



DOUBLE-ENDED AZIMUTH DRIVE FERRY

AC and DC Electrical Loads Analysis

Prepared for: NCDOT • Raleigh, NC

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PREPARED BY

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GENERAL NOTES

1. This report is intended for regulatory submittal.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
-	Initial issue	8/2/2018	TMH WA 48360

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1 PURPOSE

A new ferry is to be constructed for the North Carolina Department of Transportation (NCDOT). The vessel will be a 184 ft x 45 ft x 10.5 ft double-ended roll-on/roll-off vehicle and passenger ferry with an open vehicle space. The vessel will be owned and operated by the NCDOT, and will provide ferry service within Pamlico Sound and surrounding rivers of North Carolina. The vessel will be propelled by a diesel electric system driving azimuthing thrusters via permanent magnet motors. Ship service electrical power will be derived from the propulsion bus via transformers. An electrical loads analysis has been performed to determine the required capacity of the generators, transformers, batteries, battery chargers, and electrical equipment.

2 PROCEDURE

An electrical loads analysis was performed to establish the electrical demand loads during each vessel operation mode. Electrical loads were taken from [1] and vessel system designs. The loading conditions were transit-cruise, transit-sprint, in port, and emergency. Data from [2] was also used to perform calculations.

3 ELECTRICAL LOADS ANALYSIS

An electrical loads analysis was performed for transit-cruise, transit-sprint, in port, and emergency operation conditions. These conditions established the electrical supply requirements throughout the vessel operation modes.

The transit-cruise load case determined the load which must be supplied for normal operation during transit. The transit-sprint condition analyzed the load for the occasions when the vessel will need to operate at higher speed. Propulsion motor loads for the cruise-sprint condition were taken from [3]. Due to the high power factor, 0.92, of the propulsion motors, an additional check of kW load, instead of kVA load, was performed.

For the ship service loads the cooling required during the summer season produced a larger load than the winter heating season, so the summer cooling loads were assumed. The ship service load calculation includes a 10% growth margin to allow for equipment addition throughout the vessel life.

The in port load case accounts for operations at the terminal and vessel loading. The emergency operation load condition considered the operation of the emergency switchboard loads including one fire pump and one bilge pump as supplied by the emergency generator. This condition was used to validate the size the emergency generator.

Within the emergency operation load condition, the required battery bank capacities were calculated. The battery banks were sized to provide a 30 minute supply of power. The battery chargers were sized to power the highest load condition, with a margin to charge the batteries.

Motor horsepower values were converted to kW based on data in [4]. Each load was assigned a Duty Factor (DF) for each operational mode. These are based on guidance in References [5] and [6], operational requirements, and generally accepted marine practice. Duty Factors are considered to be the proportion of rated load at which the item operates multiplied by the proportion of a typical 24 hour period during which the item operates. Symbolically,

DF = (Operating Power/Rated Power) x (hours of operation per day/24 hours). If the quotient of operating power/rated power is unknown, it was assumed 1.0. The loads analysis is shown in Appendix A.

4 RESULTS

The results of the analysis are given in Appendix A. They show that total load under the transit-cruise condition is approximately 1134 kVA, and the load under the transit-sprint condition is 1208 kVA, versus available capacity of 1412 kVA. On the real power side, the load reaches very nearly to 100% capacity under the transit-sprint condition, but does not exceed 100%. The system will be equipped with load monitoring and limiting to avoid overloading the generator sets.

The ship service load reaches approximately 111 kVA, allowing for use of a 150 kVA transformer. The emergency bus load, also with a 10% future growth margin, is well within capacity at 50 kVA. Furthermore, the 200A shore power connection will be sufficient to supply vital loads and modest HVAC loads.

5 CONCLUSIONS

Examination and calculations show that the proposed configuration of three 565 kW propulsion generators, two of which operate in parallel at any given time, will be adequate for propulsion and ship service loads. A single 65 kW emergency generator will be adequate for all emergency loads. Battery capacities are shown on [1].

6 REFERENCES

- [1] Elliott Bay Design Group, "AC and DC Electrical One Line Diagram, Rev. -," 16101-200-300-1, Seattle, WA, 2017.
- [2] US Naval Sea Systems Command (NAVSEA), "Design Data Sheet: Calculation of Surface Ship Endurance Fuel Requirements DDS 200-1 Rev. 1," Washington, DC, 10/04/11.
- [3] RAMME Electric Machines GmbH, "Technical data sheet SW500_S_250_1241_B," RAMME, Osterwieck, Germany, 2018.
- [4] J. W. Carpenter, NFPA-70 National Electric Code, Article 430 - Motors, Motor Circuits, and Controllers, Quincy, MA: NFPA, 2011.
- [5] US Coast Guard, NVIC 2-89, Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units, Washington, DC: USCG, 1989.
- [6] SNAME, T&R Bulletin 3-11, Marine Steam Power Plant Heat Balance Practices, New York, NY: SNAME.

[7] Elliott Bay Design Group, "NEW RIVER CLASS FERRY Technical Specification, Rev A,"
16101-200-832-1, Seattle, 2017.

Appendix A

Electrical Loads Analysis

Ckt No.	Description	Connected Load		Demand Load						Remarks
		HP	KVA	Transit-Cruise DF (KVA)	Transit-Sprint DF (KVA)	In Port DF (KVA)		Emergency DF (KVA)		
PROPULSION SWITCHBOARD - 600V 3 PH 3W										
601	Motor Drive A End Stbd		255	243	258	0.00	0	0.00	0	Port Bus
602	Motor Drive A End Port		255	243	258	0.00	0	0.00	0	Stbd Bus
603	Motor Drive B End Port		255	243	262	0.00	0	0.00	0	Port Bus
604	Motor Drive B End Stbd		255	243	262	0.00	0	0.00	0	Stbd Bus
605	Port Ship Service Transformer		325	0	0		0		0	Port Bus
606	Stbd Ship Service Transformer		325	103	108		64		2	Stbd Bus
607	Port Bus Thruster Control Power		73	0.40 29	0.40 29	0.10	7	0.00	0	Port Bus
608	Stbd Bus Thruster Control Power		73	0.40 29	0.40 29	0.10	7	0.00	0	Stbd Bus

Total Load Summary (kVA) =	1814.9	1131.7	1205.3	78.5	2.0
% Loading	128.5%	80.1%	85.3%	5.6%	0.1%

Load and Generator Summary		
Generator Rating	eKW	KVA
Generator No. 1	565.00	706.25
Generator No. 2	565.00	706.25
Generator No. 3 (Standby)	0.00	0.00

Total Generator Capacity=	1412.50
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Ckt No.	Description	Connected Load		Demand Load						Remarks
		HP	KVA	Transit-Cruise DF (KVA)	Transit-Sprint DF (KVA)	In Port DF (KVA)		Emergency DF (KVA)		
S. S. SWITCHBOARD - 208V 3 PH 4W										
201	Emergency SWBD Bus Tie		46.03	6.76	6.78	3.90	0.00			
202	Panel P202 - Engine Room End A		31.76	4.89	4.89	6.29	0.00			
203	Panel P203 - Engine Room End B		41.99	15.43	16.41	11.30	0.00			
204	Panel P204 - Pilot House		21.71	6.41	6.41	5.37	0.00			
205	Panel P205 - Hold Ventilation		19.58	17.63	17.63	6.74	0.00			
206	Panel P206 - HVAC 1		41.98	23.57	27.48	10.97	0.00			
207	Panel P207 - HVAC 2		44.31	16.25	16.25	8.21	1.82			
208	Fire Pump No. 2	25.00	26.74	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	
209	Rescue Boat Davit		8.75	0.10 0.88	0.10 0.88	0.10 0.88	0.00 0.00	0.00 0.00	0.00 0.00	
210	Bilge Pump No. 2	5.00	5.98	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	
211	Generator 1 JW Heater		1.50	0.00 0.00	0.00 0.00	0.90 1.35	0.00 0.00			
212	Generator 2 JW Heater		1.50	0.00 0.00	0.00 0.00	0.90 1.35	0.00 0.00			
213	Generator 3 JW Heater		1.50	0.90 1.35	0.90 1.35	0.90 1.35	0.00 0.00			
214	EOS Lights		0.15	0.90 0.14	0.90 0.14	0.90 0.14	0.00 0.00			
215	EOS Battery Charger 24DC2		1.80	0.40	0.40	0.32	0.00			
216	Blank (3P)			1.00	1.00	1.00	0.00			
217	Blank (3P)			1.00	1.00	1.00	0.00			
218	Blank (3P)									
219	Blank (3P)									
220	Blank (3P)									

Total House Load Summary (kVA) =	295.3	93.7	98.6	58.1	1.8
Future Growth Margin	10%	29.5	9.4	9.9	0.2
End of life load (kVA)		324.8	103.1	108.5	2.0

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)	Emergency DF	(KVA)	
3 PH, 4W, 208 V, 60Hz Distribution												
Engine Room Panel A - P202												
1	Zero Discharge Pump No. 1 (Pole 1)	5.00	5.98	0.00	0.00	0.00	0.00	0.10	0.60	0.00	0.00	
2	Zero Discharge Pump No. 2 (Pole 1)	5.00	5.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	Zero Discharge Pump No. 1 (Pole 2)			0.00		0.00		0.00		0.00		
4	Zero Discharge Pump No. 2 (Pole 2)			0.00		0.00		0.00		0.00		
5	Zero Discharge Pump No. 1 (Pole 3)			0.00		0.00		0.00		0.00		
6	Zero Discharge Pump No. 2 (Pole 3)			0.00		0.00		0.00		0.00		
7	Air Compressor No. 1 (Pole 1)	5.00	5.98	0.10	0.60	0.10	0.60	0.10	0.60	0.00	0.00	
8	Air Compressor No. 2 (Pole 1)	5.00	5.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
9	Air Compressor No. 1 (Pole 2)			0.00		0.00		0.00		0.00		
10	Air Compressor No. 2 (Pole 2)			0.00		0.00		0.00		0.00		
11	Air Compressor No. 1 (Pole 3)			0.00		0.00		0.00		0.00		
12	Air Compressor No. 2 (Pole 3)			0.00		0.00		0.00		0.00		
13	MSD (Pole 1)	1.50	2.02	0.90	1.82	0.90	1.82	0.90	1.82	0.00	0.00	
14	Main Deck Receptacles		1.00	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	
15	MSD (Pole 2)			0.00		0.00		0.00		0.00		
16	Engine Room Receptacles (4)		1.00	0.40	0.40	0.40	0.40	0.30	0.30	0.00	0.00	
17	MSD (Pole 3)			0.00		0.00		0.00		0.00		
18	Hold Receptacles (4)		1.00	0.20	0.20	0.20	0.20	0.30	0.30	0.00	0.00	
19	Void A Lights		0.10	0.90	0.09	0.90	0.09	0.90	0.09	0.00	0.00	
20	Thruster Room A Lights		0.10	0.90	0.09	0.90	0.09	0.50	0.05	0.00	0.00	
21	Main Deck Deck Lights		2.10	0.50	1.05	0.50	1.05	0.90	1.89	0.00	0.00	
22	Engine Room Lights		0.50	0.90	0.45	0.90	0.45	0.90	0.45	0.00	0.00	
23	Spare			0.00		0.00		0.00		0.00		
24	Spare			0.00		0.00		0.00		0.00		
25	Spare			0.00		0.00		0.00		0.00		
26	Blank			0.00		0.00		0.00		0.00		
27	Blank			0.00		0.00		0.00		0.00		
28	Blank			0.00		0.00		0.00		0.00		
29	Blank			0.00		0.00		0.00		0.00		
30	Blank			0.00		0.00		0.00		0.00		
31	Blank			0.00		0.00		0.00		0.00		
32	Blank			0.00		0.00		0.00		0.00		
33	Blank			0.00		0.00		0.00		0.00		
34	Blank			0.00		0.00		0.00		0.00		
35	Blank			0.00		0.00		0.00		0.00		
36	Blank			0.00		0.00		0.00		0.00		
37	Blank			0.00		0.00		0.00		0.00		
38	Blank			0.00		0.00		0.00		0.00		
39	Blank			0.00		0.00		0.00		0.00		
40	Blank			0.00		0.00		0.00		0.00		
41	Blank			0.00		0.00		0.00		0.00		
42	Blank			0.00		0.00		0.00		0.00		
Totals			31.76		4.89		4.89		6.29		0.00	

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)		Emergency DF	(KVA)
3 PH, 4W, 208 V, 60Hz Distribution												
Engine Room Panel B - P203												
1	Ballast Pump No. 1 (Pole 1)	2.00	2.58	0.20	0.52	0.20	0.52	0.10	0.26	0.00	0.00	
2	Ballast Pump No. 2 (Pole 1)	2.00	2.58	0.20	0.52	0.20	0.52	0.00	0.00	0.00	0.00	
3	Ballast Pump No. 1 (Pole 2)			0.00		0.00		0.00		0.00		
4	Ballast Pump No. 2 (Pole 2)			0.00		0.00		0.00		0.00		
5	Ballast Pump No. 1 (Pole 3)			0.00		0.00		0.00		0.00		
6	Ballast Pump No. 2 (Pole 3)			0.00		0.00		0.00		0.00		
7	Waste Oil Pump	2.00	2.58	0.00	0.00	0.00	0.00	0.10	0.26	0.00	0.00	
8	Generator Heater No. 1		0.10	0.00	0.00	0.00	0.00	0.90	0.09	0.00	0.00	
9	Potable Water Pump No. 1	1.00	1.46	0.60	0.88	0.60	0.88	0.10	0.15	0.00	0.00	
10	Generator Heater No. 2		0.10	0.00	0.00	0.00	0.00	0.90	0.09	0.00	0.00	
11	Potable Water Pump No. 2	1.00	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	Generator Heater No. 3		0.10	0.10	0.01	0.10	0.01	0.90	0.09	0.00	0.00	
13	Hold Receptacles (4)		1.00	0.20	0.20	0.20	0.20	0.30	0.30	0.00	0.00	
14	Engine Room Svbld Room Lights No. 2		0.30	1.00	0.30	1.00	0.30	0.90	0.27	0.00	0.00	
15	Thruster Room B Lights		0.10	1.00	0.10	1.00	0.10	0.50	0.05	0.00	0.00	
16	Starting Battery Charger No. 2 24DC		0.50	0.10	0.05	0.10	0.05	0.10	0.05	0.00	0.00	
17	Void B Lights		0.10	1.00	0.10	1.00	0.10	0.50	0.05	0.00	0.00	
18	Starting Battery Charger No. 3 24DC		0.50	0.10	0.05	0.10	0.05	0.10	0.05	0.00	0.00	
19	SWITCHBOARD Room/EOS Receptacles		1.00	0.40	0.40	0.40	0.40	0.30	0.30	0.00	0.00	
20	Transfer Span Power Supply	5.00	5.98	0.00	0.00	0.00	0.00	0.10	0.60	0.00	0.00	
21	Machinery Space HVAC Chiller 1 (Pole 1)		3.28	0.85	2.79	1.00	3.28	0.30	0.98	0.00	0.00	
22	Machinery Space HVAC Chiller 2 (Pole 1)		3.28	0.85	2.79	1.00	3.28	0.30	0.98	0.00	0.00	
23	Mach HVAC Chiller 1 (Pole 2)											
24	Mach HVAC Chiller 2 (Pole 2)											
25	Mach HVAC Chiller 1 (Pole 3)											
26	Mach HVAC Chiller 2 (Pole 3)											
27	Aux SW Cooling Pump No. 1 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.90	3.37	0.00	0.00	
28	Aux SW Cooling Pump No. 2 (Pole 1)	3.00	3.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
29	Aux SW Pump 1 (Pole 2)											
30	Aux SW Pump 2 (Pole 2)											
31	Aux SW Pump 3 (Pole 3)											
32	Aux SW Pump 3 (Pole 3)											
33	FW Cooling Pump No. 1 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.90	3.37	0.00	0.00	
34	FW Cooling Pump No. 2 (Pole 1)	3.00	3.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
35	FW Cool Pump 1 (Pole 2)											
36	FW Cool Pump 2 (Pole 2)											
37	FW Cool Pump 1 (Pole 3)											
38	FW Cool Pump 2 (Pole 3)											
39	Blank											
40	Blank											
41	Blank											
42	Blank											
Totals			41.99	15.43		16.41		11.30		0.00		

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)		Emergency DF	(KVA)
3 PH, 4W, 208 V, 60Hz Distribution												
Pilot House Panel - P204												
1	Ship's Network System		0.20	0.90	0.18	0.90	0.18	0.90	0.18	0.00	0.00	
2	CCTV System		0.25	0.90	0.23	0.90	0.23	0.90	0.23	0.00	0.00	
3	Search Lights A (2)		2.00	0.10	0.20	0.10	0.20	0.00	0.00	0.00	0.00	
4	Search Lights B (2)		2.00	0.10	0.20	0.10	0.20	0.00	0.00	0.00	0.00	
5	Navigation Lights (Primary)		0.46	0.50	0.23	0.50	0.23	0.00	0.00	0.00	0.00	
6	Pilot House Window Heaters		2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	Main Deck and 01 Deck Lights		0.17	0.50	0.08	0.50	0.08	0.50	0.08	0.00	0.00	
8	Crew Head Exhaust Fan		0.63	0.90	0.56	0.90	0.56	0.90	0.56	0.00	0.00	
9	Pilot House Window Wipers		0.50	0.50	0.25	0.50	0.25	0.00	0.00	0.00	0.00	
10	Passenger Lounge Exhaust Fan	0.50	0.81	0.90	0.73	0.90	0.73	0.50	0.40	0.00	0.00	
11	Water Heater		2.00	0.10	0.20	0.10	0.20	0.10	0.20	0.00	0.00	
12	Pilot House Refrigerator and Coffee Maker		1.32	0.70	0.92	0.70	0.92	0.70	0.92	0.00	0.00	
13	Pilot House Lights		0.11	0.90	0.10	0.90	0.10	0.90	0.10	0.00	0.00	
14	Crew Lounge Refrigerator		0.88	0.70	0.61	0.70	0.61	0.70	0.61	0.00	0.00	
15	Crew Lounge Coffee Maker		1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	
16	Crew Lounge Microwave		1.20	0.20	0.24	0.20	0.24	0.20	0.24	0.00	0.00	
17	Pilot House Receptacles (4)		1.00	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	
18	Crew Lounge Lights		0.05	0.90	0.05	0.90	0.05	0.90	0.05	0.00	0.00	
19	Crew Lounge Receptacles (4)		1.00	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	
20	Passenger Lounge Lights		0.19	0.90	0.17	0.90	0.17	0.90	0.17	0.00	0.00	
21	Passenger Lounge Receptacles A (5)		1.00	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	
22	Vending Machines and Drinking Fountain		1.20	0.40	0.48	0.40	0.48	0.20	0.24	0.00	0.00	
23	Passenger Lounge Receptacles B (5)		1.00	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	
24	Pilot House Flood Lights		0.75	0.10	0.08	0.10	0.08	0.90	0.68	0.00	0.00	
25	Spare											
26	Spare											
27	Spare											
28	Spare											
29	Spare											
30	Spare											
Totals			21.71	6.41		6.41		5.37		0.00		

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise DF (KVA)	Transit-Sprint DF (KVA)	In Port DF (KVA)	Emergency DF (KVA)					
3 PH, 4W, 208 V, 60Hz Distribution												
Hold Ventilation - P205												
1	Engine Room Supply Fan No. 1 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.50	1.87	0.00	0.00	
2	Engine Room Supply Fan No. 2 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.50	1.87	0.00	0.00	
3	Engine Room Supply Fan No. 1 (Pole 2)											
4	Engine Room Supply Fan No. 2 (Pole 2)											
5	Engine Room Supply Fan No. 1 (Pole 3)											
6	Engine Room Supply Fan No. 2 (Pole 3)											
7	Engine Room Supply Fan No. 3 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.00	0.00	0.00	0.00	
8	Engine Room Supply Fan No. 4 (Pole 1)	3.00	3.74	0.90	3.37	0.90	3.37	0.00	0.00	0.00	0.00	
9	Engine Room Supply Fan No. 3 (Pole 2)											
10	Engine Room Supply Fan No. 4 (Pole 2)											
11	Engine Room Supply Fan No. 3 (Pole 3)											
12	Engine Room Supply Fan No. 4 (Pole 3)											
13	EOS Supply Fan		0.04	1.00	0.04	1.00	0.04	1.00	0.04	0.00	0.00	
14	Switchboard Room Supply Fan		0.04	1.00	0.04	1.00	0.04	1.00	0.04	0.00	0.00	
15	Thruster Room Supply Fan A End (Pole 1)	1.00	1.46	0.90	1.32	0.90	1.32	0.50	0.73	0.00	0.00	
16	Thruster Room Supply Fan B End (Pole 1)	1.00	1.46	0.90	1.32	0.90	1.32	0.50	0.73	0.00	0.00	
17	Thruster Room Supply Fan A End (Pole 2)											
18	Thruster Room Supply Fan B End (Pole 2)											
19	Thruster Room Supply Fan A End (Pole 3)											
20	Thruster Room Supply Fan B End (Pole 3)											
21	Void A Supply Fan	0.50	0.81	0.90	0.73	0.90	0.73	0.90	0.73	0.00	0.00	
22	Void B Supply Fan	0.50	0.81	0.90	0.73	0.90	0.73	0.90	0.73	0.00	0.00	
23	Spare											
24	Spare											
25	Spare											
26	Blank											
27	Blank											
28	Blank											
29	Blank											
30	Blank											
Totals		19.58		17.63		17.63		6.74		0.00		

Ckt No.	Description	Connected Load		Demand Load						Remarks	
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)		Emergency DF
3 PH, 4W, 208 V, 60Hz Distribution											
HVAC 1 - P206											
1	Engine Room Unit Heater No. 1		5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Engine Room Unit Heater No. 2		5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	ER Heater 1 (Pole 2)										
4	ER Heater 2 (Pole 2)										
5	ER Heater 3 (Pole 3)										
6	ER Heater 3 (Pole 3)										
7	Crew Lounge Heat Pump		5.63	0.80	4.50	0.80	4.50	0.40	2.25	0.00	0.00
8	Passenger Lounge Heat Pump No. 1		5.63	0.80	4.50	0.80	4.50	0.40	2.25	0.00	0.00
9	Crew Lounge Heat Pump (Pole 2)										
10	Pass Lounge Heat Pump 1 (Pole 2)										
11	Passenger Lounge Heat Pump No. 2		5.63	0.80	4.50	0.80	4.50	0.40	2.25	0.00	0.00
12	Passenger Lounge Heat Pump No. 3		5.63	0.80	4.50	0.80	4.50	0.40	2.25	0.00	0.00
13	Pass Lounge Heat Pump 2 (Pole 2)										
14	Pass Lounge Heat Pump 3 (Pole 2)										
15	Machinery Space HVAC Chiller 3 (Pole 1)		3.28	0.85	2.79	1.00	3.28	0.30	0.98	0.00	0.00
16	Machinery Space HVAC Chiller 4 (Pole 1)		3.28	0.85	2.79	1.00	3.28	0.30	0.98	0.00	0.00
17	Mach Space HVAC Chiller 3 (Pole 2)										
18	Mach Space HVAC Chiller 4 (Pole 2)										
19	Mach Space HVAC Chiller 3 (Pole 3)										
20	Mach Space HVAC Chiller 4 (Pole 3)										
21	Switchboard Room Fan Coil Unit No. 1	1.00	1.46	0.00	0.00	1.00	1.46	0.00	0.00	0.00	0.00
22	Switchboard Room Fan Coil Unit No. 2	1.00	1.46	0.00	0.00	1.00	1.46	0.00	0.00	0.00	0.00
23	Swbd Rm Fan Coil 1 (Pole 2)										
24	Swbd Rm Fan Coil 2 (Pole 2)										
25	Spare										
26	Spare										
27	Spare										
28	Spare										
29	Blank										
30	Blank										
31	Blank										
32	Blank										
33	Blank										
34	Blank										
35	Blank										
36	Blank										
37	Blank										
38	Blank										
39	Blank										
40	Blank										
41	Blank										
42	Blank										
Totals			41.98		23.57		27.48		10.97		0.00

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)	Emergency DF	(KVA)	
3 PH, 4W, 208 V, 60Hz Distribution												
HVAC 2 - P207												
1	Pilot House Heat Pump 1 (Pole 1)		5.63	1.00	5.63	1.00	5.63	0.40	2.25	0.00	0.00	
2	Pilot House Heat Pump 2 (Pole 1)		5.63	1.00	5.63	1.00	5.63	0.40	2.25	0.00	0.00	
3	PH Heat Pump 1 (Pole 2)											
4	PH Heat Pump 2 (Pole 2)											
5	Passenger Lounge Heaters 1		4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	Pilot House Heaters		5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	Pass Lounge Heaters 1 (Pole 2)											
8	PH Heaters (Pole 2)											
9	Passenger Lounge Heaters 2		4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	Engine Room Unit Heater No. 3		5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
11	Pass Lounge Heaters 2 (Pole 2)											
12	ER Unit Heater 3 (Pole 2)											
13	Crew Lounge Heaters		3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
14	ER Unit Heater 3 (Pole 3)											
15	Crew Lounge Heaters (Pole 2)											
16	Chilled Water Pump 1 (Pole 1)		2.00	2.58	0.90	2.33	0.90	2.33	0.40	1.03	0.00	0.00
17	Chilled Water Pump 2 (Pole 1)		2.00	2.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Chilled Water Pump 1 (Pole 2)											
19	Chilled Water Pump 2 (Pole 2)											
20	Chilled Water Pump 1 (Pole 3)											
21	Chilled Water Pump 2 (Pole 3)											
22	Switchboard Cooling Pump 1 (Pole 1)		1.50	2.02	0.90	1.82	0.90	1.82	0.90	1.82	0.90	1.82
23	Switchboard Cooling Pump 2 (Pole 1)		1.50	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Switchboard Cooling Pump 1 (Pole 2)											
25	Switchboard Cooling Pump 2 (Pole 2)											
26	Switchboard Cooling Pump 1 (Pole 3)											
27	Switchboard Cooling Pump 2 (Pole 3)											
28	EOS Fan Coil Unit (Pole 1)		2.85	0.30	0.86	0.30	0.86	0.30	0.86	0.00	0.00	
29	Spare											
30	EOS Fan Coil Unit (Pole 2)											
31	Spare											
32	Spare											
33	Spare											
34	Spare											
35	Blank											
36	Blank											
37	Blank											
38	Blank											
39	Blank											
40	Blank											
41	Blank											
42	Blank											
Totals			44.31		16.25		16.25		8.21		1.82	

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise		Transit-Sprint		In Port		Emergency		
				DF	(KVA)	DF	(KVA)	DF	(KVA)	DF	(KVA)	
EMERGENCY SWITCHBOARD - 208V 3 PH 4W												
201	Fire Pump No. 1	25.00	26.74	0.00	0.00	0.00	0.00	0.00	0.00	1.00	26.74	
202	Emergency Generator JW Heater		1.00	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	
203	Bilge Pump No. 1	5.00	5.98	0.00	0.00	0.00	0.00	0.00	0.00	1.00	5.98	
204	Panel EP204 - Engine Room		4.30		2.34		2.34		1.63		4.10	
205	Panel EP205 - Pilot House		7.05		3.72		3.74		1.57		5.71	
206	EGEN Starting Battery Charger 24DC		0.50	0.10	0.05	0.10	0.05	0.10	0.05	1.00	0.50	
207	Void, Thruster Room E Lights A End		0.15	1.00	0.15	1.00	0.15	1.00	0.15	1.00	0.15	
208	Void, Thruster Room E Lights B End		0.15	1.00	0.15	1.00	0.15	1.00	0.15	1.00	0.15	
209	Emergency Generator Room E Lights		0.15	1.00	0.15	1.00	0.15	1.00	0.15	1.00	0.15	
210	Blank (3P)											
211	Blank (3P)											
212	Blank (3P)											
213	Blank (3P)											
214	Blank (3P)											

Total Load Summary (kVA) =	46.0	6.8	6.8	3.9	43.5
Future Growth Margin 10%	4.6	0.7	0.7	0.4	4.3
End of life load (kVA)	50.6	7.4	7.5	4.3	47.8

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise		Transit-Sprint		In Port		Emergency		
				DF	(KVA)	DF	(KVA)	DF	(KVA)	DF	(KVA)	
3 PH, 4W, 208 V, 60Hz Distribution												
Emergency Engine Room Panel - EP204												
1	Engine Room Emergency Lights		0.16	0.90	0.14	0.90	0.14	0.90	0.14	1.00	0.16	
2	EOS and Swbd Room Emergency Lights		0.08	0.90	0.07	0.90	0.07	0.90	0.07	1.00	0.08	
3	Engine Order Telegraph		0.13	0.50	0.06	0.50	0.06	0.10	0.01	1.00	0.13	
4	Machinery Alarm and Monitoring System		0.38	0.90	0.34	0.90	0.34	0.20	0.08	1.00	0.38	
5	Fire Detection System		0.50	0.90	0.45	0.90	0.45	0.90	0.45	1.00	0.50	
6	Propulsion Monitoring and Indication		0.50	0.90	0.45	0.90	0.45	0.10	0.05	1.00	0.50	
7	EOS Console		0.25	0.90	0.23	0.90	0.23	0.90	0.23	1.00	0.25	
8	Starting Battery Charger No. 1 24DC		0.50	0.10	0.05	0.10	0.05	0.10	0.05	1.00	0.50	
9	Engine Room Battery Charger (DC1)		1.81		0.55		0.55		0.55		1.61	
10	ER and Swbd Rm Emerg Recept			0.00		0.00		0.00		0.00		
11	Spare			0.00		0.00		0.00		0.00		
12	Spare			0.00		0.00		0.00		0.00		
13	Blank			0.00		0.00		0.00		0.00		
14	Blank			0.00		0.00		0.00		0.00		
15	Blank			0.00		0.00		0.00		0.00		
16	Blank			0.00		0.00		0.00		0.00		
17	Blank			0.00		0.00		0.00		0.00		
18	Blank			0.00		0.00		0.00		0.00		
Totals			4.30		2.34		2.34		1.63		4.10	

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)		Emergency DF	(KVA)
3 PH, 4W, 208 V, 60Hz Distribution												
Emergency Pilot House Panel - EP205												
1	Pilot House 12V Battery Charger (12DC1)		0.50		0.11		0.11		0.11		0.14	
2	Navigation Lights (Secondary)		0.46	0.90	0.42	0.90	0.42	0.90	0.42	1.00	0.46	
3	Pilot House 24V Battery Charger (24DC3)		1.88		0.97		0.99		0.30		1.02	
4	ESS System IP Phone/Command Intercom		0.13	0.20	0.03	0.20	0.03	0.20	0.03	0.60	0.08	
5	Infrared Night Vision		1.25	0.50	0.63	0.50	0.63	0.10	0.13	1.00	1.25	
6	Public Address and General Alarm System		0.38	0.20	0.08	0.20	0.08	0.10	0.04	0.80	0.30	
7	Radar with AIS and Chartplotter		0.90	0.90	0.81	0.90	0.81	0.10	0.09	1.00	0.90	
8	Pilot House Console		0.50	0.90	0.45	0.90	0.45	0.20	0.10	1.00	0.50	
9	01 Deck Emergency Lights		0.11	0.00	0.00	0.00	0.00	0.50	0.06	1.00	0.11	
10	Pilot House Emergency Lights		0.06	0.00	0.00	0.00	0.00	0.50	0.03	1.00	0.06	
11	Crew Lounge Emergency Lights		0.03	0.90	0.03	0.90	0.03	0.90	0.03	1.00	0.03	
12	Passenger Lounge Emergency Lights		0.22	1.00	0.22	1.00	0.22	1.00	0.22	1.00	0.22	
13	Life Raft Launching Lights		0.45	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.45	
14	Spare											
15	Main Deck Exterior Emergency Lights		0.20	0.00	0.00	0.00	0.00	0.20	0.04	1.00	0.20	
16	Spare											
17	Spare											
18	Spare											
19	Blank											
20	Blank											
21	Blank											
22	Blank											
23	Blank											
24	Blank											
25	Blank											
26	Blank											
27	Blank											
28	Blank											
29	Blank											
30	Blank											
Totals			7.05		3.72		3.74		1.57		5.71	

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	(KVA)	Transit-Sprint DF	(KVA)	In Port DF	(KVA)		Emergency DF	(KVA)
2W 24VDC Distribution												
Panel 24DC1 - Engine Room												
1	Generator 1 Control Power		0.10	1.00	0.10	1.00	0.10	1.00	0.10	1.00	0.10	
2	Backup Thruster Control A End Stbd		0.36	0.10	0.04	0.10	0.04	0.10	0.04	1.00	0.36	
3	Generator 2 Control Power		0.10	1.00	0.10	1.00	0.10	1.00	0.10	1.00	0.10	
4	Backup Thruster Control B End Port		0.36	0.10	0.04	0.10	0.04	0.10	0.04	1.00	0.36	
5	Machinery Alarm and Monitoring		0.20	0.10	0.02	0.10	0.02	0.10	0.02	1.00	0.20	
6	Tank Monitoring System		0.20	0.20	0.04	0.20	0.04	0.20	0.04	1.00	0.20	
7	Fire Dampers w/ Electric Actuators		0.25	0.10	0.03	0.10	0.03	0.10	0.03	0.20	0.05	
8	Propulsion Drive Control A End Stbd		0.12	0.80	0.10	0.80	0.10	0.80	0.10	1.00	0.12	
9	Propulsion Drive Control B End Port		0.12	0.80	0.10	0.80	0.10	0.80	0.10	1.00	0.12	
10	Spare											
11	Spare											
12	Blank											
13	Blank											
14	Cross Connect to 24DC2											
Totals			1.81		0.55		0.55		0.55		1.61	

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	Transit-Cruise (KVA)	Transit-Sprint DF	Transit-Sprint (KVA)	In Port DF	In Port (KVA)		Emergency DF	Emergency (KVA)
2W 24VDC Distribution												
Panel 24DC2 - EOS												
1	Generator 3 Control Power		0.10	1.00	0.10	1.00	0.10	1.00	0.10	0.00	0.00	
2	Backup Thruster Control A End Port		0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	Backup Thruster Control B End Stbd		0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	Engine Order Telegraph		0.20	0.50	0.10	0.50	0.10	0.10	0.02	0.00	0.00	
5	Main Switchbd Ctrl Pwr DC UPS		0.20	1.00	0.20	1.00	0.20	1.00	0.20	0.00	0.00	
6	Propulsion Drive Control A End Port		0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	Propulsion Drive Control B End Stbd		0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
8	Spare											
9	Blank											
10	Blank											
11	Blank											
12	Blank											
13	Blank											
14	Cross Connect to 24DC1											
Totals			1.46		0.40		0.40		0.32		0.00	

Ckt No.	Description	Connected Load		Demand Load						Remarks		
		HP	KVA	Transit-Cruise DF	Transit-Cruise (KVA)	Transit-Sprint DF	Transit-Sprint (KVA)	In Port DF	In Port (KVA)		Emergency DF	Emergency (KVA)
2W 24VDC Distribution												
Panel 24DC3 - Pilot House Nav/Com												
1	Radar No. 1		0.27	1.00	0.27	1.00	0.27	0.00	0.00	1.00	0.27	
2	Radar No. 2		0.27	1.00	0.27	1.00	0.27	0.00	0.00	1.00	0.27	
3	AIS		0.25	1.00	0.25	1.00	0.25	1.00	0.25	1.00	0.25	
4	Electronic Horn		0.50	0.20	0.10	0.20	0.10	0.00	0.00	0.20	0.10	
5	Nav Lights and Control Panel (Backup)		0.03	0.50	0.02	0.50	0.02	0.50	0.02	0.50	0.02	
6	Fog Signal Timer		0.10	0.10	0.01	0.10	0.01	0.10	0.01	0.10	0.01	
7	Thruster Control and Monitoring		0.25	0.20	0.05	0.30	0.08	0.10	0.03	0.40	0.10	
8	Spare											
9	Spare											
10	Spare											
11	Blank											
12	Blank											
13	Blank											
14	Blank											
Totals			1.67		0.97		0.99		0.30		1.02	

Ckt No.	Description	Connected Load		Demand Load								Remarks
		HP	KVA	Transit-Cruise		Transit-Sprint		In Port		Emergency		
				DF	(KVA)	DF	(KVA)	DF	(KVA)	DF	(KVA)	
2W 12VDC Distribution												
Panel 12DC1 - Pilot House Nav/Com												
1	VHF Radio No. 1		0.03	0.10	0.00	0.10	0.00	0.10	0.00	0.50	0.02	
2	VHF Radio No. 2		0.03	0.10	0.00	0.10	0.00	0.10	0.00	0.10	0.00	
3	Loud Hailer		0.06	0.10	0.01	0.10	0.01	0.10	0.01	0.50	0.03	
4	Depth Sounder/Weather Displays		0.02	1.00	0.02	1.00	0.02	1.00	0.02	1.00	0.02	
5	GPS Chart Plotter No. 1		0.05	1.00	0.05	1.00	0.05	1.00	0.05	1.00	0.05	
6	GPS Chart Plotter No. 2		0.01	1.00	0.01	1.00	0.01	1.00	0.01	1.00	0.01	
7	Satellite Compass		0.01	1.00	0.01	1.00	0.01	1.00	0.01	1.00	0.01	
8	Anemometer		0.01	1.00	0.01	1.00	0.01	1.00	0.01	1.00	0.01	
9	Spare											
10	Spare											
11	Spare											
12	Blank											
13	Blank											
14	Blank											
Totals			0.22	0.11		0.11		0.11		0.14		