# Bristol Harbor Group, Inc.

## Casco Bay Island Transit District- Down Bay Ferry Design

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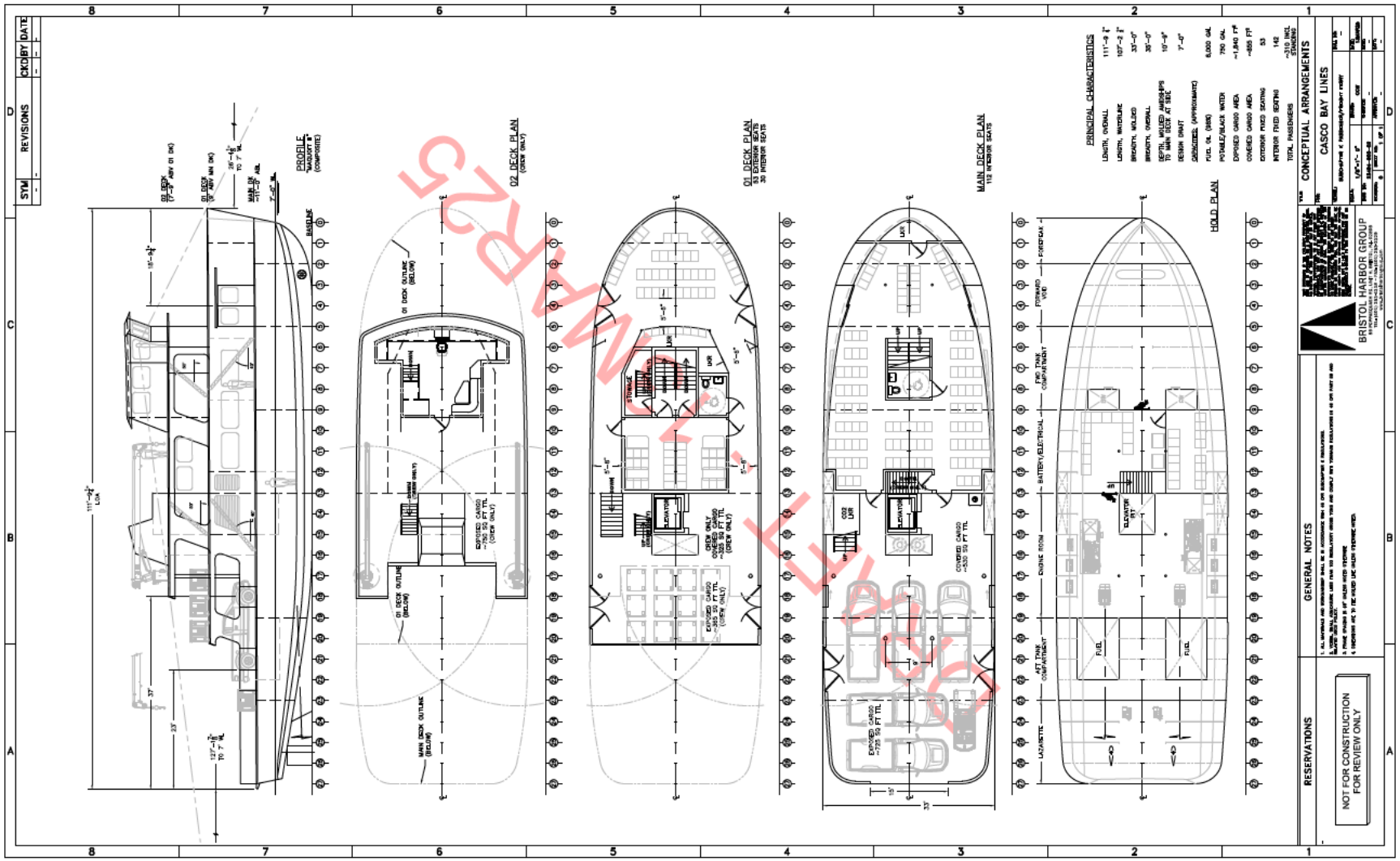
24JUN25

Casco Bay Lines
Portland, Maine

# Project Update

- MAQUOIT III design development – *ONGOING*
- Weights/stability – *COMPLETE*
- Propulsion System Options & Evaluation – *ONGOING*
- Noise/Vibration Assessment– *UPCOMING TASK*
- Concept Level Cost Estimate – *UPCOMING TASK*

# Conceptual Arrangement

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# Principal Characteristics

## PRINCIPAL CHARACTERISTICS

| | |
|---|---|
| LENGTH, OVERALL | 111'–9 ¼" |
| LENGTH, WATERLINE | 107'–2 ½" |
| BREADTH, MOLDED | 33'–0" |
| BREADTH, OVERALL | 35'–0" |
| DEPTH, MOLDED AMIDSHIPS TO MAIN DECK AT SIDE | 10'–9" |
| DESIGN DRAFT | 7'–0" |
| CAPACITIES: (APPROXIMATE) | |
| FUEL OIL (98%) | 6,000 GAL |
| POTABLE/BLACK WATER | 750 GAL |
| EXPOSED CARGO AREA | ~1,840 $FT^2$ |
| COVERED CARGO AREA | ~855 $FT^2$ |
| EXTERIOR FIXED SEATING | 53 |
| INTERIOR FIXED SEATING | 142 |
| TOTAL PASSENGERS | ~310 INCL STANDING |

# Preliminary Stability Assessment

- Assumes protected waters similar to MAQUOIT II
- Stability assessment included
  - Intact
  - Damage
  - Lifting

**Vessel Comparison - Cargo, Passenger & Total Capacity**

**(Capacities in pounds; percentages reflect improvement over *Maquoit II* [1])**

| ***MAQUOIT II*** | | | |
|---|---|---|---|
| | Cargo (lb) | Passengers (lb) | Total (lb) |
| 300 Passengers | 60000 | 55500 | 115500 |
| 399 Passengers | 40000 | 73815 | 113815 |

| ***MAQUOIT III*** | | | |
|---|---|---|---|
| | Cargo (lb) | Passengers (lb) | Total (lb) |
| 310 Passengers (Full Load) | 74000<br>123% | 57350<br>103% | 131350<br>114% |
| 178 Passengers (Increased Cargo) | 106000<br>177% | 32930<br>59% | 138930<br>120% |

Notes:

1) All percentages are relative to Maquoit II 300 Passenger case, as it reflects her maximum cargo and deadweight capacity.

2) Maquoit II is not subject to lifting stability due to her cranes' limited off-vessel reach; Maquoit III is subject to lifting criteria, significantly affecting carrying capacity.

# Preliminary Stability Assessment

06/17/25 09:59:44 Bristol Harbor Group
GHS 19.50 **INTACT STABILITY CBL DOWN BAY FERRY** 23494
**Dep Condition, PaxCargo, 310Pax**
Protected Waters

**HYDROSTATIC PROPERTIES**
Trim: Aft 0.11/111.77, Heel: Stbd 0.86 deg., VCG = 13.79

| LCF Draft | Displacement Weight(LT) | Buoyancy-Ctr. LCB | VCB | Weight/ Inch | LCF | Moment/ In trim | GML | GMT |
|---|---|---|---|---|---|---|---|---|
| 6.932 | 365.81 | 52.91a | 4.29 | 6.75 | 58.20a | 45.21 | 165.8 | 5.12 |

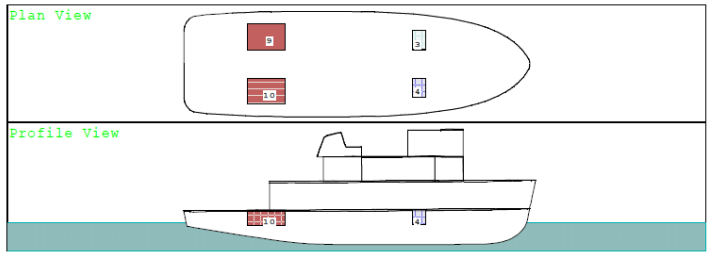
Distances in FEET. Specific Gravity = 1.025. Moment in Ft-LT.
Trim is per 111.77Ft
Draft is from Baseline. True Free Surface included.

**WEIGHT and DISPLACEMENT STATUS**
Baseline draft: 6.872 @ Origin
Trim: Aft 0.11/111.77, Heel: Stbd 0.86 deg.

| Part | | | Weight(LT) | LCG | TCG | VCG | |
|---|---|---|---|---|---|---|---|
| LIGHT SHIP | | | 286.40 | 50.77a | 0.00 | 13.24 | |
| CREW | | | 0.41 | 66.00a | 0.00 | 20.00 | |
| Pax MD | | | 14.70 | 30.00a | 0.00 | 14.00 | |
| Pax 01 | | | 10.90 | 28.00a | 0.00 | 23.00 | |
| Cargo MD Covered | | | 8.38 | 72.44a | 0.00 | 14.50 | |
| Cargo 01 Covered | | | 2.56 | 66.94a | 3.24s | 23.50 | |
| Cargo MD Exposed | | | 11.47 | 94.73a | 0.00 | 14.50 | |
| Cargo 01 Exposed | | | 2.88 | 73.86a | 0.00 | 23.50 | |
| Cargo 02 Exposed | | | 5.94 | 50.38a | 0.00 | 31.25 | |
| Total Fixed | | | 343.63 | 51.48a | 0.02s | 14.14 | |
| | Load | SpGr | Weight(LT) | LCG | TCG | VCG | FSM |
| BW.P | 0.100 | 1.025 | 0.31 | 34.00a | 7.41p | 6.49 | 2.0 |
| FW.S | 1.000 | 1.000 | 3.00 | 34.00a | 7.49s | 8.61 | 0.0 |
| FO.P | 0.950 | 0.870 | 9.43 | 82.00a | 8.48p | 8.38 | 11.8 |
| FO.S | 0.950 | 0.870 | 9.43 | 82.00a | 8.52s | 8.38 | 11.8 |
| Total Tanks | | | 22.18 | 74.83a | 0.93s | 8.39 | 25.5 |
| Total Weight | | | 365.81 | 52.90a | 0.08s | 13.79 | |
| | | | Displ(LT) | LCB | TCB | VCB | RefHt |
| HULL | | 1.025 | 365.81 | 52.91a | 0.22s | 4.29 | -6.87 |
| | Righting Arms: | | | 0.00 | 0.00s | | |

Distances in FEET. Moments in Ft-LT.

CG - Draft: 6.87 @ 0.00 Trim: aft 0.11/111.77 Heel: stbd 0.86 deg.

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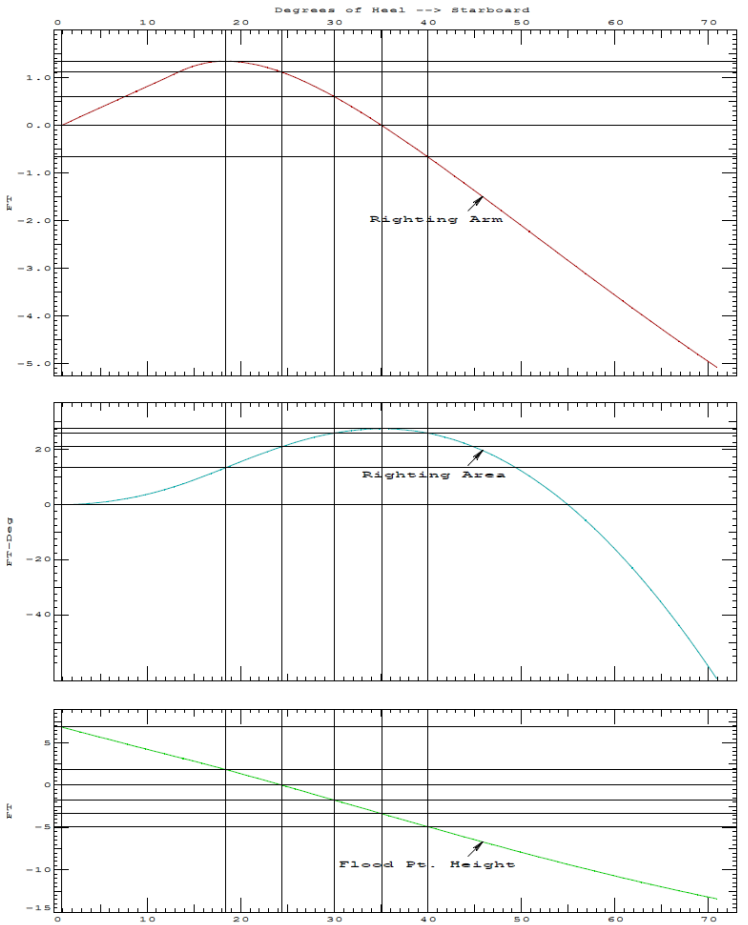
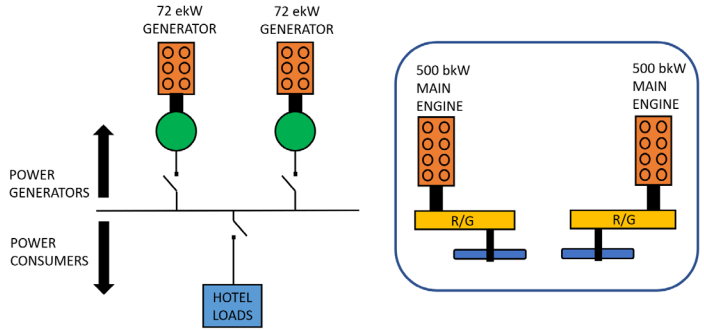


# Propulsion System Feasibility Study

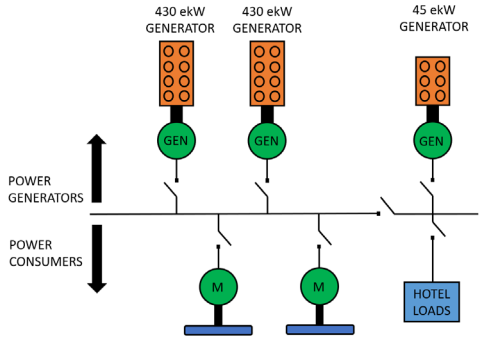
Propulsion Systems Studied:

1. Diesel mechanical system with 2 C18 (500 bkW) engines and two house generators (72 ekW)
2. Diesel electric system with 2 C18 generators (430 ekW) and one house generator (45 ekW)
3. Diesel electric system with 3 C9 generators (300 ekW) and one house generator (45 ekW)
4. Diesel electric system with 2 C18 generators (430 ekW) and 1,000 kWh of NMC batteries
5. Diesel electric system with 2 C18 generators (430 ekW) and 1,000 kWh of LFP batteries

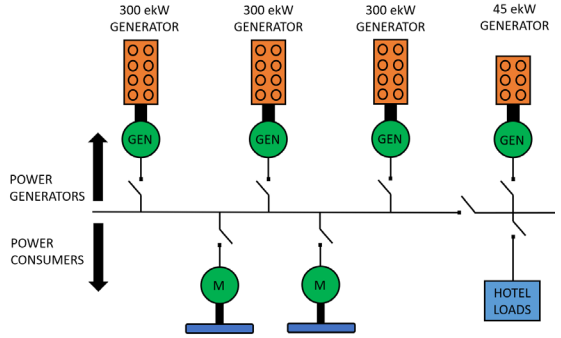
MECH:



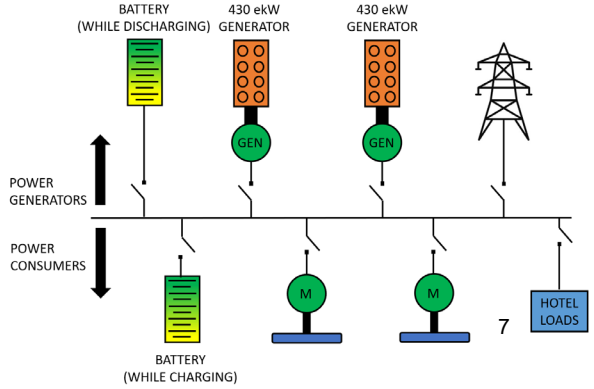

DE (2x C18s):




DE (3x C9s):



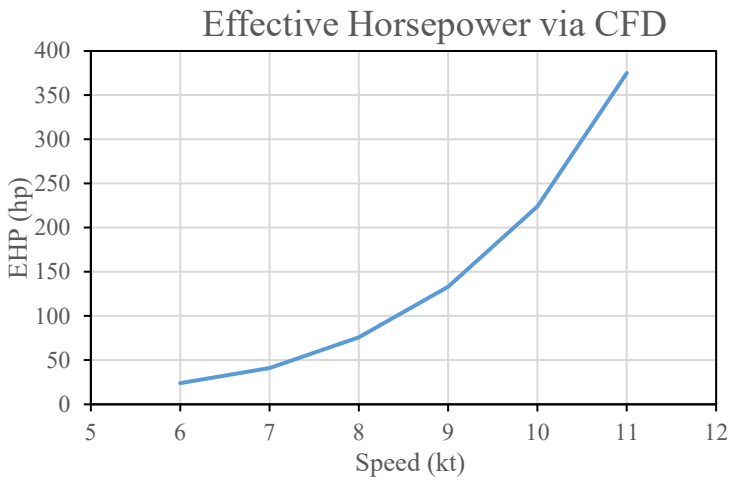

DEWB (NMC or LFP):

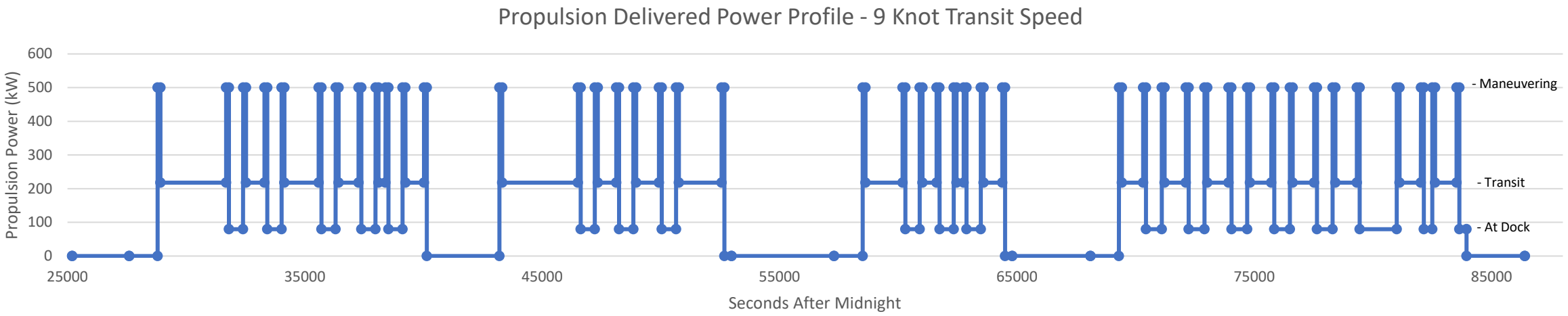


# Propulsion System Feasibility Study

Operational Profile:

- Used existing vessel schedule and computational fluid dynamics (CFD) analysis used to get power demand
- 8, 9, 10 & 11 knot transit speeds studied (9 knot transit speed was used in feasibility study calculations)
  - 8 knots was minimum speed to enforce 30-minute load and unload time in Portland
- Departure time from Portland fixed. Other departure times dependent on transit speed
- 10-minute load/unload time at each location
- 2-minute maneuvering/acceleration/deceleration

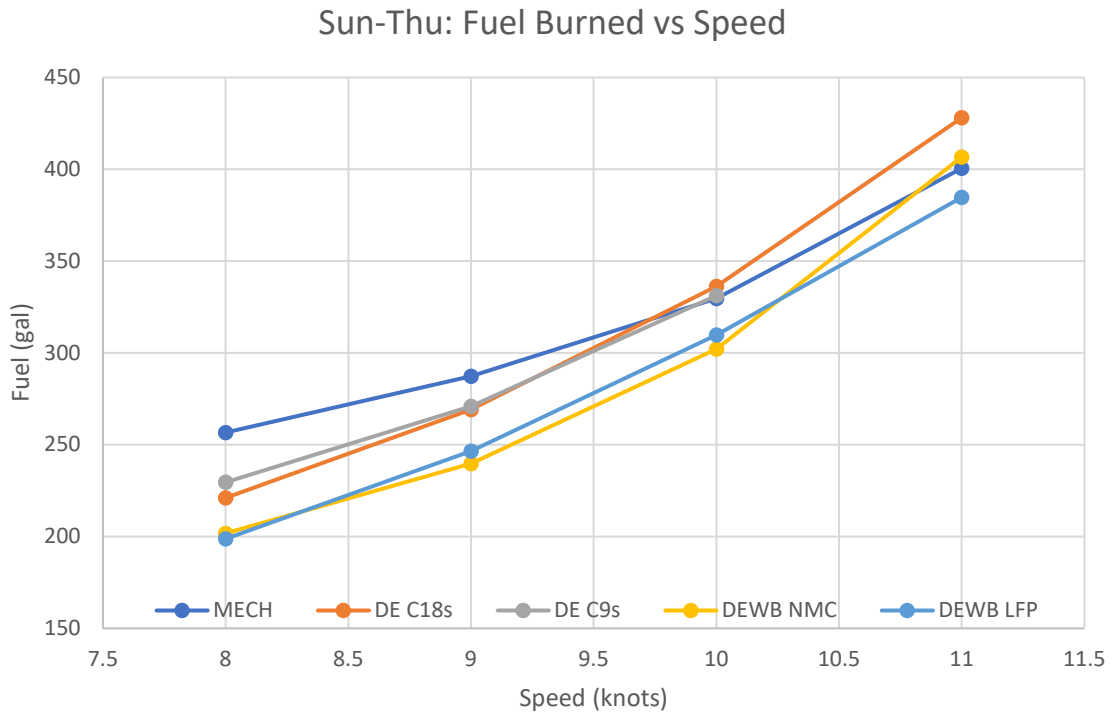


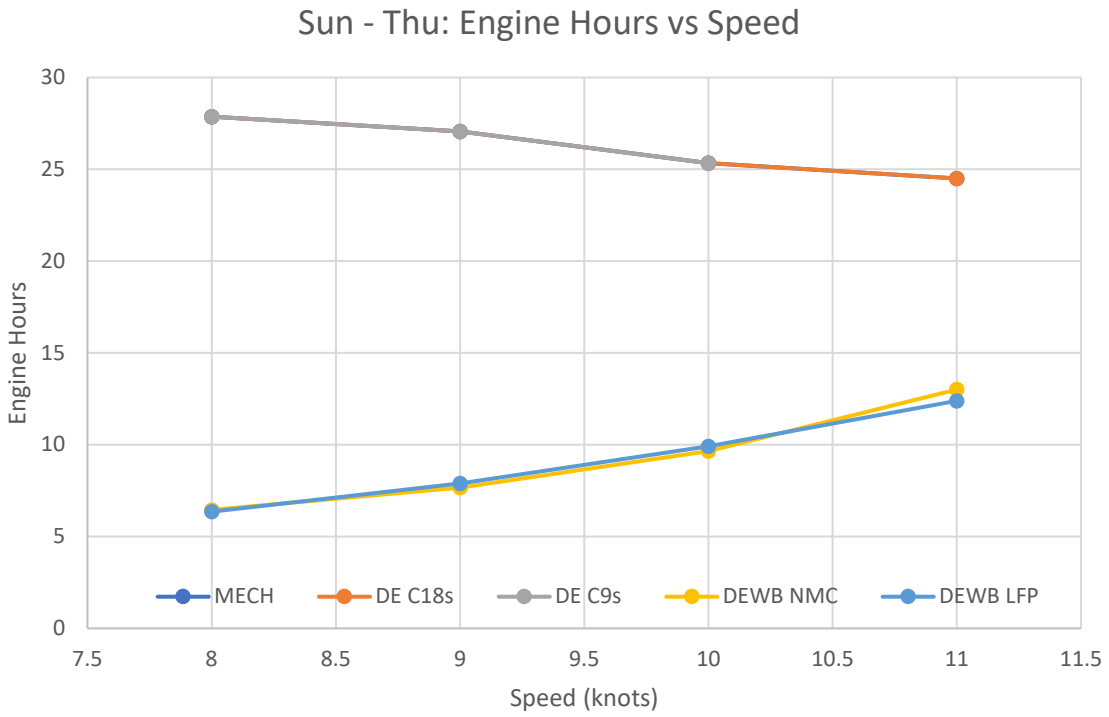



# Propulsion System Feasibility Study

Propulsion System Simulations:

- Models and control logic were set up in MATLAB and Simulink
- Transit speeds from 8-11 knots were simulated
- Engine/generator hours, fuel usage, and emissions were tracked

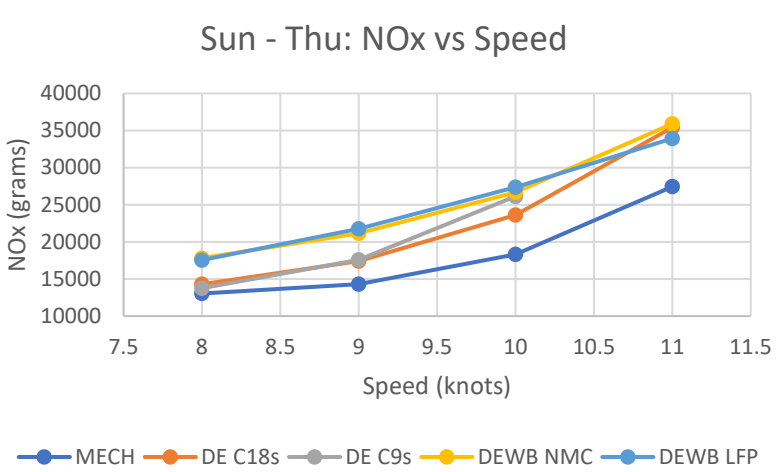


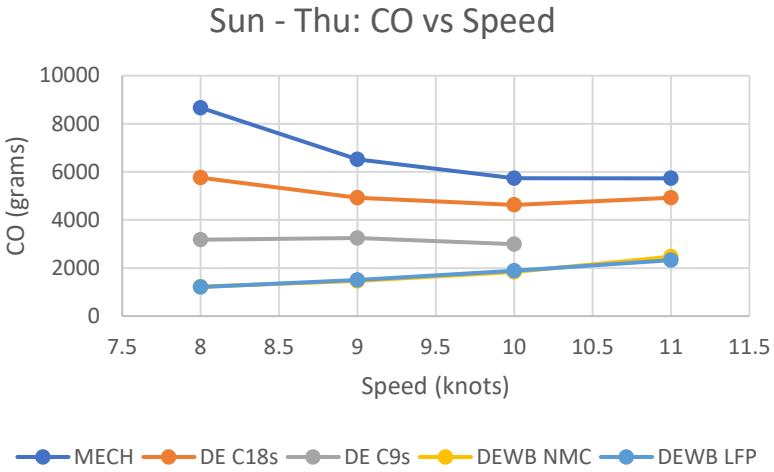



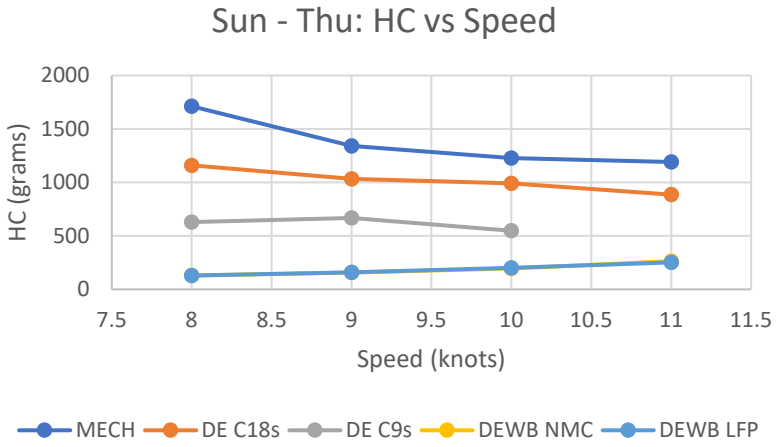
# Propulsion System Feasibility Study

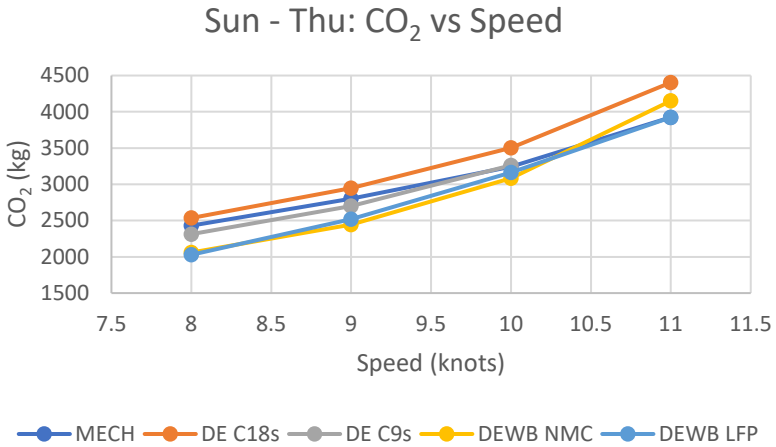
Estimated Vessel Emissions:

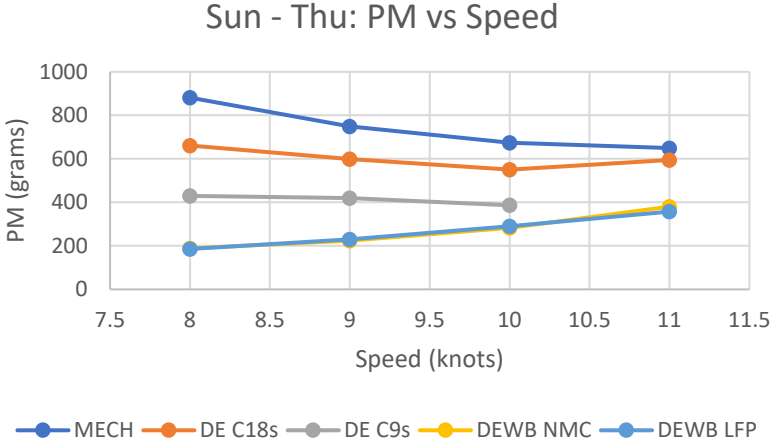
- 5 pollutants were tracked based on engine loading.
  - Nitrogen oxides (NOx in the form of nitric oxide, $NO_2$)
  - Carbon monoxide (CO)
  - Hydrocarbons (HC)
  - Carbon dioxide ($CO_2$),
  - Particulate matter (PM)



# Propulsion System Feasibility Study

Feasibility Study Criteria:

- Seeking client feedback for the weighting of criteria used in the feasibility study
  - Operational Expenses (OPEX)
  - Capital Expenses (CAPEX)
  - Sustainability
  - Operability

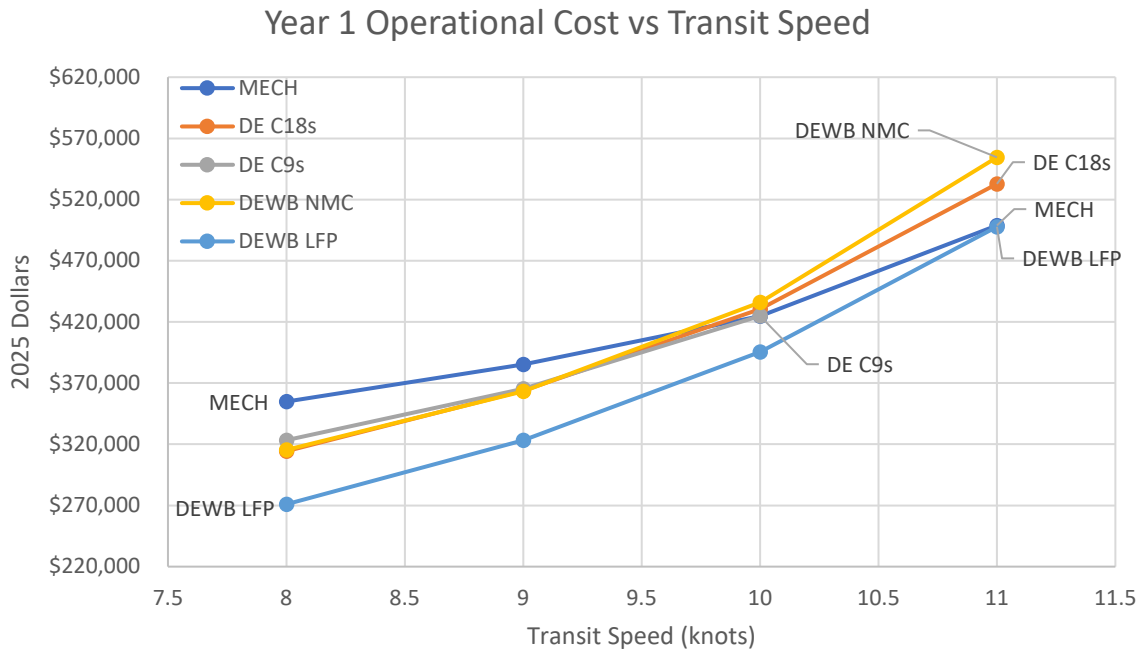
| Evaluation Criteria | MECH | DE C18s | DE C9s | DEWB NMC | DEWB LFP |
|---|---|---|---|---|---|
| OPEX | 8.08 | 8.56 | 8.52 | 9.48 | 9.77 |
| CAPEX | 10.00 | 1.78 | 1.91 | 0.98 | 1.06 |
| Sustainability | 5.59 | 5.62 | 6.38 | 9.45 | 9.40 |
| Operability | 7.87 | 3.47 | 6.20 | 8.18 | 8.18 |
| **Average:** | **7.89** | **4.86** | **5.75** | **7.02** | **7.10** |

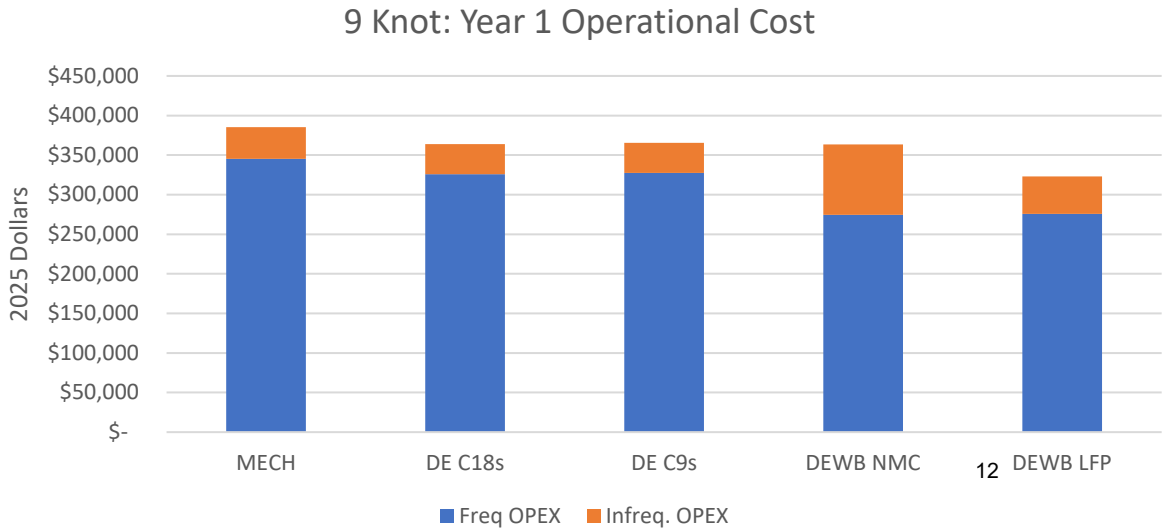
# Propulsion System Feasibility Study

## Operational Expenses:

- Frequent OPEX
  - Fuel Costs
  - Electricity Costs
  - Frequent Main Engine Maintenance
    - (frequency <= every 1,000 hours)
- Infrequent OPEX
  - Main Engine Maintenance
    - (frequency > every 1,000 hours)
  - House Generator Maintenance
  - Battery Replacement
  - Motor Replacement

- Evaluated at 9 knots for feasibility study



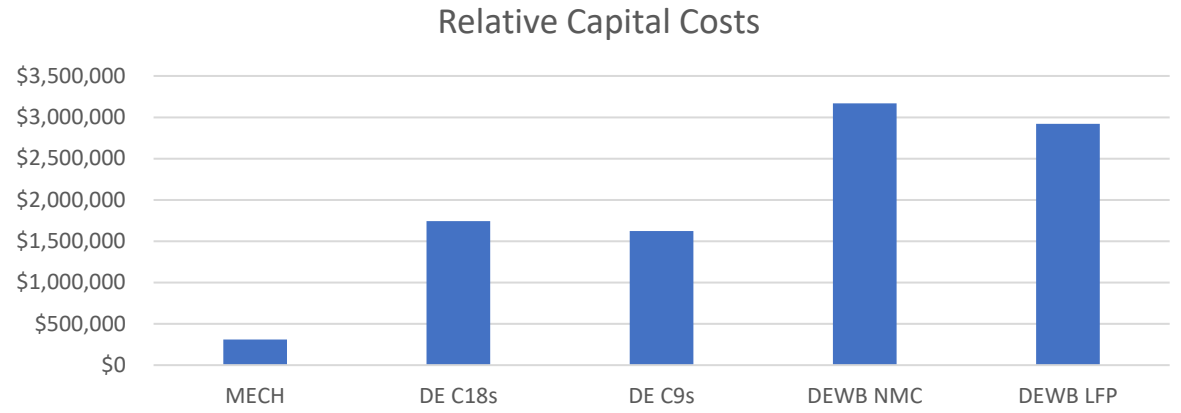
# Propulsion System Feasibility Study:

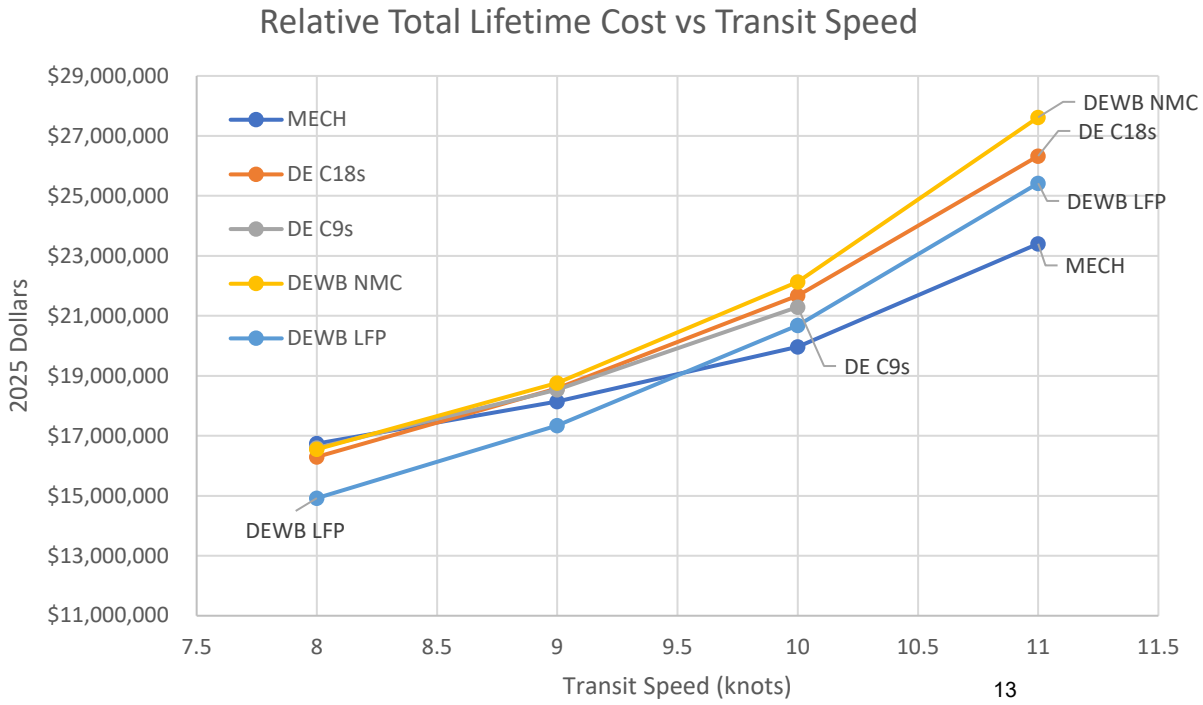
Capital Expenses (CAPEX):

- Relative cost comparison of unique propulsion system equipment
    - Includes engines, generators, reduction gears, propulsion switchboard, VFD drives, and propulsion motors
    - Also includes batteries, battery room equipment, and extra fire protection if applicable

Total Lifetime Expenses (Relative):

- OPEX and CAPEX
- 30-year lifespan of vessel
- Assumed 2.57% average inflation



# Propulsion System Feasibility Study:

Sustainability:

- Fuel consumption and emissions of five greenhouse gasses were evaluated for a 9-knot transit speed.
- These were directly compared to calculate scores for each propulsion system
- Emission curves are very non-linear.
  - Mechanical and diesel electric must meet power demand exactly
  - Using energy storage, the generators can be loaded at their most efficient loading. The generator control logic in the simulations minimizes engine hours. However, there is an emissions vs fuel consumption vs engine hour/maintenance cost tradeoff that can be considered.

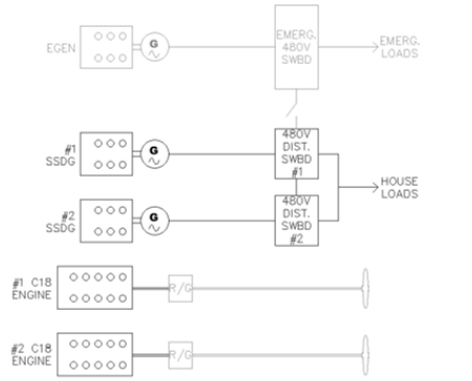
| Sustainability Sub-Criteria: | MECH | DE C18s | DE C9s | DEWB NMC | DEWB LFP |
|---|---|---|---|---|---|
| Fossil Fuel Consumption | 8.37 | 8.94 | 8.89 | 10.00 | 9.95 |
| Nitrogen Oxides (NOx via $NO_2$) | 10.00 | 8.21 | 8.13 | 6.72 | 6.69 |
| Carbon Monoxide (CO) | 2.25 | 2.97 | 4.48 | 10.00 | 9.95 |
| Hydrocarbons (HC) | 1.17 | 1.51 | 2.32 | 10.00 | 9.95 |
| Carbon Dioxide ($CO_2$) | 8.76 | 8.33 | 9.10 | 10.00 | 9.95 |
| Particulate Matter (PM) | 3.00 | 3.75 | 5.35 | 10.00 | 9.95 |

# Propulsion System Feasibility Study:

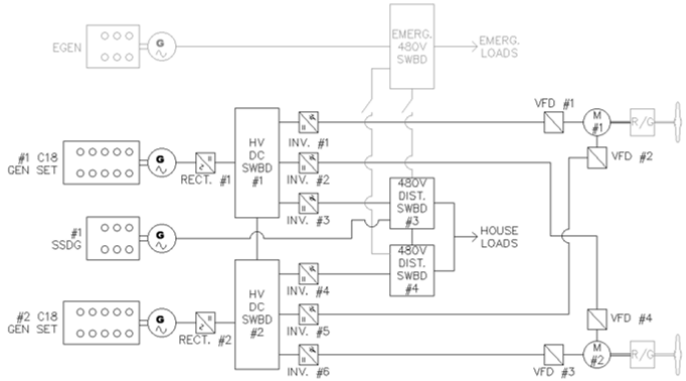
Operability:

- Monte Carlo simulations were run to evaluate availability of propulsion systems at specified scenarios
  - System has all components available
  - System has the necessary components available to be able to make it back to port
  - System can perform normal operations
- Complexity was measured the number of components unique to each propulsion system.

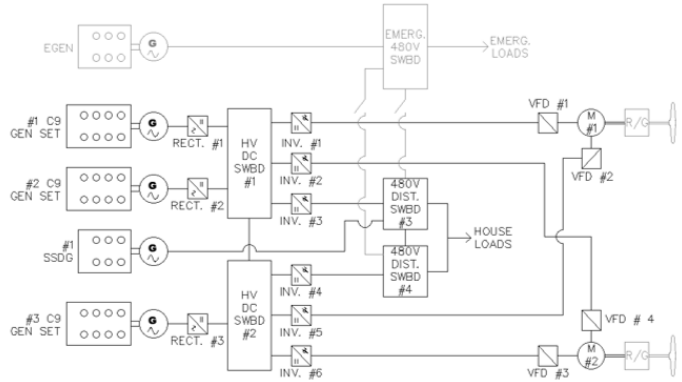
DIESEL MECHANICAL: 2X C18S, 2X SSDG, AND EGEN



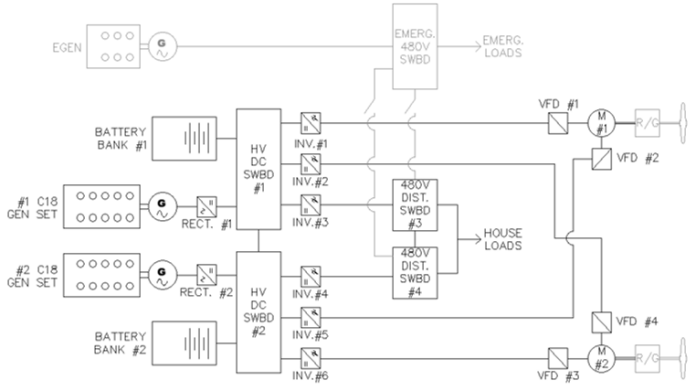

DIESEL ELECTRIC: 2X C18S, 1X SSDG, AND EGEN




DIESEL ELECTRIC: 3X C9S, 1x SSDG, AND EGEN




DIESEL ELECTRIC: 2X C18S, 2X BATTERY BANKS AND EGEN




| Operability Sub-Criteria: | MECH | DE C18s | DE C9s | DEWB NMC | DEWB LFP |
|---|---|---|---|---|---|
| Availability - All Components Online | 9.83 | 6.17 | 2.28 | 10.00 | 10.00 |
| Availability - Reduced Power | 2.52 | 2.61 | 9.95 | 10.00 | 10.00 |
| Availability - Continued Operations | 9.14 | 2.25 | 9.96 | 10.00 | 10.00 |
| Complexity | 10.00 | 2.86 | 2.61 | 2.73 | 2.73 |