

ALASKA CLASS FERRY

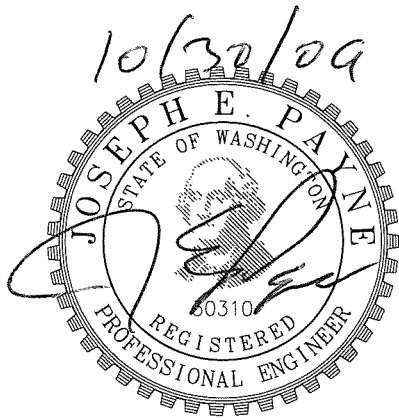
Preliminary Equipment List & Generator Sizing Analysis

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PREPARED BY

Elliott Bay Design Group
5305 Shilshole Ave. NW, Ste. 100
Seattle, WA 98107

REVISIONS

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PURPOSE

The purpose of this report is to summarize the preliminary equipment list and generator sizing analysis of the ALASKA CLASS FERRY. The subject vessel is a 350 ft long × 74 ft wide × 24 ft deep passenger vehicle ferry designed for service in Prince William Sound and southeast Alaska. An estimate of required generator ratings is provided.

PROCEDURE

The preliminary equipment list was compiled based on preliminary system calculations using the American Bureau Shipping's Steel Vessel Rules, the United States Coast Guard's Code of Federal Regulations, and Safety of Life at Sea (SOLAS) regulations. The electrical one-line diagram for the TAKU was also used to assist in determining the preliminary equipment list. The estimated HVAC loads were determined using a simplified version of the calculation method in Reference 1.

Motor horsepower values are converted to kW based on data in Reference 2. Each load was assigned a Duty Factor (DF) for each a summer mode of operation (assumed to be the worst case scenario due to the air conditioning load and high passenger volume). The duty factors are based on guidance in References 3 and 4, operational requirements, experience, and generally accepted marine practice.

RESULTS

The total electrical load is summarized in Appendix A for the ship service generators and the emergency generator. The minimum required generator sizing is calculated based on the load summation and client-specified future growth requirements. Ship service loads and maneuvering loads are listed and totaled separately to provide for analysis of a motor-driven bow thruster versus a direct-drive bow thruster.

CONCLUSIONS

Three 600kW, 1200RPM, water-cooled units (CAT 3508B) are presently shown for the ship's service generators due to AMHS's desire for fleet standardization. This will permit powering a motor-driven bow thruster with three gen-sets on-line (maneuvering mode) and utilizing two gen-sets (with a stand-by unit) when transiting. In the event of a generator failure, non-critical loads can be shed to permit use of the bow thruster with two gen-sets during critical maneuvering situations.

It is important to note that **the CAT 3508B generator configuration is not currently compliant with the Environmental Protection Agency's (EPA) Tier 2 emissions regulations.** Elliott Bay Design Group (EBDG) understands AMHS's desire to maintain the fleet standard of generators; however the vessel will be required to have Tier 2 compliant generators. Tier 3 compliant generators may even be required depending on the construction schedule of the first vessel and acquisition strategy of any potential sister vessels. EBDG will continue its research to determine the current and future availability of Tier 2 and Tier 3 compliant 1200RPM generators for the vessel.

While the calculations (with a 50% future growth criteria) indicate a 635kW unit is required for the emergency generator, we recommend utilizing one (1) 600kW, radiator-cooled generator (CAT 3508B). This would still provide for a 40% future growth, provide for commonality of parts with all generators, and prevent jumping to a much larger gen-set.

REFERENCES

1. SNAME T&R Bulletin 4-16, Calculations for Merchant Ship Heating, Ventilation and Air Conditioning Design.
2. NFPA-70 National Electric Code, Article 430 – Motors, Motor Circuits, and Controllers.
3. NVIC 2-89, Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units.
4. SNAME T&R Bulletin 3-11, Marine Steam Power Plant Heat Balance Practices.

Appendix A

Equipment List & Generator Sizing Spreadsheet

Data Color Coding Key

Data is very preliminary or non-existent.

Data has been reviewed for application to this project.

Data has been confirmed w/latest info.

DESCRIPTION, TYPE	Cog Engr	Mech Rating		Electrical				Power Source	MFGR	MAKE/MODEL	REMARKS
		Value	Unit	Connected Load		Demand Load (Summer)					
				eKW	Voltage	Duty	eKW				
Port Reduction Gear	CML								Falk	31.5x12 ZM	
Starboard Reduction Gear	CML								Falk	31.5x12 ZM	
Port Main Engine	CML	5000	HP						EMD	20-710G7C-T2	
Starboard Main Engine	CML	5000	HP						EMD	20-710G7C-T2	
Port ME JW Heat Recovery Circ Pump	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Stbd ME JW Heat Recovery Circ Pump	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Port ME SW Circ Pump	CML	25.0	HP	22.1	480/3P	0.9	19.8	Emerg			
Stbd ME SW Circ Pump	CML	25.0	HP	22.1	480/3P	0.9	19.8	Main			
Port ME SCAC SW Circ Pump	CML	10.0	HP	9.1	480/3P	0.9	8.2	Emerg			
Stbd ME SCAC SW Circ Pump	CML	10.0	HP	9.1	480/3P	0.9	8.2	Main			
Port Red Gear SW Circ Pump	CML	5.0	HP	4.7	480/3P	0.9	4.2	Emerg			
Stbd Red Gear SW Circ Pump	CML	5.0	HP	4.7	480/3P	0.9	4.2	Main			
Port Reduction Gear Cooling Water Pump	CML	5.0	HP	4.7	480/3P	0.9	4.2	Emerg			
Stbd Reduction Gear Cooling Water Pump	CML	5.0	HP	4.7	480/3P	0.9	4.2	Main			
Generator JW Heat Recovery Circ Pump	CML	10.0	HP	9.1	480/3P	0.0	0.0	Main			
SS Gen #1 JW Htr and Circ Pump	CML			3.0	480/3P	0.0	0.0	Main			
SS Gen #2 JW Htr and Circ Pump	CML			3.0	480/3P	0.0	0.0	Main			
SS Gen #3 JW Htr and Circ Pump	CML			3.0	480/3P	0.0	0.0	Main			
E Gen JW Htr and Circ Pump	CML			3.0	480/3P	0.0	0.0	Main			
Port ME JW Htr and Circ Pump	CML			15.0	480/3P	0.0	0.0	Main			
Stbd ME JW Htr and Circ Pump	CML			15.0	480/3P	0.0	0.0	Main			
Main Engine Jacket Water Xfer Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Generator Jacket Water Xfer Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
FO Purifier #1	CML	5.5	HP	5.1	480/3P	0.1	0.5	Main			
FO Purifier #2	CML	5.5	HP	5.1	480/3P	0.1	0.5	Main			
FO Xfer Pump #1	CML	5.0	HP	4.7	480/3P	0.1	0.5	Emerg			
FO Xfer Pump #2	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
ME Aux Fuel Pump #1	CML	3.0	HP	2.9	480/3P	0.0	0.0	Emerg			
ME Aux LO Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Emerg			
Port ME LO Prelube Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Port ME Soakback Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Port Reduction Gear Aux LO Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Emerg			
Stbd ME LO Prelube Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Stbd ME Soakback Pump	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Stbd Reduction Gear Aux LO Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
LO Purifier #1	CML	5.5	HP	5.1	480/3P	0.1	0.5	Main			
LO Purifier #2	CML	5.5	HP	5.1	480/3P	0.0	0.0	Main			
Main Engine LO Xfer Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Generator LO Xfer Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			

DESCRIPTION, TYPE	Cog Engr	Mech Rating		Electrical					Power Source	MFGR	MAKE/MODEL	REMARKS
		Value	Unit	Connected Load		Demand Load (Summer)						
				eKW	Voltage	Duty	eKW					
Reduction Gear LO Xfer Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main				
Oily Water Separator	CML	5.0	kW	6.3	480/3P	0.9	5.6	Main				
Sludge Xfer Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main				
Waste/Dirty Oil Xfer	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main				
E Gen Start Battery Charger	JEP			0.5	120/1P	0.6	0.3	Emerg				
Lighting, Pilothouse/Elex Space	JEP			2.0	120/1P	1.0	2.0	Main				
Lighting, Sun Deck	JEP			7.0	120/1P	0.5	3.5	Main				
Lighting, Boat Deck	JEP			30.0	120/1P	0.5	15.0	Main				
Lighting, Passenger Deck	JEP			34.0	120/1P	0.7	23.8	Main				
Lighting, Gallery Deck	JEP			14.0	120/1P	0.5	7.0	Main				
Lighting, Car Deck	JEP			15.0	120/1P	1.0	15.0	Main				
Lighting, 2nd Deck	JEP			7.0	120/1P	1.0	7.0	Main				
Lighting, EOS/Machinery Spaces	JEP			15.0	120/1P	1.0	15.0	Main				
Lighting, Hold/Voids	JEP			13.0	120/1P	0.3	3.9	Main				
Emergency Lighting	JEP			30.0	120/1P	1.0	30.0	Emerg				
Searchlight #1	JEP			1.0	120/1P	0.0	0.0	Main				
Searchlight #2	JEP			1.0	120/1P	0.0	0.0	Main				
Pilothouse Electronics	JEP			5.0	120/1P	1.0	5.0	Emerg				
Gyro	JEP	2.0	HP	1.9	480/3P	0.9	1.7	Main				
Interior Comms/Alarms	JEP			6.0	120/1P	1.0	6.0	Emerg				
Solarium Heaters	JEP			50.0	208/3P	0.0	0.0	Main				
HVAC Ventilation	CML	250.0	HP	204.0	480/3P	0.9	183.6	Main				
HVAC Cooling	CML	80.0	HP	67.8	480/3P	0.7	47.5	Main				
Boiler Motor #1	CML	2.0	HP	1.9	480/3P	0.0	0.0	Main				
Boiler	CML	156.0	HP						Weil McLain	1994		
SW Service Pump #1	CML	20.0	HP	17.8	480/3P	0.9	16.0	Main				
SW Service Pump #2	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main				
Stem Tube Lubrication Pump #1	CML	3.0	HP	2.9	480/3P	1.0	2.9	Emerg				
Stem Tube Lubrication Pump #2	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main				
Fire Pump #1	CML	50.0	HP	43.1	480/3P	0.0	0.0	Main				
Fire Pump #2	CML	50.0	HP	43.1	480/3P	0.0	0.0	Emerg				
Water Mist Fire Suppression	CML			100.0	480/3P	0.0	0.0	Emerg			Contains multiple pumps	
Water Mist Fire Suppression FW Boost Pump	CML	10.0	HP	9.1	480/3P	0.0	0.0	Emerg				
Water Mist Fire Suppression SW Boost Pump	CML	10.0	HP	9.1	480/3P	0.0	0.0	Emerg				
Fire/Sprinkler Pump	CML	60.0	HP	51.3	480/3P	0.0	0.0	Main				
Sprinkler Pump	CML	60.0	HP	51.3	480/3P	0.0	0.0	Emerg				
Bilge Pump #1	CML	20.0	HP	17.8	480/3P	0.0	0.0	Emerg				
Bilge Pump #2	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main				
Bilge/Ballast Pump #1	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main				
Bilge/Ballast Pump #2	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main				
Ballast Water Treatment Device	CML	30.0	HP	26.3	480/3P	0.0	0.0	Main				
Bilge Stripping Pump	CML	1.5	HP	1.5	480/3P	0.2	0.3	Main				
A/C Refrigeration FW Cooling Pump #1	CML	3.0	HP	2.9	480/3P	0.9	2.6	Main				

DESCRIPTION, TYPE	Cog Engr	Mech Rating		Electrical				Power Source	MFGR	MAKE/MODEL	REMARKS
		Value	Unit	Connected Load		Demand Load (Summer)					
				eKW	Voltage	Duty	eKW				
A/C Refrigeration FW Cooling Pump #2	CML	3.0	HP	2.9	480/3P	0.0	0.0	Main			
Sanitary Water Pump #1	CML	20.0	HP	17.8	480/3P	0.7	12.4	Main			
Sanitary Water Pump #2	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
HW Circ Pump #1	CML	15.0	HP	13.5	480/3P	0.0	0.0	Main			
HW Circ Pump #2	CML	15.0	HP	13.5	480/3P	0.0	0.0	Main			
Water Heater	CML			50.0	480/3P	0.5	25.0	Main			
PW Pump #1	CML	10.0	HP	9.1	480/3P	0.7	6.4	Main			
PW Pump #2	CML	10.0	HP	9.1	480/3P	0.0	0.0	Main			
SS Air Compressor #1	CML	15.0	HP	13.5	480/3P	0.3	4.0	Main			
SS Air Compressor #2	CML	15.0	HP	13.5	480/3P	0.0	0.0	Emerg			
SS Air Dryer #1	CML	0.5	HP	0.5	480/3P	0.3	0.2	Main			
SS Air Dryer #2	CML	0.5	HP	0.5	480/3P	0.0	0.0	Emerg			
Hyd Xfer Pump	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Port Steering HPU	CML	30.0	HP	26.3	480/3P	0.5	13.1	Emerg			
Stbd Steering HPU	CML	30.0	HP	26.3	480/3P	0.5	13.1	Main			
Port Fin Stabilizer	CML	30.0	HP	26.3	480/3P	0.0	0.0	Main			
Stbd Fin Stabilizer	CML	30.0	HP	26.3	480/3P	0.0	0.0	Main			
Port CPP HPU #1	CML	15.0	HP	13.5	480/3P	0.7	9.4	Emerg			
Port CPP HPU #2	CML	15.0	HP	13.5	480/3P	0.0	0.0	Main			
Stbd CPP HPU #1	CML	15.0	HP	13.5	480/3P	0.7	9.4	Main			
Stbd CPP HPU #2	CML	15.0	HP	13.5	480/3P	0.0	0.0	Main			
Anchor Windlass #1	CML	50.0	HP	43.1	480/3P	0.0	0.0	Main			
Anchor Windlass #2	CML	50.0	HP	43.1	480/3P	0.0	0.0	Main			
Port Fwd Capstan	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Stbd Fwd Capstan	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Port Spring Mooring Capstan	CML	25.0	HP	22.1	480/3P	0.0	0.0	Main			
Stbd Spring Mooring Capstan	CML	25.0	HP	22.1	480/3P	0.0	0.0	Main			
Aft Capstan	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Life Boat Davit #1	CML	20.0	HP	17.8	480/3P	0.0	0.0	Main			
Life Boat Davit #2	CML	20.0	HP	17.8	480/3P	0.0	0.0	Emerg			
Rescue Boat Davit #1	CML	34.4	HP	30.0	480/3P	0.0	0.0	Main			
Rescue Boat Davit #2	CML	34.4	HP	30.0	480/3P	0.0	0.0	Main			
Port Vehicle Door	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Stbd Vehicle Door	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Stern Vehicle Door	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Passenger Elevator #1	CML	5.0	HP	4.7	480/3P	0.3	1.4	Emerg	Kone	MonoSpace	Electric motor-driven unit.
Passenger Elevator #2	CML	5.0	HP	4.7	480/3P	0.3	1.4	Emerg	Kone	MonoSpace	Electric motor-driven unit.
Sewage Vacuum Pump #1	CML	0.5	HP	0.5	120/1P	0.5	0.3	Main			
Sewage Vacuum Pump #2	CML	0.5	HP	0.5	120/1P	0.5	0.3	Main			
Sewage Lift Pump #1	CML	2.0	HP	1.9	480/3P	0.2	0.4	Main			
Sewage Lift Pump #2	CML	2.0	HP	1.9	480/3P	0.2	0.4	Main			
Sewage Xfer Pump #1	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			
Sewage Xfer Pump #2	CML	5.0	HP	4.7	480/3P	0.0	0.0	Main			

DESCRIPTION, TYPE	Cog Engr	Mech Rating		Electrical				Power Source	MFGR	MAKE/MODEL	REMARKS
		Value	Unit	Connected Load		Demand Load (Summer)					
				eKW	Voltage	Duty	eKW				
MSD		29.0	HP	25.4	480/3P	0.5	12.7	Main			
Food Service Refrigeration Compressor #1	CML	10.0	HP	9.1	208/3P	0.6	5.5	Main			
Food Service Refrigeration Compressor #2	CML	10.0	HP	9.1	208/3P	0.6	5.5	Main			
Food Service Equipment	JEP			97.8	480/3P	0.8	78.2	Main			
		0.0		0		0.9	0.0				

Total, Ship Service Loads

Yellow highlighted items are user defined.

Green highlighted items are calculated.

Total Load: 668 kW

Misc Elect Loads: 50 kW

25% Future Growth: 179 kW

Projected Load: 897 kW

Qty should decrease as Eqpt List detail improves.

Number Gen-sets normally on-line: 2

Max. MCR: 90.0%

Min. Generator Rating: 498

Required Power: 997 kW

(kW)

Maneuvering Loads

Bow Thruster Electric Drive Unit	JEP	600.0	HP	476.0	480/3P	0.9	428.4	Main			
Bow Thruster Steering Motor	JEP	10.0	HP	9.1	480/3P	0.9	8.2	Main			
Bow Thruster Motor Cooling Fan	JEP	10.0	HP	9.1	480/3P	0.9	8.2	Main			

Total, Ship Service & Maneuvering Loads

Projected Load: 1342 kW

Number Gen-sets on-line: 3

Max. MCR: 95.0%

Min. Generator Rating: 471

Required Power: 1413 kW

(kW)

Preliminary Generator Size: 600 kW

System/Generator Voltage: 480 V

Generator FLA: 902 Amps

Minimum Bus Rating: 2030 Amps

Estimated Generator Impedance: 12.0%

Estimated Fault Current: 26.3 kAIC

Emergency Generator

Total Load: 413 kW

Misc Elect Loads: 15 kW

50% Future Growth: 207 kW

Projected Load: 635 kW