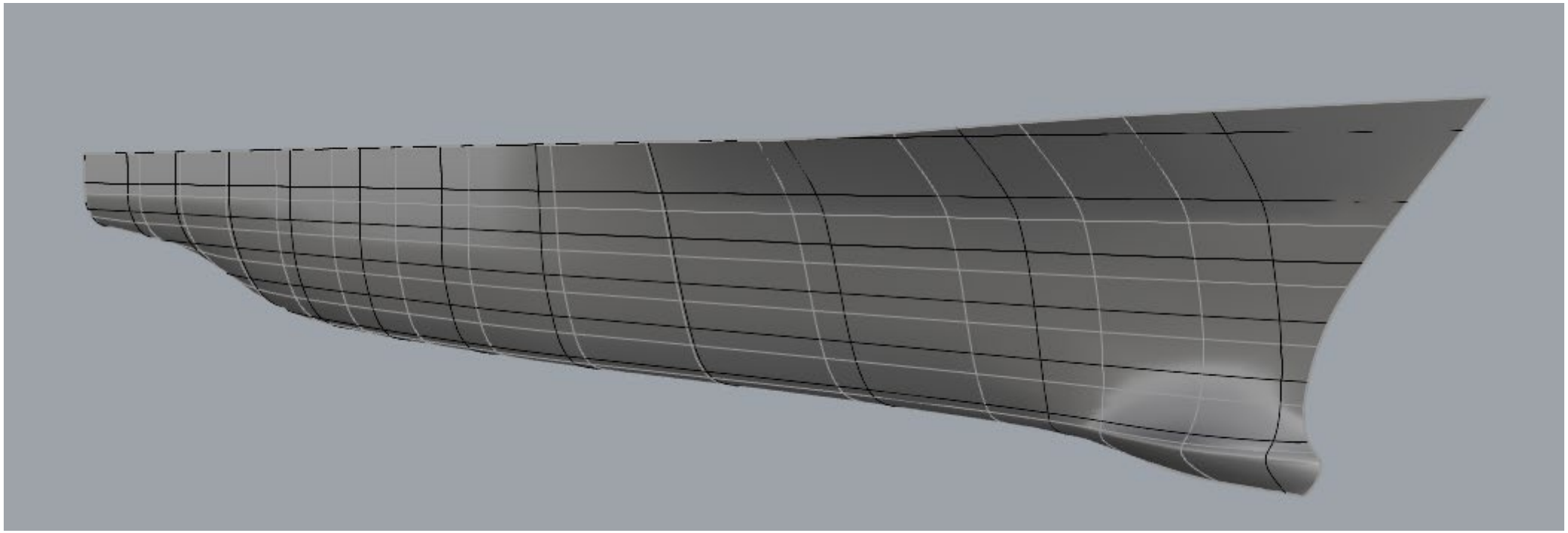


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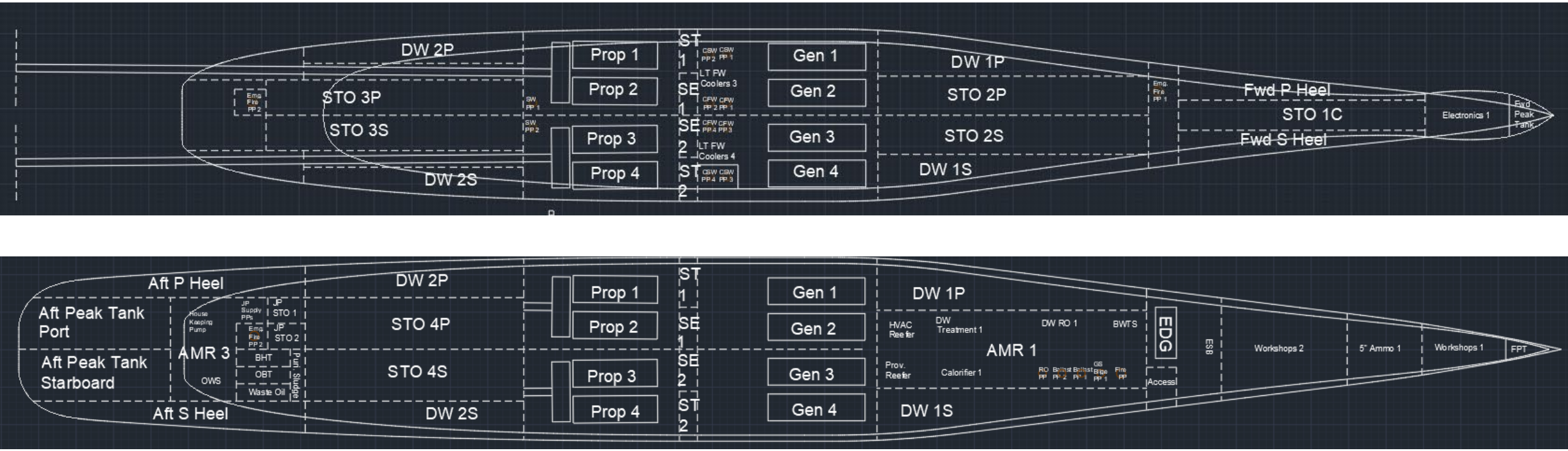


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Hull Model



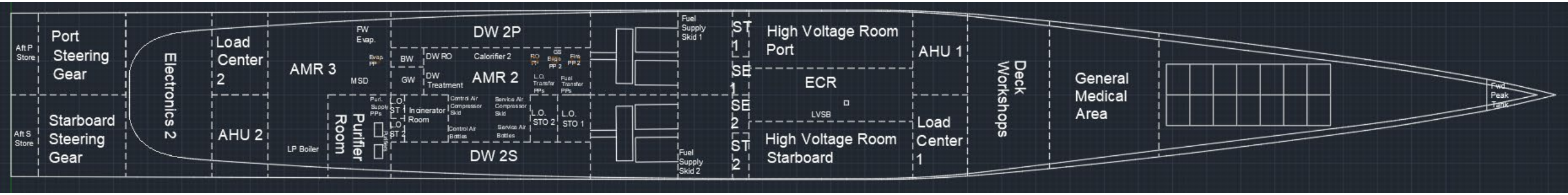
Placing Tanks and Compartmentalizing In Plans



Preliminary 5th and 4th Deck

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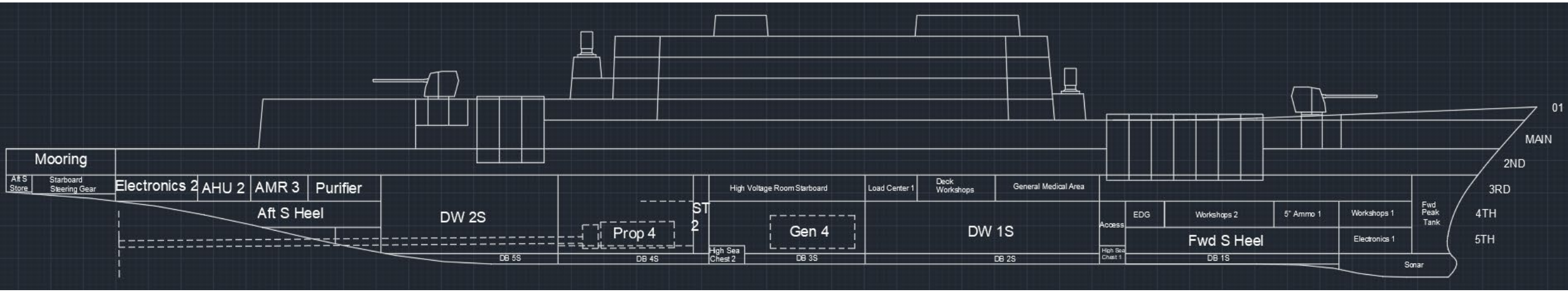
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Preliminary 3rd Deck

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Placing Tanks and Compartmentalizing In Plans



Category Weight Estimates

- Steel Weight: Bessant
- Superstructure Weight: Boccolini & Coppola
- Machinery: Carreyette
- Support Equipment Weight: Stenard

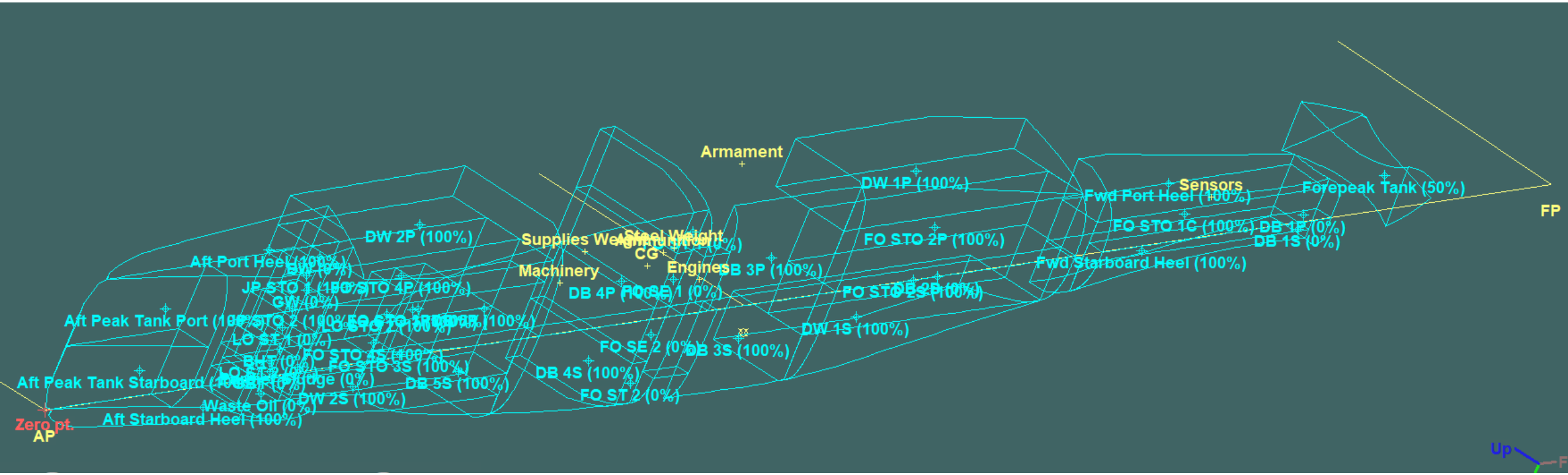
Hull Steel Weight			
Displacement	12756	LT	
Length	588	ft	
Beam	58	ft	
Depth	60	ft	
Draft	31	ft	
Stress	8.035714	LTsi	
Hull Steel Weight	5320.663	LT	Bessant
Superstructure Weight	970.5834	LT	Boccolini and Coppola
Total Steel Weight	**6291.247**	LT	

Machinery Weight			
Shaft x2	25	LT	
Propeller x2	70	LT	
Reactors	217	LT	
Machinery	2632.721	LT	Carreyette
Machinery Weight	**2944.721**	LT	

Outfit Weight			
Supp Equipment	**375**	LT	Stenard

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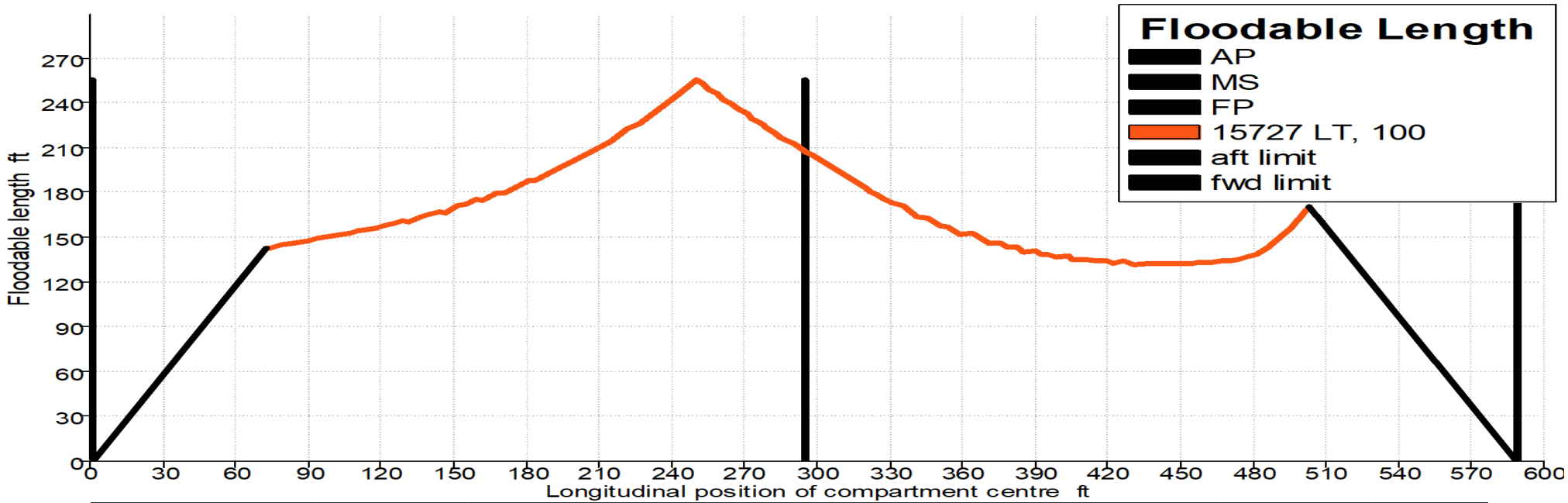
Placing Weights Into Maxsurf

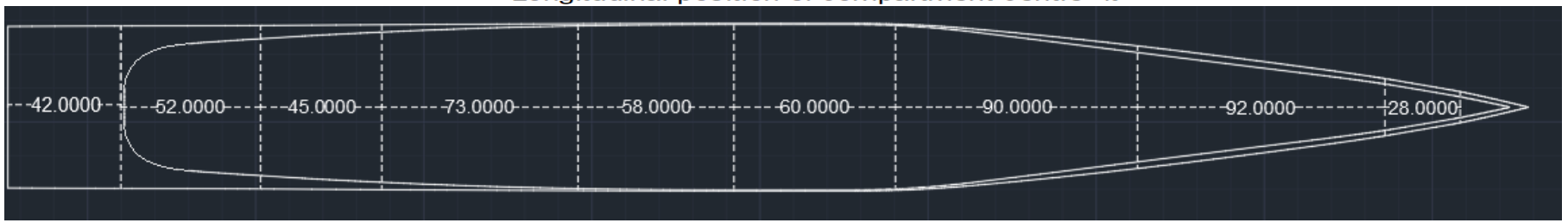
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Initial Estimates of Key Consumables

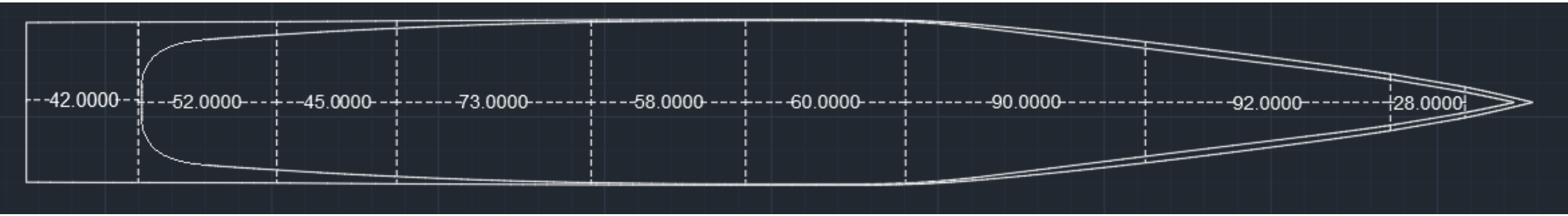
Liquid Cargoes	GOAL	MODEL ACTUAL	
Propulsion Fuel	403		LT
Electricity Fuel	643		LT
Total Fuel	1046	1906	LT
Drinking Water (40 Days)	1653	1775	LT
Lube Oil (x2 for Propulsion, 50 Journeys)	43	95	LT
EDG Fuel Tank (36 Hours, 46 CFR 112.05-5)	2.1	0	LT
Jet Fuel		54	LT

Floodable Length





Floodable Length



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Questions?