# MONTEREY BAY AQUARIUM RESEARCH INSTITUTE
NEW VESSEL CONCEPT

- GENERAL SCIENCE
- ROV & AUV FOCUS
- LOW IMPACT

MBARI explored the ship options available to them when they replace their flagship the R/V Western Flyer. The vessel needed to fill the primary role of ROV and AUV operation, while also filling the need for more general research. There is also a focus on exploring technologies to reduce the environmental impact of operating the vessel. Glosten developed concept designs for three different hull types to compare arrangements, seakeeping performance, and environmental performance. The study indicated that the monohull provided the best overall design as it provides the best arrangement and environmental performance as well as comparable seakeeping performance.
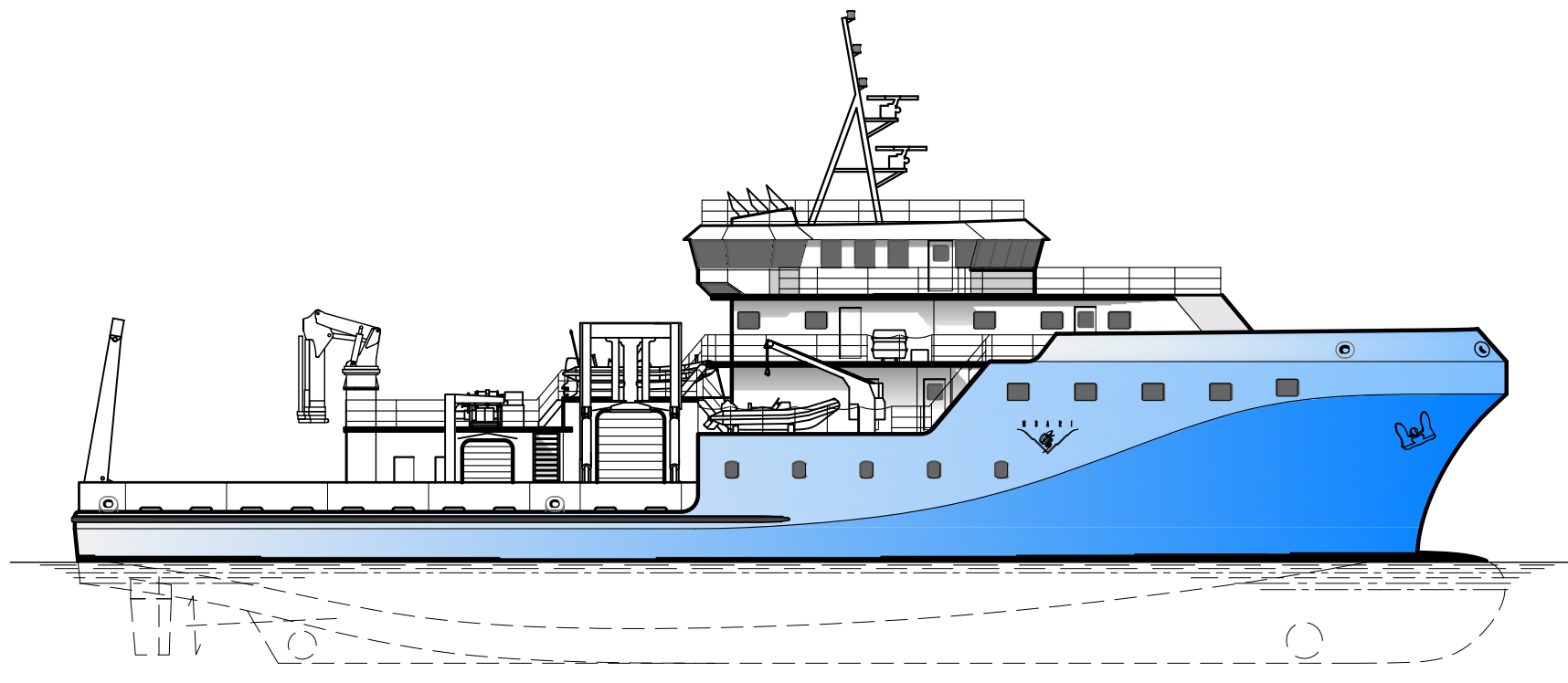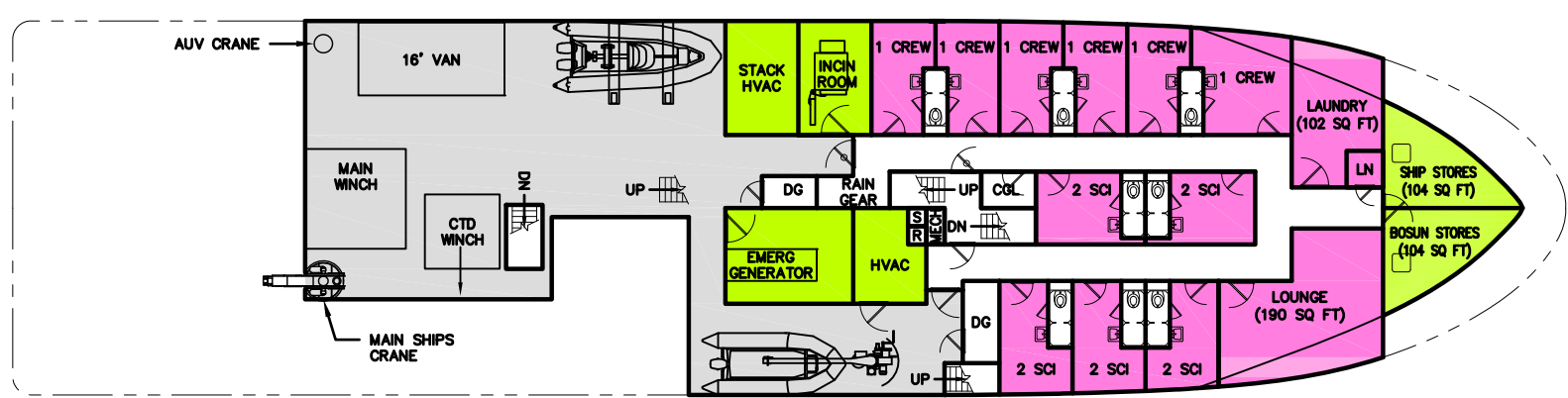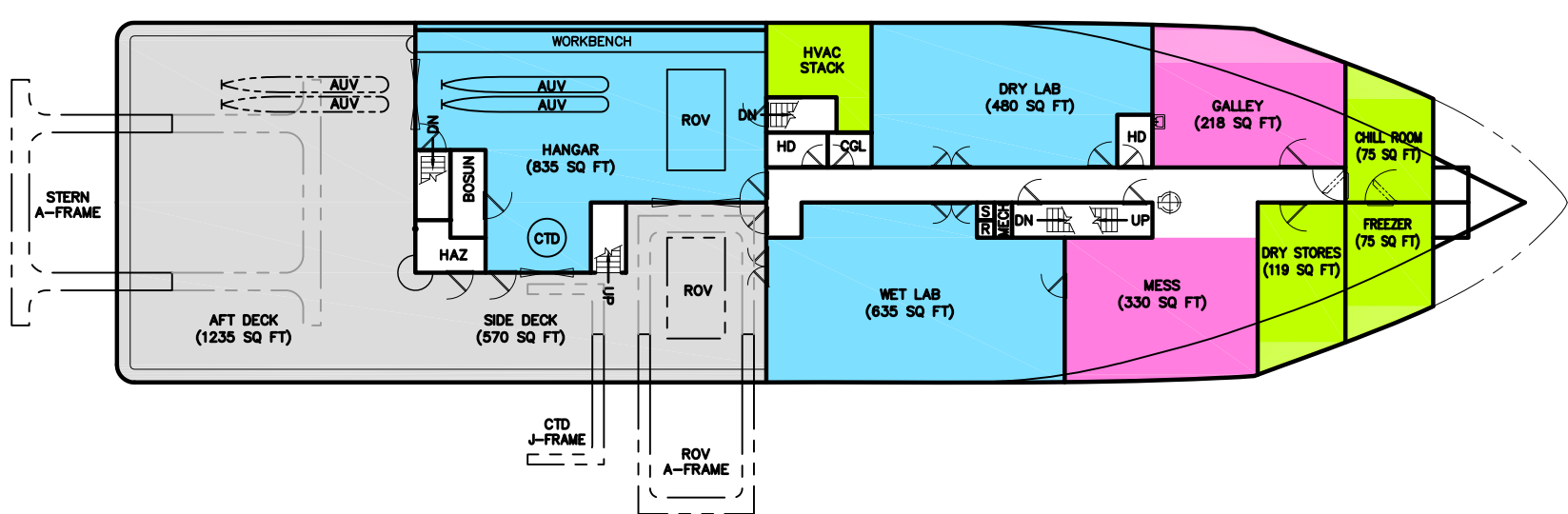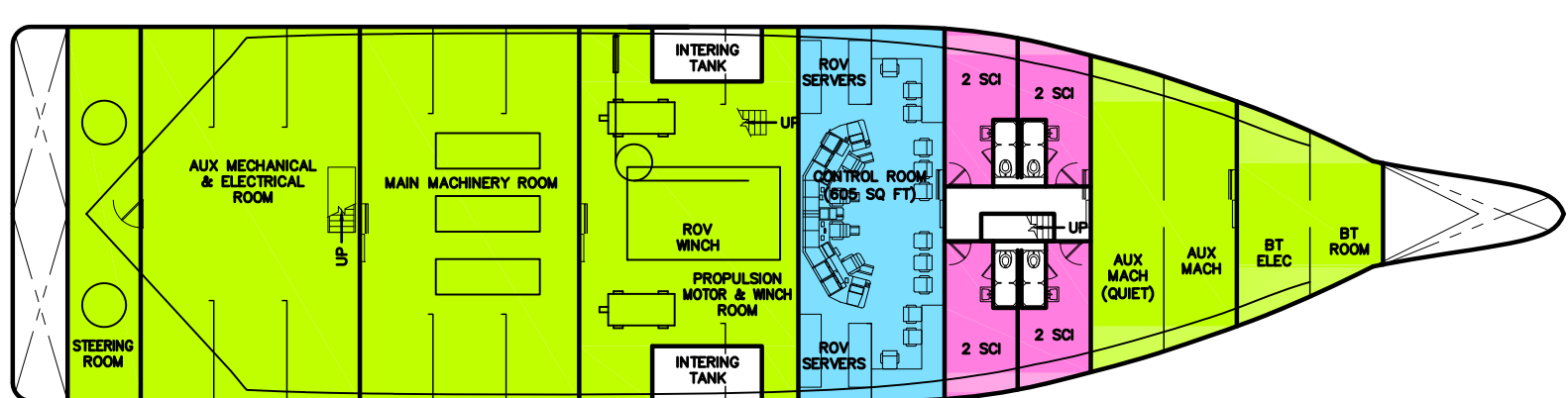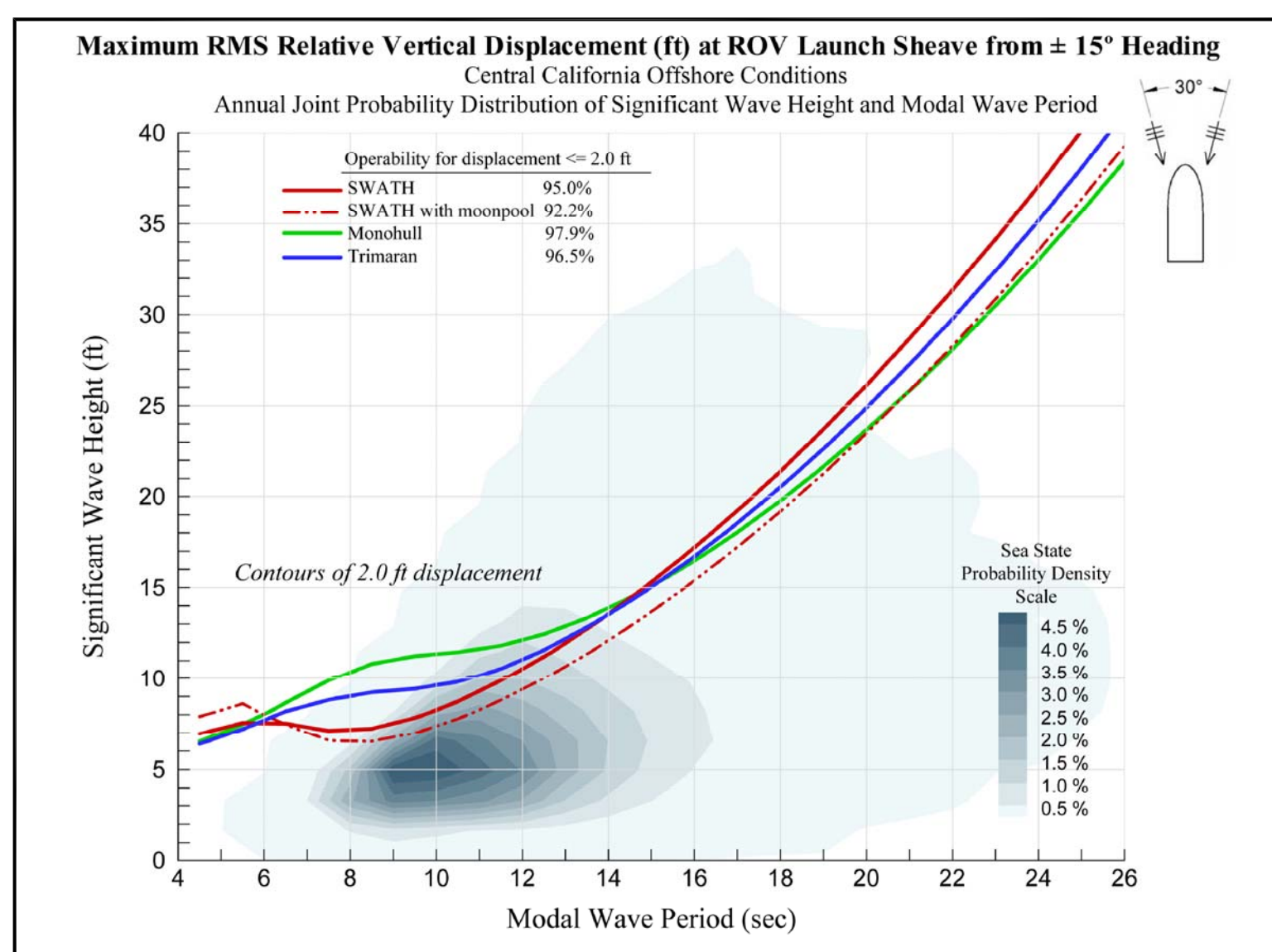

OUTBOARD PROFILE
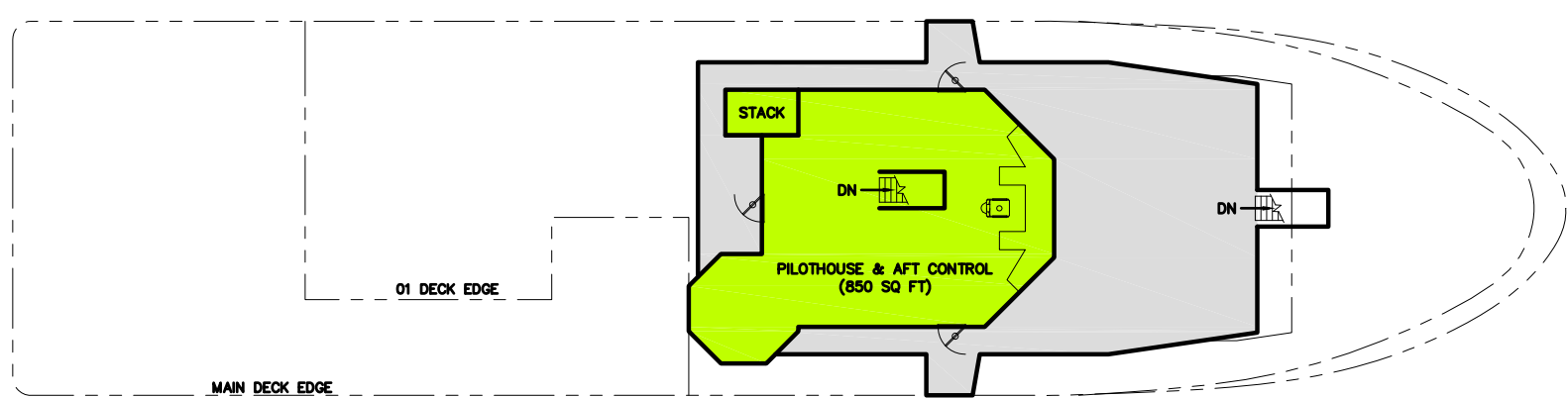
03 LEVEL
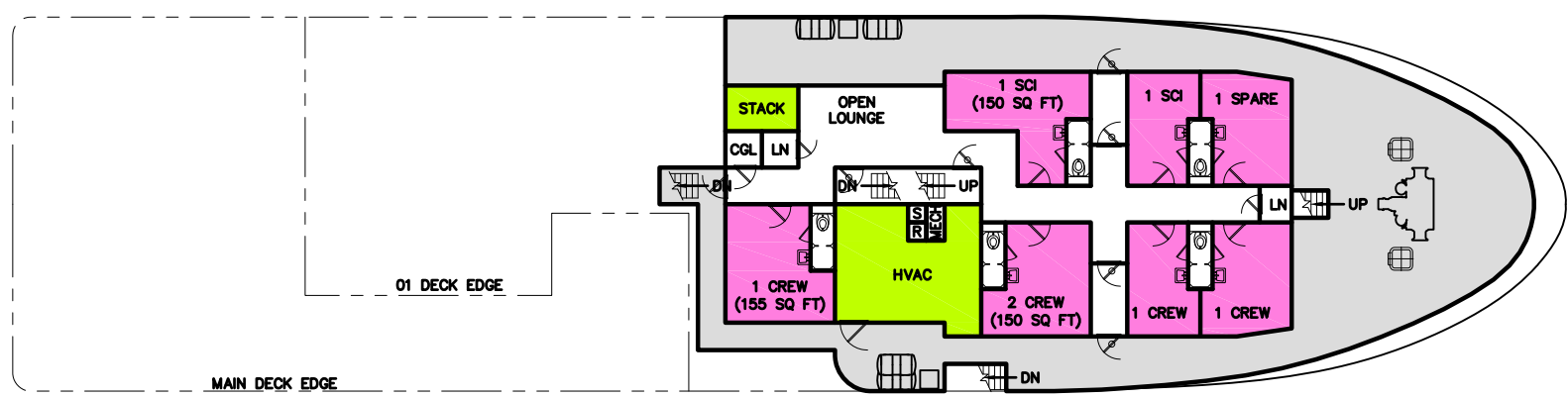
02 LEVEL

01 LEVEL

MAIN DECK

1ST PLATFORM

PARTICULARS

LENGTH	170' (51.8m)	CREW	13 PERSON
BREADTH	41' (12.5m)	SCIENCE	19 PERSON
DRAFT	12' (3.7m)	RANGE	> 4000 NM
SPEED	12 KNOTS	ENDURANCE	> 21 DAYS

Maximum RMS Relative Vertical Displacement (ft) at ROV Launch Sheave from ± 15° Heading
Central California Offshore Conditions
Annual Joint Probability Distribution of Significant Wave Height and Modal Wave Period

Operability for displacement <= 2.0 ft

SWATH	95.0%
SWATH with moonpool	92.2%
Monohull	97.9%
Trimaran	96.5%

Operability plots combine motion predictions and climatology data to demonstrate the percentage of time the displacement, velocity, and acceleration at a point are below the criteria.

POWER /PROPULSION SYSTEM
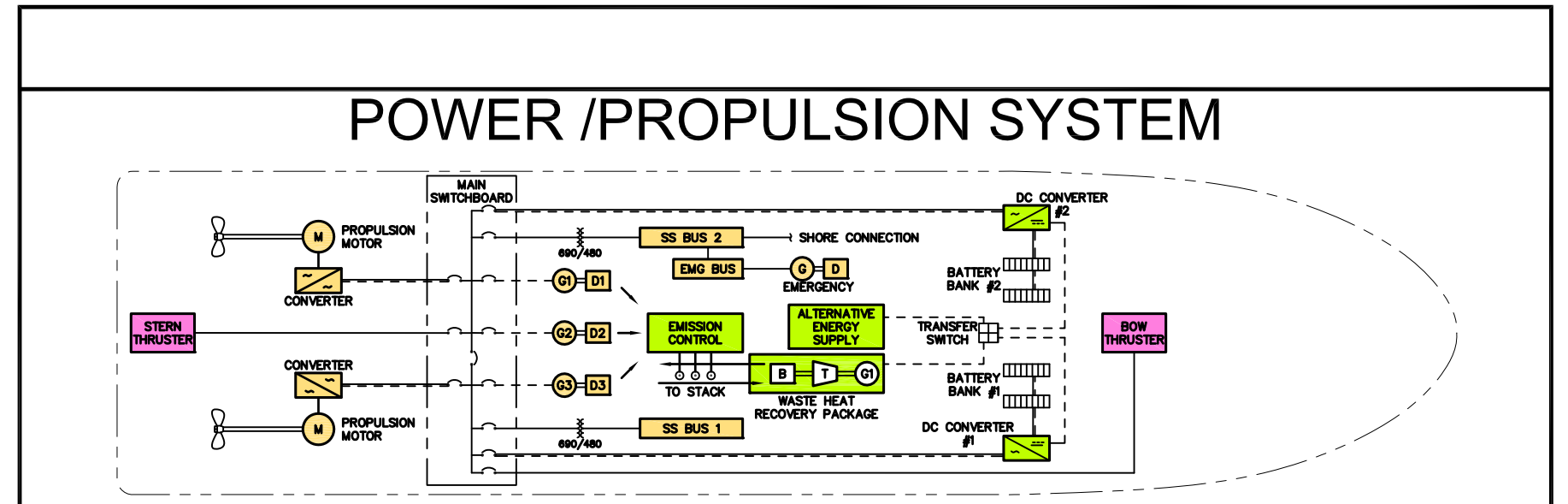
POWER REQUIREMENTS

SERVICE	MONOHULL (170' LOA)	NOTES
PROPULSION (12 KNOTS)		
REQUIRED SHAFT POWER (kW)	725	DELIVERED POWER
NUMBER PROPULSION MOTORS	2	
PROPULSION MOTOR POWER EACH (kW)	388	2% SHAFT LOSSES 5% DESIGN MARGIN
PROPULSION POWER DEMAND (kW)	844	92% MOTOR/DRIVE EFF.
SHIPS SERVICE LOAD (kW)	425	10% GROWTH MARGIN 170 kW TYPICAL
POWER GENERATION		
TOTAL POWER REQUIRED (kW)	1269	
NUMBER OF GENERATORS	3	
GENERATOR POWER EACH (kW)	423	
EMERGENCY GENERATOR (kW)	115	
ACCUMULATOR BATTERY BANK (LT)	30	ESTIMATE - 80 kWh/LT

OPERATING MODES

MODE	DIESEL ENGINES	WASTE HEAT	PROPULSION	HOTEL	BATTERY
DIESEL	OPTIMALLY LOADED	RETURN ~10% ELECTRICAL PWR	UP TO 12 KN UNLIMITED	YES	CHARGING
BATTERY	OFF	N/A	6 KN / 5 HRS 3 KN / 12 HRS	YES	DISCHARGING

Diesel electric propulsion provides robust and reliable power while allowing alternative energy creation and storage. A battery hybrid system permits the generators to run at a constant load, generating consistent and useful waste heat also enabling exhaust after treatment. The vessel is expected to exceed EPA Tier 4 requirements.

EFFLUENT MANAGEMENT PLAN
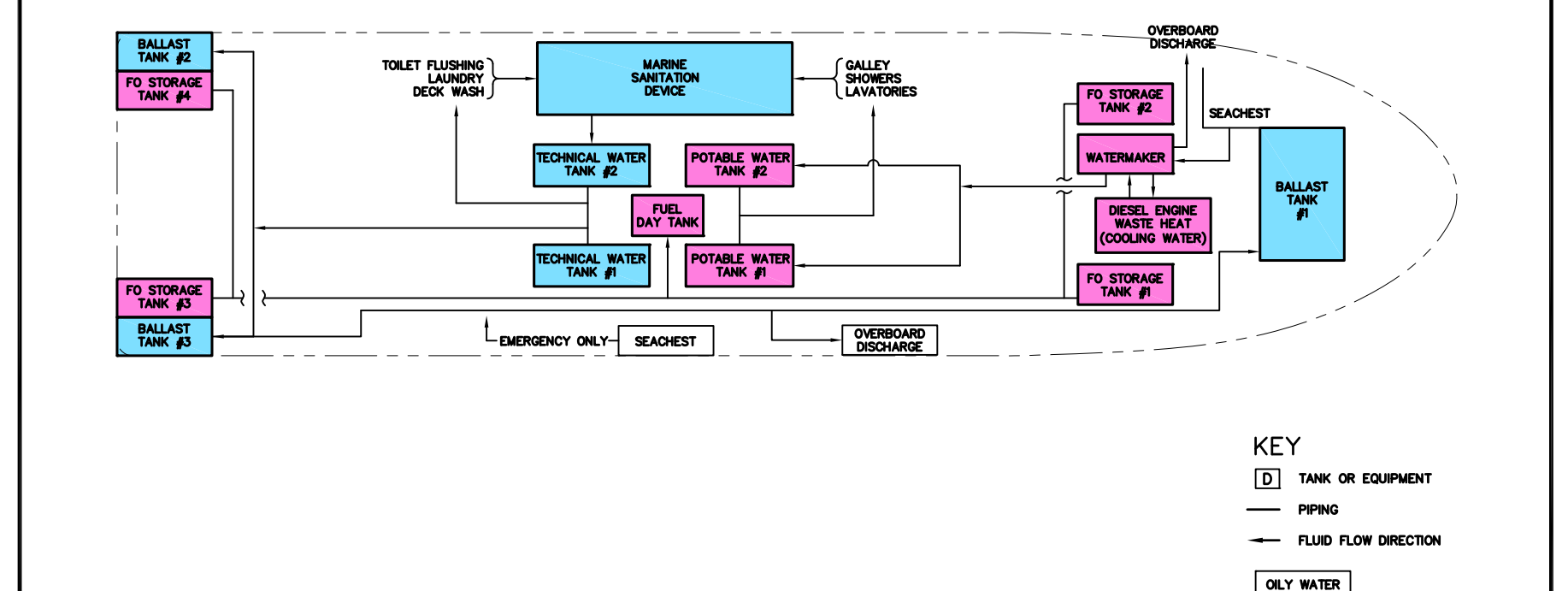
WATER MANAGEMENT SYSTEM

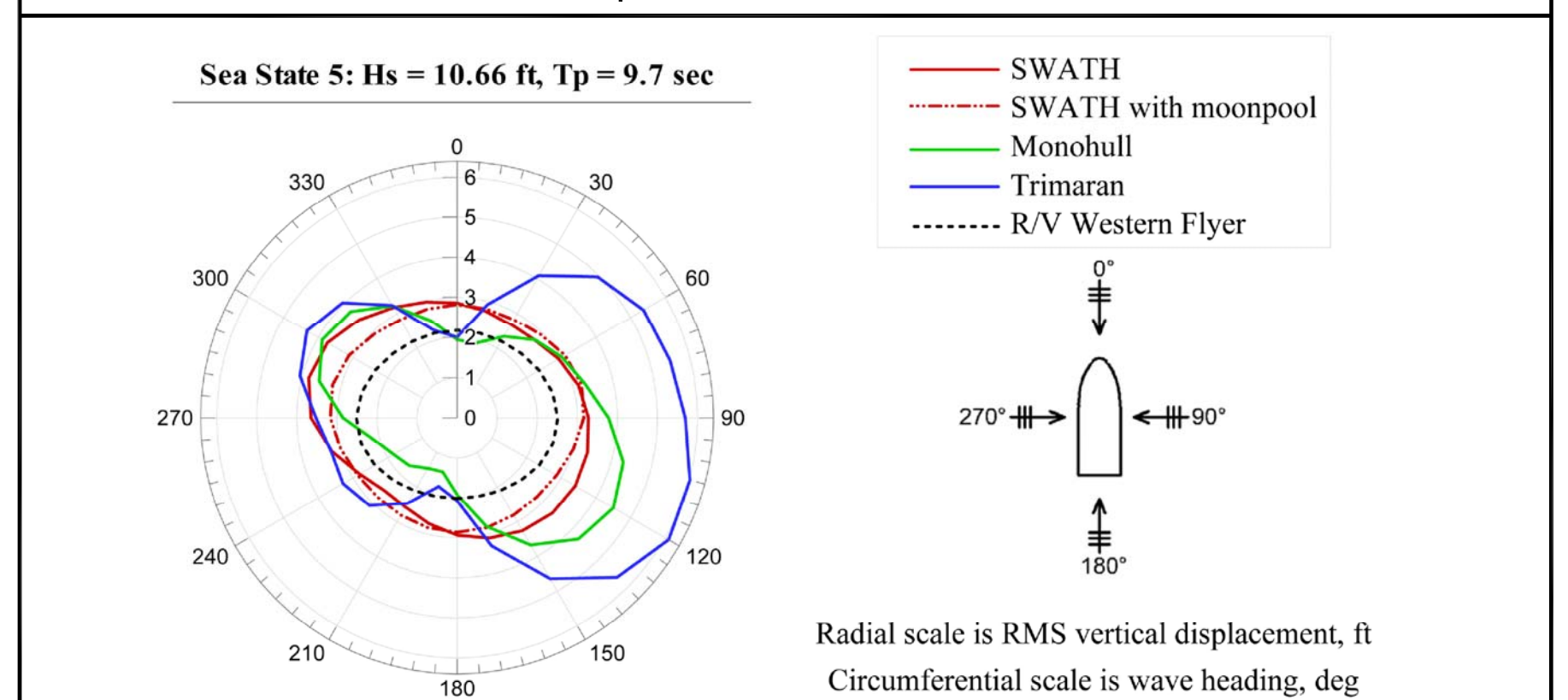| TANK CAPACITIES (MIN.)	MONOHULL (170' LOA)	W.F.	NOTES
FUEL OIL STORAGE (LT)	59	64	ENDURANCE 4000nm @ 10 KNOTS, 24 HR RESERVE
BALLAST WATER (LT)	30	54	BASED ON APPROXIMATE FUEL/BALLAST RATIOS
POTABLE WATER (LT)	25	9.1	ASSUMES USE OF TECHNICAL WATER
TECHNICAL WATER (LT)	25	1.3	WESTERN FLYER GRAY WATER HOLDING CAPACITY
OILY WATER HOLDING (LT)	3	NA	
WASTE OIL HOLDING (LT)	2	2.3	

Potable water is generated using engine jacket water waste heat evaporators. A high efficiency biological treatment system allows for non potable water recycling. Excess treated water can be used as ballast to offset the weight lost from burned fuel.

GREEN OPTIONS LIFECYCLE ANALYSIS

(Monohull shown, other hulls similar)	Capital Cost ($k)	Consumable[12] (fuel, urea) ($k/yr)	Maintenance[2] ($k/yr)	Lifecycle Cost[2] 15 Year ($k)	Carbon Footprint[3] $/LT	Air Quality[4] (NOx + HC + 20 $/lb
Baseline Vessel (EPA Tier 3)	5000	290	29.0	11883	N/A	N/A
SCR/DPF/DOC	500	14.5	1.45	844	N/A	2.64
Sail	837	-22.4		299	236	10.26
Battery Hybrid	1560	-43.8	-9.4	411.5	166.27	7.24
Solar (Photovoltaics)	42.3	-0.49		31.7	1137	49.5

Notes:
1. Consumables cost in 2015 dollars
2. Assumes 5% yearly inflation
3. For Carbon Footprint the $/LT represents the cost of carbon emissions to reach a break even point in 15 years
4 Carl Moyer Program weighted formula to determine the cost effectiveness of emissions reductions.

SEAKEEPING COMPARISON
RMS Vertical Displacement at ROV Launch Sheave

Sea State 5: Hs = 10.66 ft, Tp = 9.7 sec

SWATH
SWATH with moonpool
Monohull
Trimaran
R/V Western Flyer

Radial scale is RMS vertical displacement, ft
Circumferential scale is wave heading, deg

Polar plots quantify the motion at a point for a constant sea state with varying headings to the waves.

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