Dual Ring Bus Electrical Distribution System for US Navy Destroyer- and Frigate-Sized Vessels

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Topology: Dual Ring Bus

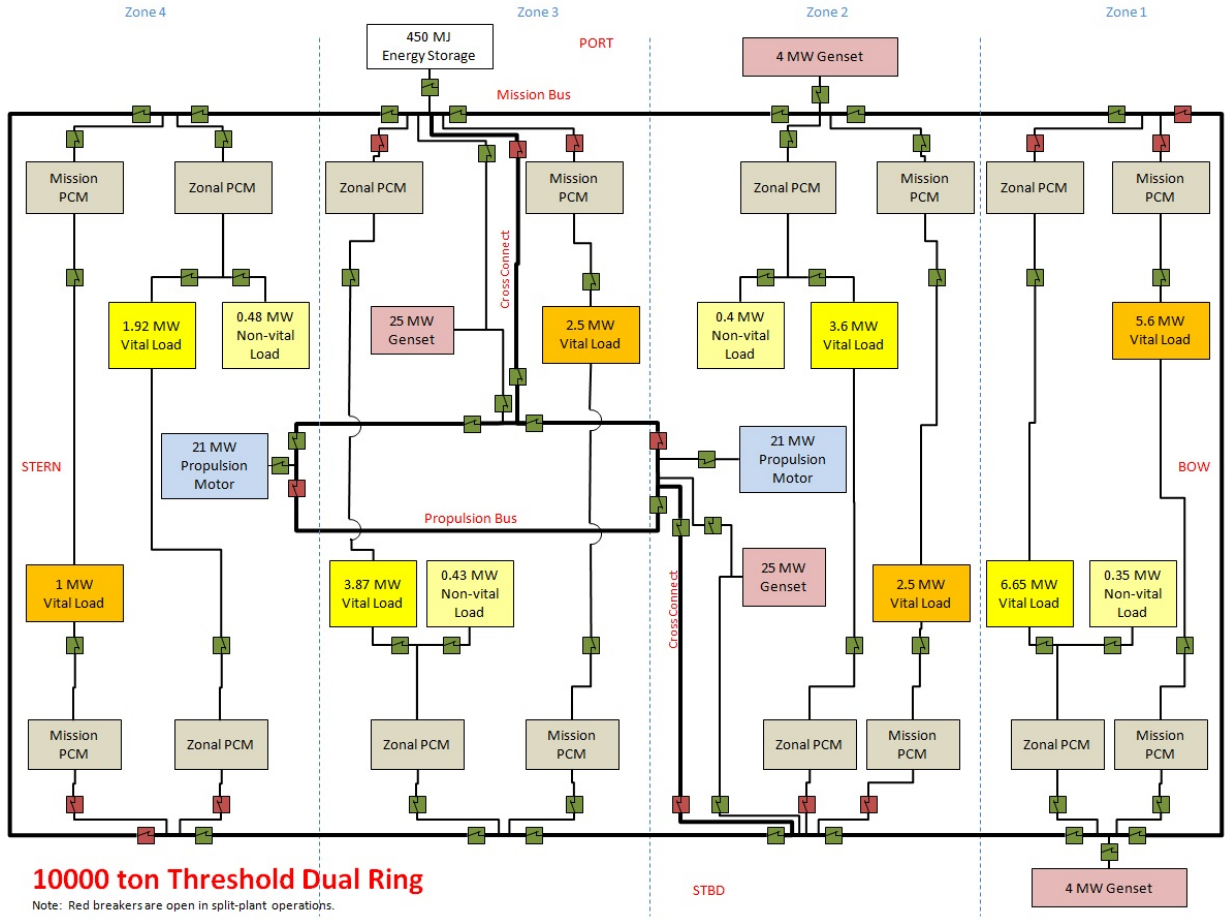
In response to a Request for Information from the Office of Naval Research regarding electrical architectures to be considered in an architecture evaluation study for two candidate hull forms including a 10,000 ton destroyer-sized vessel and a 5,000 ton frigate-sized vessel, the Design Laboratory of the MIT Sea Grant College Program proposes a dual ring bus topology as described in the following.

Brief Topology Description

The dual ring bus topology shown in Figure 1 consists of two separate ring buses: one for propulsion and one for all other loads. The propulsion bus is a short ring that extends from zone 2 through zone 4 and provides power to the propulsion motors. The mission bus runs throughout the length of the ship and provides power to all mission and hotel loads. The small gas turbine generators are connected to the mission bus, and the large gas turbine generators are connected to both the mission and propulsion bus; the amount of power sent to each bus is driven by the load demand. A cross-connect between the buses allows propulsion power to be provided by the small gas turbine generators if no large gas turbine generators are on line.

Each vital load is connected to both the port and starboard sides of the ring. There are redundant power conversion modules for each zone and for each major mission load.

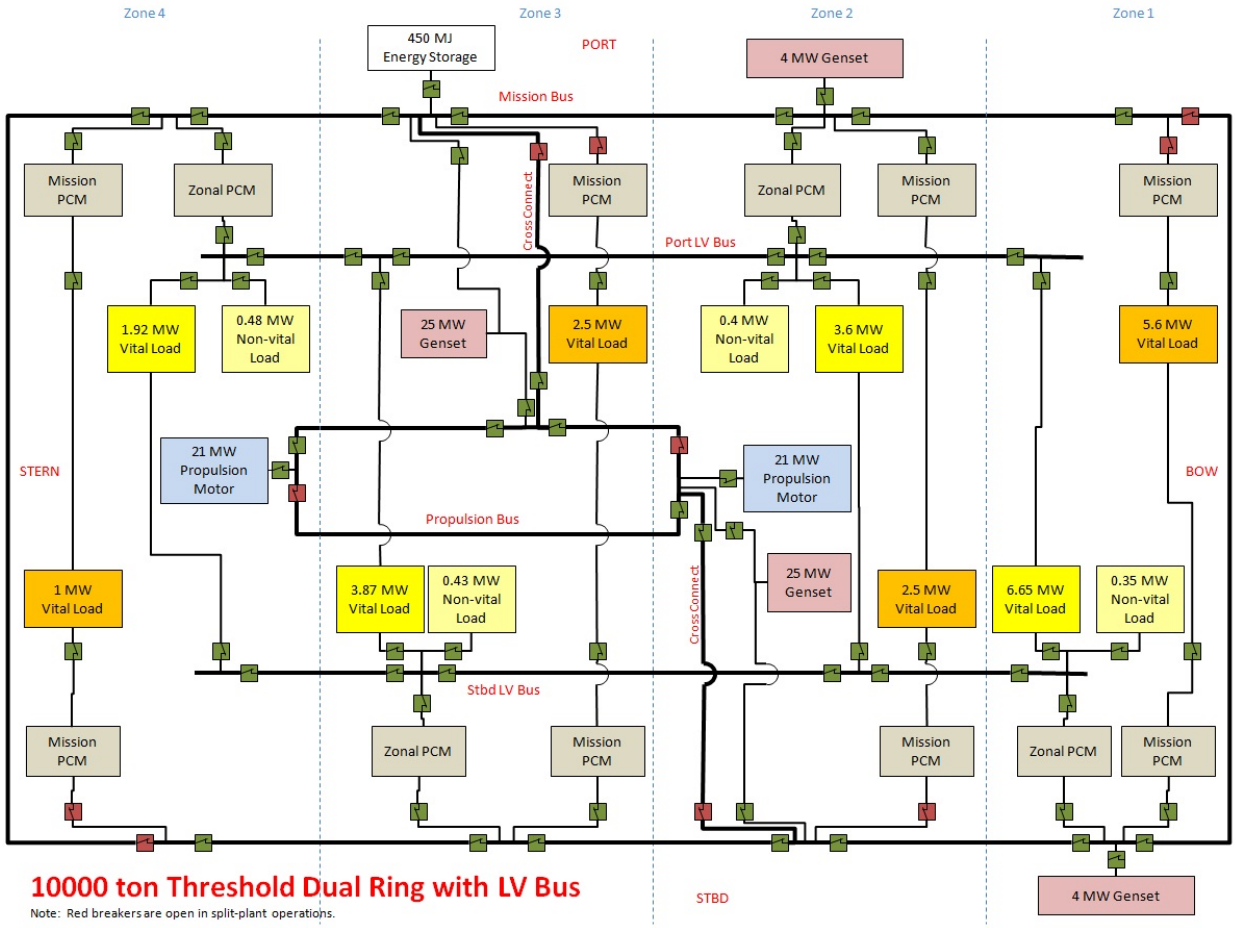
Figure 1: Top Level Block Diagram of Dual Ring Bus Topology for 10,000 ton Threshold Variant Ship



Dual ring with low-voltage bus variant

The dual ring bus with low-voltage bus topology, shown in Figure 2, is very similar to the dual ring bus topology described above. The difference is that a low voltage bus runs the length of the ship on both port and starboard sides. Instead of having two zonal power conversion modules in each zone, redundancy is provided through connectivity to the zonal power conversion modules in other zones. Thus, there are four zonal converters instead of eight.

Figure 2: Top Level Block Diagram of Dual Ring Topology with Low Voltage Bus for 10,000 ton Threshold Variant Ship



Architecture Advantages and Disadvantages

The dual ring bus topology reduces the maximum power level on each bus, so that the full installed power of the vessel is not required to be transmitted throughout the ship. This reduces the size of each bus and the breakers or disconnects associated with the main bus, at the expense of adding cable length (an additional bus and the cross connects) and additional breakers or disconnects. Separating the propulsion loads from the mission and hotel loads reduces the complexity of each bus, which improves reliability while maintaining flexibility. Improvements to safety and power transmission issues may be seen as well.

The ring bus topology inherently provides two sources of power to every load (from both forward and aft); this robustness is increased by linking the vital loads to the ring buses on both the port and starboard sides of the ship and providing redundant converters for zonal and mission loads, also on both sides of the ship. The mission bus and redundant converters are separated transversely and vertically for reduced vulnerability. The cross connects between the mission and propulsion buses provide yet another path for power flow.

It would be interesting to investigate the filtering requirements of this topology in more detail. For example, the propulsion bus is connected only to the motors and the two large generators, so it may be possible to allow this bus to operate with reduced filtering since the equipment connected to the bus might be resilient to harmonics. If this were allowed, the cross connects to the mission bus would need to be filtered. In an ac application, it may be feasible to allow the bus frequency to vary.

Protection/Reconfiguration Philosophy

This topology features a ring configuration for the main distribution bus which provides two alternate feeds for each vital load and each mission load. The ring-tie allows bow and stern cross connects if needed. In addition, the propulsion bus is a ring configuration with cross connects that can bring power in from the mission bus.

All vital loads are connected to the distribution buses via an automatic bus transfer (ABT) that automatically shifts power from one bus to the other in case of loss of power from one side. The control system limits total power drawn from any bus as described in the following section, thus avoiding overloading the remaining operational generator(s).

Control Philosophy

Since the installed power is less than the aggregate total load, the load must be controlled at all times to avoid exceeding the power supply. We recommend a supervisory fully-redundant control system using a concept similar to smart grid technology in which the power distribution is controlled through the control of the load levels. This control system must maintain essentially real-time status of load demand and power generation, even in the face of disruptions up to and including combat damage. Detailed discussion of the control philosophy in damage scenarios is not addressed herein. When the plant is operated in split-plant mode, the control system manages power for each bus (port and starboard) independently.

For normal operations, all loads except propulsion will be allowed to draw full power; note that this means non-vital loads will be able to draw full power as well. The maximum propulsion load allowed will be limited to the amount of generation capacity on line minus the active mission and hotel load; as equipment is operated, the available maximum propulsion load will fluctuate. The propulsion load may of course take any value less than the maximum allowed at any point in time; in other words, the ship may always go slower than maximum speed available. Operating all loads at maximum power and taking distribution losses into account leaves approximately 26 MW available for propulsion with all generators on line. Using a speed-power curve for a representative 10000 ton destroyer, 26 MW of propulsion power allows the ship to maintain approximately 25 knots in speed.

An alternative restricted maneuvering mode must be available in which propulsion power takes priority over other loads. In this scenario, the remaining loads must be prioritized and limits set that allow full propulsion power.

During an emergent event such as a fault or other casualty, non-vital loads will be shed; however, non-vital loads are only 3% of the installed power, so shedding these loads will have little impact on overall powering and further action must be taken. Propulsion power will be limited, and a scenario must be developed to potentially limit other loads as required. Examples could include limiting repetition rate for pulse weapon firing or instantiating a lower power mode for radar operations.

An additional consideration is that a minimum allowable propulsion upper limit must be in place to allow the ship to maintain steerageway. This minimum upper limit could come into play in casualty events, but also during operations with less than maximum power on line.

Concept of Operations

1. Battle Condition. The ship operating in battle condition will have all generators running and on line in a split plant configuration. This configuration will be achieved by opening breakers forward and aft on both the propulsion and mission buses such that the port side motors and generators and the zonal and mission loads in zones 2 and 4 are connected to the port bus and the remaining equipment is connected to the starboard bus. The breakers that would be open in this configuration are colored red in the top level block diagram.
2. Single Generator Operations. The energy storage module has sufficient capacity to provide 2.5 MW of power for 3 minutes, which should be sufficient time to start a standby generator, even allowing for a misfire. Therefore, single generator operations will be allowed when the ship is in a threat-free environment. For single generator operations, all breakers are closed in both the ring and mission buses. Assuming the single generator is one of the main generators, the breakers in the cross connects will be open as the generator will be connected to both buses simultaneously.

Implementation details

Medium voltage dc implementation details:

In the medium-voltage dc version, power is generated as variable frequency ac using high-speed generators operating at the most economical speed for the load. Power is rectified at the source and is distributed throughout the ship at 9.3 kVdc. The propulsion motor drives and the pulse weapon are powered via a variable frequency ac drive which can accept dc bus voltage without conversion. The remaining major mission loads require a 1 kVdc voltage input, so a dc-dc converter is required for each major load. We assume that all in-zone loads are 450Vac 60 Hz, so the power is transformed and inverted at the entry to each zone, then distributed individually to each in-zone load at 450 Vac 60 Hz.

All switches on the dc side of the bus are dc disconnects; when power must be interrupted, power flow is controlled through the associated power electronics equipment and the disconnect is used for isolation. AC breakers are provided within the ac portions of the distribution system and between the generators and associated rectifiers.

Medium voltage 240 Hz. ac implementation details:

Power is generated at 240 Hz ac using high-speed generators and is distributed throughout the ship at 6.9 kV. The major mission loads and propulsion motor drives require a dc voltage input, so power is transformed and rectified for each major load. We assume that all in-zone loads are 450Vac 60 Hz, so the power is converted and transformed at the entry to each zone.

Medium voltage 60 Hz. ac implementation details:

Power is generated at 60 Hz ac using conventional generators and is distributed throughout the ship at 6.9 kV. The major mission loads and propulsion motor drives require a dc voltage input, so power is rectified for each major load. We assume that all in-zone loads are 450Vac 60 Hz, so the power is transformed at the entry to each zone.

Ship variant details:

Top-level block diagrams and detailed equipment lists for all variants are included below. In addition, detailed one-line diagrams of the 10,000 ton threshold variant in MVDC, HFAC and MVAC are provided.

Acknowledgments

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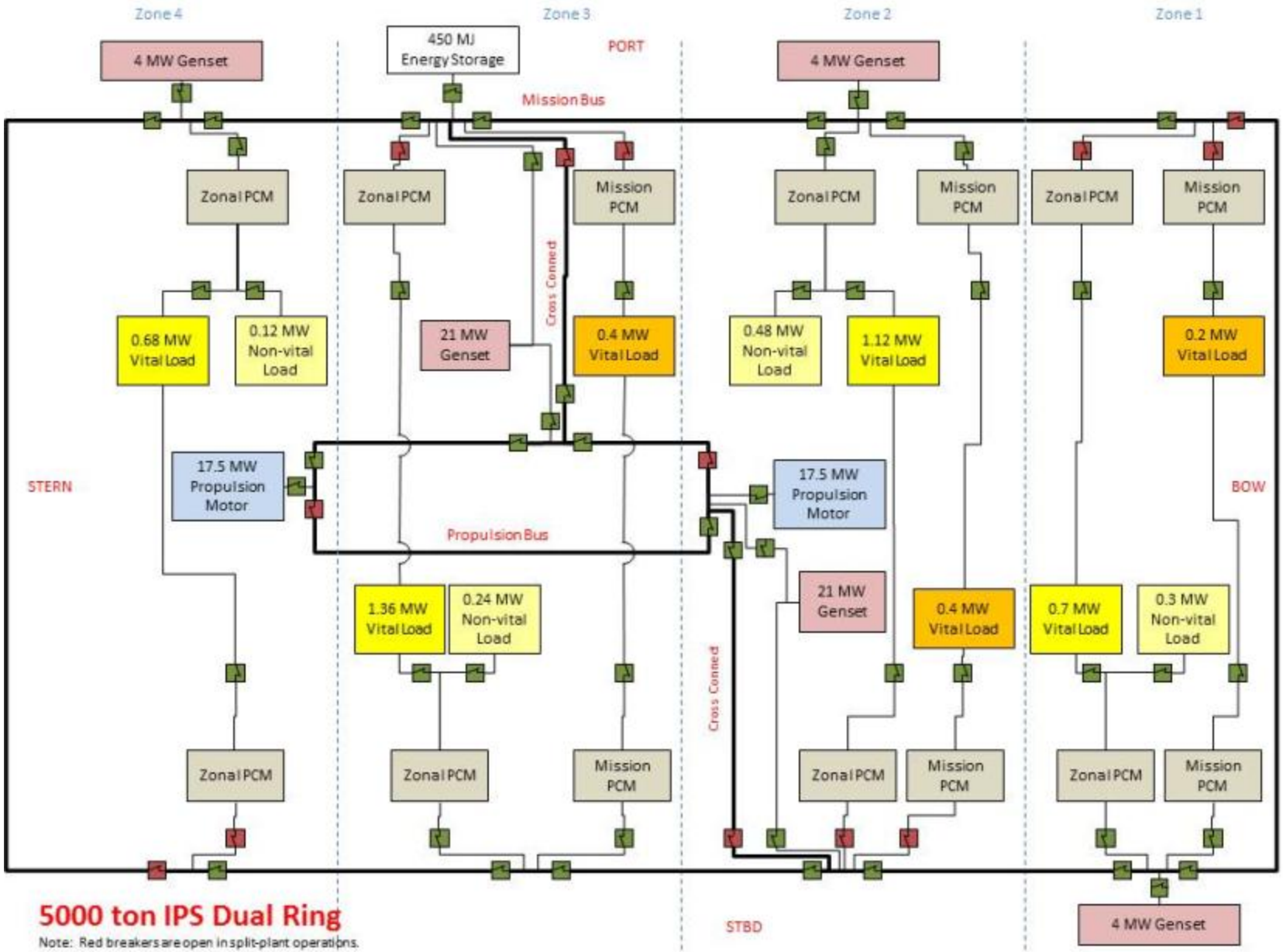


5000 ton IPS Dual Ring

Note: Red breakers are open in split-plant operations.

5,000 ton ship - "IPS 60 Hz Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	Transformer		1.02	AC	450	1309	6900	1	0.98	0.44	0.6	2	4.6	3,401
	Z2L3	Mission load	0.2	60 Hz Filter		0.20	AC-DC	1000	200	740	1	1	0.5	1	2	0.8	400
				Rectifier AC-DC		0.20	AC-DC	1000	204	740	1	0.98	3.33	6.67	2	0.1	61
				Transformer		0.21	AC	740	162	6900	1	0.98	0.44	0.6	2	0.9	694
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
														TOTAL ZONE 1		120.7	52,890
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	Transformer		1.63	AC	450	2095	6900	1	0.98	0.44	0.6	2	7.4	5,442
	Z2L3	Mission load	0.4	60 Hz Filter		0.40	AC-DC	1000	400	740	1	1	0.5	1	2	1.6	800
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	3172	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
			21	LM2500 GTG		25.74	AC	6900	2153		0.85	0.96	0.033	0.054	1	779.9	476,580
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	25.00	AC	6900	2092		1	1	250	200	2	0.2	250
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	cross connect	12.00	AC	6900	1004		1	1	250	200	2	0.1	120
														TOTAL ZONE 2		928.2	543,697
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	Transformer		1.63	AC	450	2095	6900	1	0.98	0.44	0.6	2	7.4	5,442
	Z3L3	Mission load	0.4	60 Hz Filter		0.40	AC-DC	1000	400	740	1	1	0.5	1	2	1.6	800
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Power Generation	21	LM2500 GTG		25.74	AC	6900	2153		0.85	0.96	0.033	0.054	1	779.9	476,580
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	25.00	AC	6900	2092		1	1	250	200	2	0.2	250
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		791.8	485,287
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	Transformer		0.82	AC	450	1047	6900	1	0.98	0.44	0.6	2	3.7	2,721
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	3172	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
														TOTAL ZONE 4		140.6	61,716
														GRAND TOTAL		1,981.4	1,143,591
ALL				Cable	mission bus	6.00	AC	6900	502								4,748
				Cable	propulsion bus	33.00	AC	6900	2761								6,401
				Cable	cross connect	12.00	AC	6900	1004								640
														Total Cable Weight			11,789
														Total Weight Including Cable			1,155,380

Total GTG Weight	1,097,334
Total PCM Weight	43,157
Total Breaker/Disconnect Weight	3,100
Total Cable Weight	11,789
Total Weight	1,155,380

5,000 ton ship - "IPS 240 Hz Dual Ring" variant

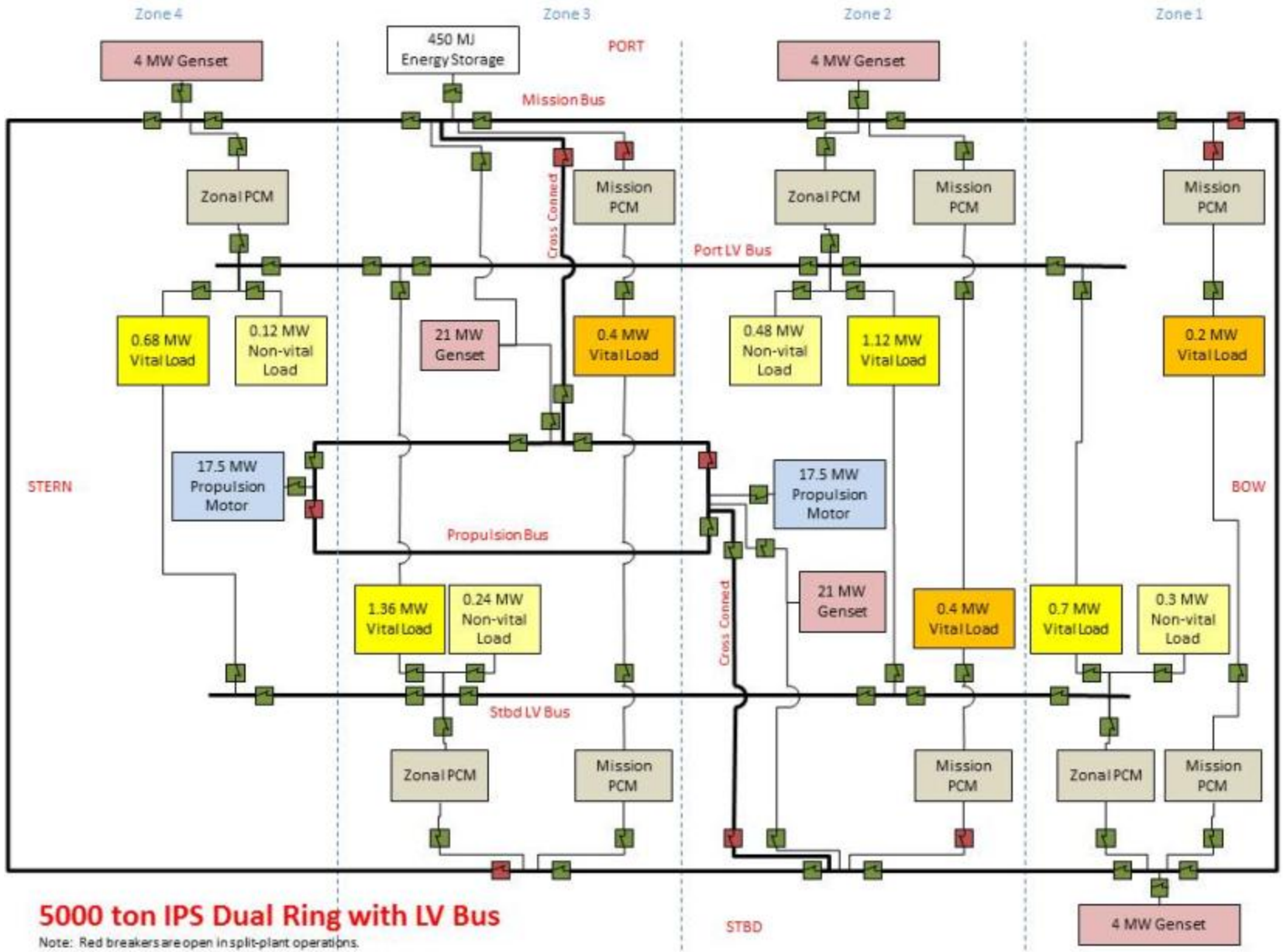
ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	240 Hz Filter		1.00	AC	450	1283	480	1	1	1	1.75	2	2.0	1,143
				Converter AC-AC		1.02	AC	450	1309	480	1	0.98	1.35	2.25	2	1.5	907
				Transformer		1.04	AC	480	1252	6900	1	0.98	0.44	0.6	2	4.7	3,471
	Z2L3	Mission load	0.2	240 Hz Filter		0.20	AC-DC	1000	200	740	1	1	1	1.75	2	0.4	229
				Rectifier AC-DC		0.20	AC-DC	1000	204	740	1	0.98	3.33	6.67	2	0.1	61
				Transformer		0.21	AC	740	162	6900	1	0.98	0.44	0.6	2	0.9	694
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
														TOTAL ZONE 1		77.0	34,711
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	Converter AC-AC		1.63	AC	450	2095	480	1	0.98	1.35	2.25	2	2.4	1,451
				Converter AC-AC		1.67	AC	450	2137	480	1	0.98	1.35	2.25	2	2.5	1,481
				Transformer		1.70	AC	480	2045	6900	1	0.98	0.44	0.6	2	7.7	5,667
	Z2L3	Mission load	0.4	240 Hz Filter		0.40	AC-DC	1000	400	740	1	1	1	1.75	2	0.8	457
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	1000	22330	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
			21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.6	202,640
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	2	0.3	313
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 Hz Breakers	cross connect	12.00	AC	6900	1004		1	1	200	160	2	0.1	150
														TOTAL ZONE 2		471.1	252,348
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	240 Hz Filter		1.60	AC	450	2053	480	1	1	1	1.75	2	3.2	1,829
				Converter AC-AC		1.63	AC	450	2095	480	1	0.98	1.35	2.25	2	2.4	1,451
				Transformer		1.67	AC	480	2004	6900	1	0.98	0.44	0.6	2	7.6	5,553
	Z3L3	Mission load	0.4	240 Hz Filter		0.40	DC	1000	400	1000	1	1	1	1.75	2	0.8	457
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Power Generation	21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.6	202,640
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	2	0.3	313
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		381.5	212,806
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	240 Hz Filter		0.80	AC	450	1026	480	1	1	1	1.75	2	1.6	914
				Converter AC-AC		0.82	AC	450	1047	480	1	0.98	1.35	2.25	2	1.2	726
				Transformer		0.83	AC	480	1002	6900	1	0.98	0.44	0.6	2	3.8	2,777
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	2	0.1	63
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
														TOTAL ZONE 4		97.1	43,663
														GRAND TOTAL		1,029.0	543,528
ALL				Cable	mission bus	6.00	AC	6900	502								4,748
				Cable	propulsion bus	33.00	AC	6900	2761								6,401
				Cable	cross connect	12.00	AC	6900	1004								640
														Total Cable Weight			11,789
														Total Weight Including Cable			555,317

Total GTG Weight	492,297
Total PCM Weight	52,662
Total Breaker/Disconnect Weight	3,906
Total Cable Weight	11,789
Total Weight	560,654

5,000 ton ship - "IPS dc Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	Inverter		1.02	DC-AC	450	1309	9300	1	0.98	0.75	1.5	2	2.7	1,361
	Z2L3	Mission load	0.2	Converter DC-DC		0.20	DC-DC	1000	204	9300	1	0.98	0.9	2	2	0.5	204
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.03	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
														TOTAL ZONE 1		74.0	31,406
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	Inverter		1.63	DC-AC	450	2095	9300	1	0.98	0.75	1.5	2	4.4	2,177
	Z2L3	Mission load	0.4	Converter DC-Dc		0.41	DC-DC	1000	408	9300	1	0.98	0.9	2	2	0.9	408
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
			21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.6	202,640
				Rectifier AC-DC		25.22	AC-DC	9300	2712	6900	1	0.98	3.33	6.67	1	7.6	3,781
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	generators	25.00	DC	9300	2688		1	1	180	650	2	0.3	77
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	1	0.13	156
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				Disconnects	cross connect	12.00	DC	9300	1290		1	1	180	650	2	0.1	37
														TOTAL ZONE 2		468.0	246,103
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	Inverter		1.63	DC-AC	450	2095	9300	1	0.98	0.75	1.5	2	4.4	2,177
	Z3L3	Mission load	0.4	Converter DC-Dc		0.41	DC-DC	1000	408	9300	1	0.98	0.9	2	2	0.9	408
		Power Generation	21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.6	202,640
				Rectifier AC-DC		25.22	AC-DC	9300	2712	6900	1	0.98	3.33	6.67	1	7.6	3,781
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	25.00	DC	9300	2688		1	1	180	650	2	0.3	77
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	1	0.13	156
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				Disconnects	cross connect	12.00	DC	9300	1290		1	1	180	650	2	0.1	37
														TOTAL ZONE 3		381.7	209,469
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	Inverter		0.82	DC-AC	450	1047	9300	1	0.98	0.75	1.5	2	2.2	1,088
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	generators	5.00	AC	6900	418		1	1	180	650	1	0.03	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
														TOTAL ZONE 4		89.2	37,915
														GRAND TOTAL		1,012.8	524,893
ALL				Cable	mission bus	6.00	DC	9300	645								2,809
				Cable	propulsion bus	33.00	DC	9300	3548								4,126
				Cable	cross connect	12.00	DC	9300	1290								413
														Total Cable Weight			7,347
														Total Weight Including Cable			532,240

Total GTG Weight	492,297
Total PCM Weight	31,224
Total Breaker/Disconnect Weight	1,372
Total Cable Weight	7,347
Total Weight	532,240



5000 ton IPS Dual Ring with LV Bus

Note: Red breakers are open in split-plant operations.

5,000 ton ship - "IPS 60 Hz Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Equipment	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	Transformer		2.65	AC	450	3404	6900	1	0.98	0.44	0.6	1	6.0	4,422
	Z2L3	Mission load	0.2	60 Hz Filter		0.20	AC-DC	1000	200	740	1	1	0.5	1	2	0.8	400
				Rectifier AC-DC		0.20	AC-DC	1000	204	740	1	0.98	3.33	6.67	2	0.1	61
				Transformer		0.21	AC	740	162	6900	1	0.98	0.44	0.6	2	0.9	694
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.00	48,058
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
														TOTAL ZONE 1		122.2	53,961
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	Transformer		2.65	AC	450	3404	6900	1	0.98	0.44	0.6	1	6.0	4,422
	Z2L3	Mission load	0.4	60 Hz Filter		0.40	AC-DC	1000	400	740	1	1	0.5	1	2	1.6	800
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	3172	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.00	48,058
			21	LM2500 GTG		25.74	AC	6900	2153		0.85	0.96	0.033	0.054	1	779.86	476,580
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	25.00	AC	6900	2092		1	1	250	200	2	0.2	250
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				60 Hz Breakers	cross connect	12.00	AC	6900	1004		1	1	250	200	2	0.1	120
														TOTAL ZONE 2		926.9	542,777
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	Transformer		2.45	AC	450	3142	6900	1	0.98	0.44	0.6	1	5.6	4,082
	Z3L3	Mission load	0.4	60 Hz Filter		0.40	AC-DC	1000	400	740	1	1	0.5	1	2	1.6	800
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Power Generation	21	LM2500 GTG		25.74	AC	6900	2153		0.85	0.96	0.033	0.054	1	779.86	476,580
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	25.00	AC	6900	2092		1	1	250	200	2	0.2	250
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		790.0	484,027
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	Transformer		2.45	AC	450	3142	6900	1	0.98	0.44	0.6	1	5.6	4,082
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	3172	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.00	48,058
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
														TOTAL ZONE 4		142.5	63,127
														GRAND TOTAL		1,981.6	1,143,891
ALL				Cable	misison bus	6.00	AC	6900	502								4,748
				Cable	propulsion bus	33.00	AC	6900	2761								6,401
				Cable	LV bus	5.00	AC	450	6415								17,280
				Cable	cross connect	12.00	AC	6900	1004								640
														Total Cable Weight			29,069
														Total Weight Including Cable			1,172,960

Total GTG Weight	1,097,334
Total PCM Weight	43,157
Total Breaker/Disconnect Weight	3,400
Total Cable Weight	29,069
Total Weight	1,172,960

5,000 ton ship - "IPS 240 Hz Dual Ring LV Bus" variant

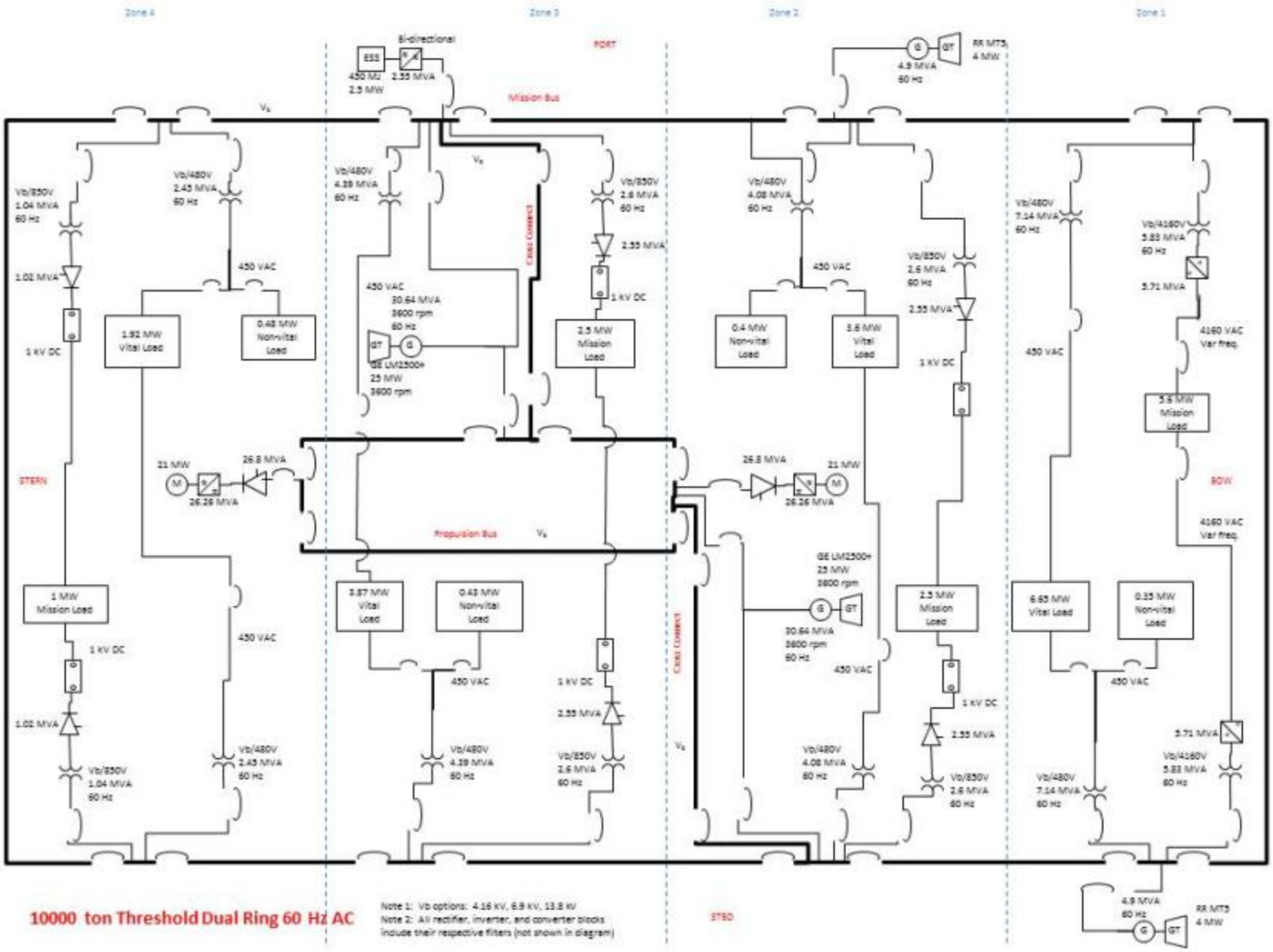
ZONE	LOAD	Type	MW	Equipment	Equipment	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	240 Hz Filter		2.60	AC	450	3336	480	1	1	1	1.75	1	2.6	1,486
				Converter AC-AC		2.65	AC	450	3404	480	1	0.98	1.35	2.25	1	2.0	1,179
				Transformer		2.71	AC	480	3256	6900	1	0.98	0.44	0.6	1	6.2	4,512
	Z2L3	Mission load	0.2	240 Hz Filter		0.20	AC-DC	1000	200	740	1	1	1	1.75	2	0.4	229
				Rectifier AC-DC		0.20	AC-DC	1000	204	740	1	0.98	3.33	6.67	2	0.1	61
				Transformer		0.21	AC	740	162	6900	1	0.98	0.44	0.6	2	0.9	694
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
														TOTAL ZONE 1		78.9	36,075
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	240 Hz Filter		2.60	AC	450	3336	480	1	1	1	1.75	1	2.6	1,486
				Converter AC-AC		2.65	AC	450	3404	480	1	0.98	1.35	2.25	1	2.0	1,179
				Transformer		2.71	AC	480	3256	6900	1	0.98	0.44	0.6	1	6.2	4,512
	Z2L3	Mission load	0.4	240 Hz Filter		0.40	AC-DC	1000	400	740	1	1	1	1.75	2	0.8	457
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	1000	22330	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
			21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.65	202,640
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	2	0.3	313
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				240 Hz Breakers	cross connect	12.00	AC	6900	1004		1	1	200	160	2	0.1	150
														TOTAL ZONE 2		471.3	250,991
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	240 Hz Filter		2.40	AC	450	3079	480	1	1	1	1.75	1	2.4	1,371
				Converter AC-AC		2.45	AC	450	3142	480	1	0.98	1.35	2.25	1	1.8	1,088
				Transformer		2.50	AC	480	3006	6900	1	0.98	0.44	0.6	1	5.7	4,165
	Z3L3	Mission load	0.4	240 Hz Filter		0.40	AC-DC	1000	400	740	1	1	1	1.75	2	0.8	457
				Rectifier AC-DC		0.41	AC-DC	1000	408	740	1	0.98	3.33	6.67	2	0.2	122
				Transformer		0.42	AC	740	325	6900	1	0.98	0.44	0.6	2	1.9	1,388
		Power Generation	21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.65	202,640
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	2	0.3	313
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		379.1	211,155
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	240 Hz Filter		2.40	AC	450	3079	480	1	1	1	1.75	1	2.4	1,371
				Converter AC-AC		2.45	AC	450	3142	480	1	0.98	1.35	2.25	1	1.8	1,088
				Transformer		2.50	AC	480	3006	6900	1	0.98	0.44	0.6	1	5.7	4,165
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
				Rectifier AC-DC		22.33	AC-DC	9300	2401	6900	1	0.98	3.33	6.67	1	6.7	3,348
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	mission bus	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				240 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
														TOTAL ZONE 4		98.7	45,433
														GRAND TOTAL		1,029.0	543,654
ALL				Cable	misison bus	6.00	AC	6900	502								4,748
				Cable	propulsion bus	33.00	AC	6900	2761								6,401
				Cable	LV bus	5.00	AC	450	6415								17,280
				Cable	cross connect	12.00	AC	6900	1004								640
														Total Cable Weight			29,069
														Total Weight Including Cable			572,723

Total GTG Weight	492,297
Total PCM Weight	52,896
Total Breaker/Disconnect Weight	4,175
Total Cable Weight	29,069
Total Weight	578,437

5,000 ton ship - "IPS dc Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Equipment	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	0.7														
	Z1L2	Hotel non-vital	0.3														
		Total Hotel Load	1.00	Inverter		2.65	DC-AC	450	3404	9300	1	0.98	0.75	1.5	1	3.5	1,769
	Z2L3	Mission load	0.2	Converter DC-DC		0.20	DC-DC	1000	204	9300	1	0.98	0.9	2	2	0.5	204
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.44	720
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.03	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
														TOTAL ZONE 1		74.8	31,865
2	Z2L1	Hotel vital	1.12														
	Z2L2	Hotel non-vital	0.48														
		Total Hotel Load	1.60	Inverter		2.65	DC-AC	450	3404	9300	1	0.98	0.75	1.5	1	3.5	1,769
	Z2L3	Mission load	0.4	Converter DC-DC		0.41	DC-DC	1000	408	9300	1	0.98	0.9	2	2	0.9	408
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
			21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.65	202,640
				Rectifier AC-DC		25.22	AC-DC	9300	2712	6900	1	0.98	3.33	6.67	1	7.6	3,781
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	generators	25.00	DC	9300	2688		1	1	180	650	2	0.3	77
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	1	0.13	156
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				Disconnects	cross connect	12.00	DC	9300	1290		1	1	180	650	2	0.1	37
														TOTAL ZONE 2		467.3	245,795
3	Z3L1	Hotel vital	1.36														
	Z3L2	Hotel non-vital	0.24														
		Total Hotel Load	1.60	Inverter		2.45	DC-AC	450	3142	9300	1	0.98	0.75	1.5	1	3.3	1,633
	Z3L3	Mission load	0.4	Converter DC-DC		0.41	DC-DC	1000	408	9300	1	0.98	0.9	2	2	0.9	408
		Power Generation	21	LM2500 High Speed GTG		25.74	AC	6900	2153		0.85	0.96	0.07	0.127	1	367.65	202,640
				Rectifier AC-DC		25.22	AC-DC	9300	2712	6900	1	0.98	3.33	6.67	1	7.6	3,781
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	25.00	DC	9300	2688		1	1	180	650	2	0.3	77
				240 Hz Breakers	generators	25.00	AC	6900	2092		1	1	200	160	1	0.13	156
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	4	0.1	100
				Disconnects	cross connect	12.00	DC	9300	1290		1	1	180	650	2	0.1	37
														TOTAL ZONE 3		380.7	209,025
4	Z4L1	Hotel vital	0.68														
	Z4L2	Hotel non-vital	0.12														
		Total Hotel Load	0.80	Inverter		2.45	DC-AC	450	3142	9300	1	0.98	0.75	1.5	1	3.3	1,633
		Propulsion Load	17.5	Motor		21.45	AC	6900	1794	6900	0.85	0.96					
				VSD		21.88	DC-AC	6900	1831	9300	1	0.98	1.4	3.2	1	15.6	6,839
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.04	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.44	720
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	mission bus	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				60 Hz Breakers	LV bus	5.00	AC	450	6415		1	1	250	200	2	0.0	50
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
														TOTAL ZONE 4		90.3	38,502
														GRAND TOTAL		1,013.1	525,186
ALL				Cable	misison bus	6.00	DC	9300	645								2,809
				Cable	propulsion bus	33.00	DC	9300	3548								4,126
				Cable	LV bus	5.00	AC	450	6415								17,280
				Cable	cross connect	12.00	DC	9300	1290								413
														Total Cable Weight			24,627
														Total Weight Including Cable			549,813

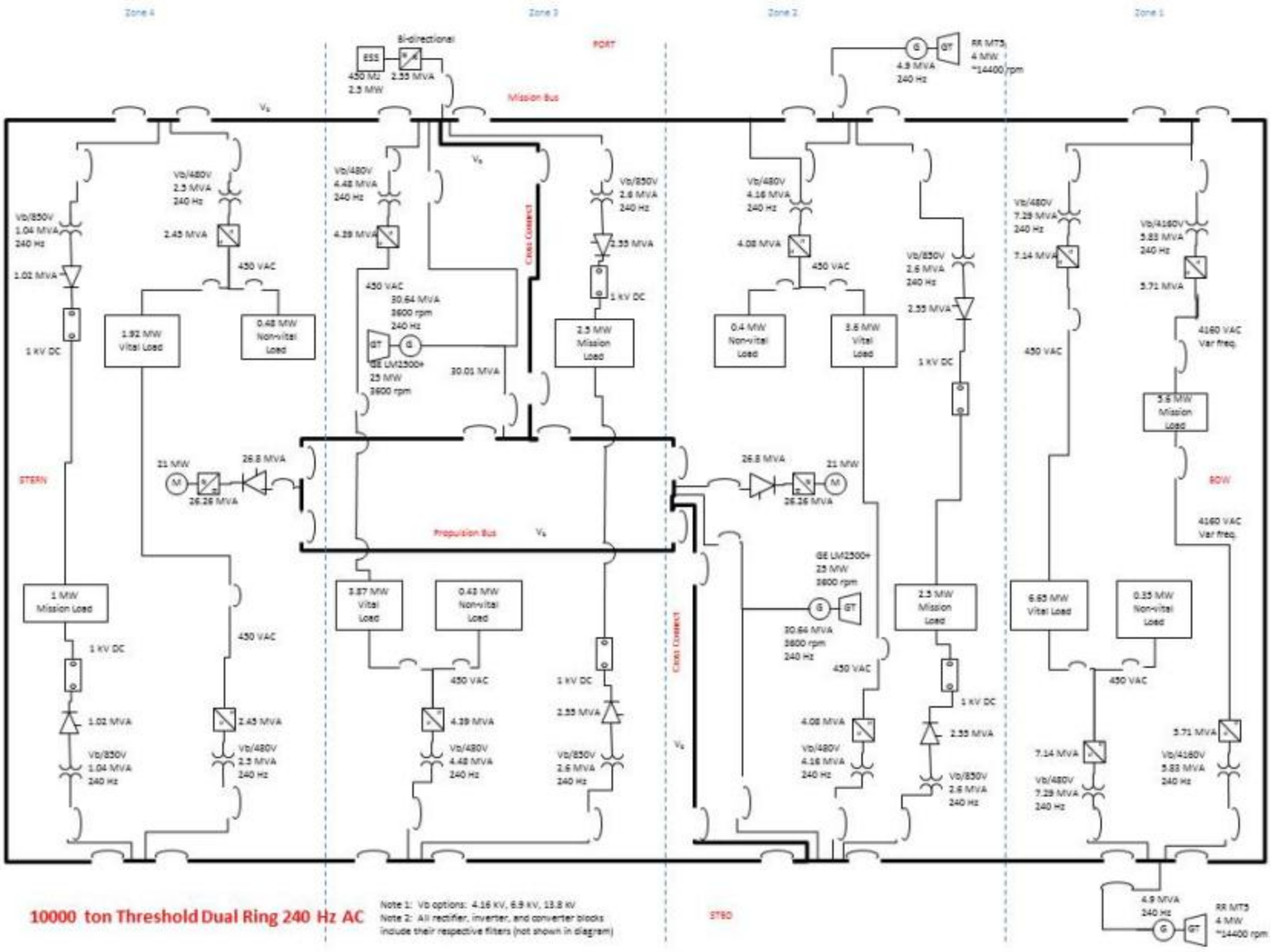
Total GTG Weight	492,297
Total PCM Weight	31,224
Total Breaker/Disconnect Weight	1,665
Total Cable Weight	24,627
Total Weight	549,813


Zone 4
Zone 3
Zone 2
Zone 1
Bi-directional
ESS
450 MJ
2.5 MW
2.55 MVA
PORT
Mission Bus
Vb
Vb/850V
1.04 MVA
60 Hz
1.02 MVA
1 kV DC
Vb/480V
2.45 MVA
60 Hz
450 VAC
1.92 MW
Vital Load
0.48 MW
Non-vital
Load
Vb/480V
4.39 MVA
60 Hz
450 VAC
30.64 MVA
3600 rpm
60 Hz
GT
G
GE LM2500+
25 MW
3600 rpm
Cross Connect
Vb/850V
2.6 MVA
60 Hz
2.55 MVA
1 kV DC
2.5 MW
Mission
Load
4.9 MVA
60 Hz
RR MT5
4 MW
Vb/480V
4.08 MVA
60 Hz
450 VAC
0.4 MW
Non-vital
Load
3.8 MW
Vital
Load
Vb/850V
2.6 MVA
60 Hz
2.55 MVA
1 kV DC
Vb/480V
7.14 MVA
60 Hz
Vb/4160V
5.83 MVA
60 Hz
5.71 MVA
4160 VAC
Var freq.
450 VAC
3.8 MW
Mission
Load
STERN
21 MW
26.8 MVA
26.26 MVA
Propulsion Bus
BOW
4160 VAC
Var freq.
1 MW
Mission Load
1 kV DC
1.02 MVA
Vb/850V
1.04 MVA
60 Hz
450 VAC
Vb/480V
2.45 MVA
60 Hz
3.87 MW
Vital
Load
0.43 MW
Non-vital
Load
450 VAC
Vb/480V
4.39 MVA
60 Hz
1 kV DC
2.55 MVA
Vb/850V
2.6 MVA
60 Hz
Cross Connect
Vb
26.8 MVA
21 MW
26.26 MVA
GE LM2500+
25 MW
3600 rpm
30.64 MVA
3600 rpm
60 Hz
2.5 MW
Mission
Load
450 VAC
1 kV DC
2.55 MVA
Vb/480V
4.08 MVA
60 Hz
Vb/850V
2.6 MVA
60 Hz
6.65 MW
Vital Load
0.35 MW
Non-vital
Load
450 VAC
5.71 MVA
Vb/4160V
5.83 MVA
60 Hz
Vb/480V
7.14 MVA
60 Hz
4.9 MVA
60 Hz
RR MT5
4 MW
10000 ton Threshold Dual Ring 60 Hz AC
Note 1: Vb options: 4.16 kV, 6.9 kV, 13.8 kV
Note 2: All rectifier, inverter, and converter blocks
include their respective filters (not shown in diagram)
STBD

10,000 ton ship - "Threshold 60 Hz Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	Transformer		7.14	AC	450	9164	6900	1	0.98	0.44	0.6	2	32.5	23,810
	Z1L3	Mission load	5.6	Converter VFD AC-AC		5.71	AC	4160	793	4160	1	0.98	1.35	2.25	2	8.5	5,079
				Transformer		5.83	AC	4160	809	6900	1	0.98	0.44	0.6	2	26.5	19,436
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
														TOTAL ZONE 1		182.1	97,159
2	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	Transformer		4.08	AC	450	5237	6900	1	0.98	0.44	0.6	2	18.6	13,605
	Z2L3	Mission load	2.5	60 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	0.5	1	2	10.0	5,000
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	3806	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
			25	LM2500+ GTG		30.64	AC	6900	2564		0.85	0.96	0.186	0.326	1	164.7	93,979
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 2		348.7	183,939
3	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	Transformer		4.39	AC	450	5629	6900	1	0.98	0.44	0.6	2	19.9	14,626
	Z3L3	Mission load	2.5	60 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	0.5	1	2	10.0	5,000
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Power Generation	25	LM2500+ GTG		30.64	AC	6900	2564		0.85	0.96	0.186	0.326	1	164.7	93,979
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		209.2	124,552
4	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	Transformer		2.45	AC	450	3142	6900	1	0.98	0.44	0.6	2	11.1	8,163
	Z4L3	Mission load	1	60 Hz Filter		1.00	AC-DC	1000	1000	740	1	1	0.5	1	2	4.0	2,000
				Rectifier AC-DC		1.02	AC-DC	1000	1020	740	1	0.98	3.33	6.67	2	0.6	306
				Transformer		1.04	AC	740	812	6900	1	0.98	0.44	0.6	2	4.7	3,471
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	3806	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
														TOTAL ZONE 4		48.2	27,339
														GRAND TOTAL		788.2	432,988
ALL				Cable	mission bus	29.00	AC	6900	2427								32,004
				Cable	propulsion bus	33.00	AC	6900	2761								8,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			40,485
														Total Weight Including Cable			473,474

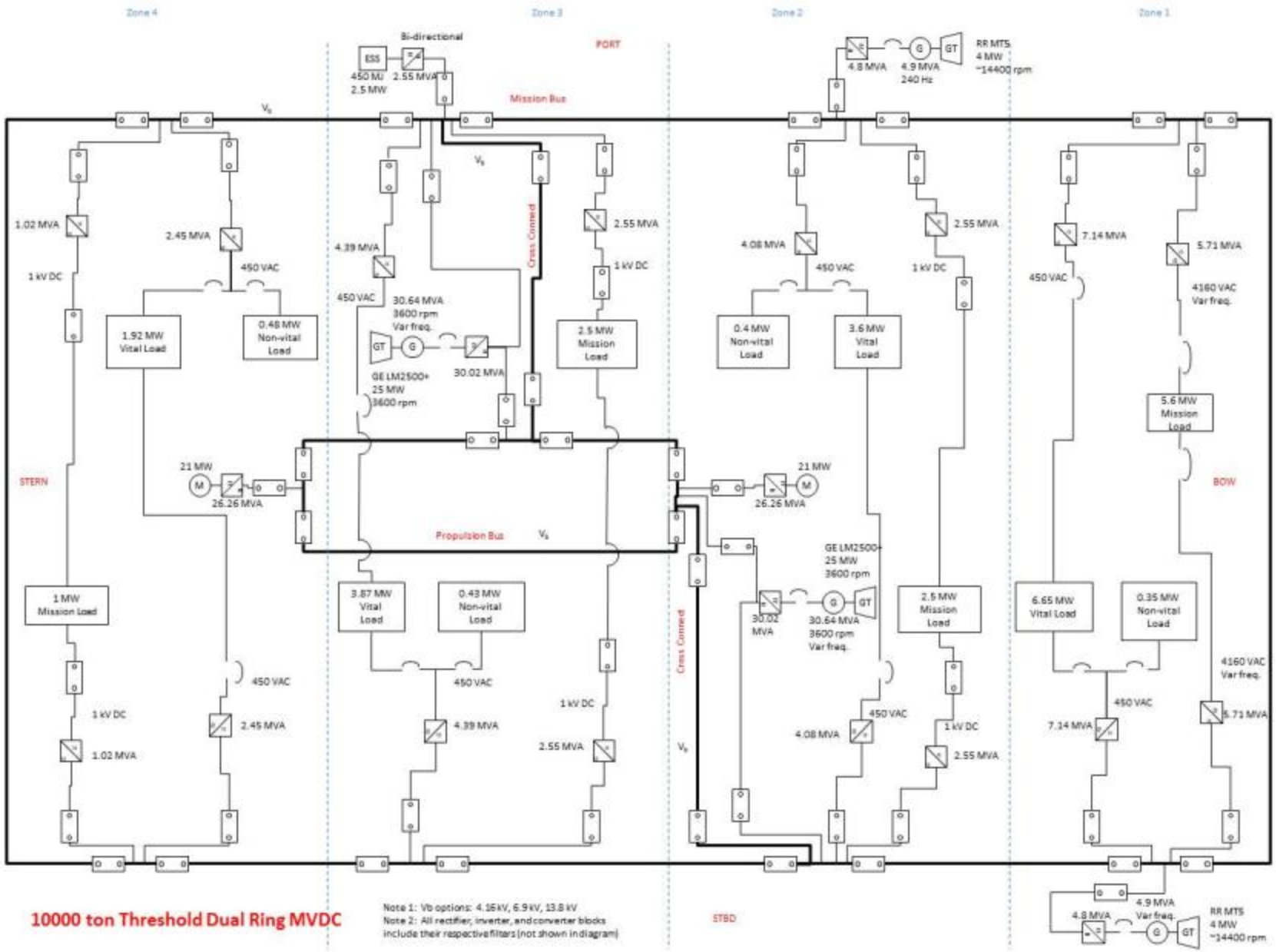
Total GTG Weight	284,075
Total PCM Weight	143,828
Total Breaker/Disconnect Weight	5,085
Total Cable Weight	40,485
Total Weight	473,474


Zone 4
Zone 3
Zone 2
Zone 1
Bi-directional
ESS
450 Mz
2.5 MW
2.55 MVA
PORT
Mission Bus
RR MT5
4 MW
*14400 rpm
4.9 MVA
240 Hz
Vb/480V
2.5 MVA
240 Hz
Vb/850V
1.04 MVA
240 Hz
1.02 MVA
1 kV DC
2.45 MVA
450 VAC
1.92 MW
Vital Load
0.48 MW
Non-vital
Load
Vb/480V
4.48 MVA
240 Hz
4.39 MVA
450 VAC
30.64 MVA
3600 rpm
240 Hz
GE LM2500+
25 MW
3600 rpm
30.01 MVA
Vb/850V
2.6 MVA
240 Hz
2.55 MVA
1 kV DC
2.5 MW
Mission
Load
Cross Connect
Vb/480V
4.16 MVA
240 Hz
4.08 MVA
450 VAC
0.4 MW
Non-vital
Load
3.6 MW
Vital
Load
Vb/850V
2.6 MVA
240 Hz
2.55 MVA
1 kV DC
Vb/480V
7.29 MVA
240 Hz
7.14 MVA
450 VAC
Vb/4160V
5.83 MVA
240 Hz
5.71 MVA
4160 VAC
Var freq.
3.6 MW
Mission
Load
STERN
21 MW
26.8 MVA
26.26 MVA
Propulsion Bus
BOW
4160 VAC
Var freq.
1 MW
Mission Load
1 kV DC
1.02 MVA
Vb/850V
1.04 MVA
240 Hz
450 VAC
2.45 MVA
Vb/480V
2.5 MVA
240 Hz
3.87 MW
Vital
Load
0.43 MW
Non-vital
Load
450 VAC
4.39 MVA
Vb/480V
4.48 MVA
240 Hz
1 kV DC
2.55 MVA
Vb/850V
2.6 MVA
240 Hz
Cross Connect
GE LM2500+
25 MW
3600 rpm
30.64 MVA
3600 rpm
240 Hz
450 VAC
4.08 MVA
Vb/480V
4.16 MVA
240 Hz
2.5 MW
Mission
Load
1 kV DC
2.55 MVA
Vb/850V
2.6 MVA
240 Hz
6.65 MW
Vital Load
0.35 MW
Non-vital
Load
450 VAC
7.14 MVA
Vb/480V
7.29 MVA
240 Hz
5.71 MVA
Vb/4160V
5.83 MVA
240 Hz
4.9 MVA
240 Hz
RR MT5
4 MW
*14400 rpm
10000 ton Threshold Dual Ring 240 Hz AC
Note 1: Vb options: 4.16 KV, 6.9 KV, 13.8 kV
Note 2: All rectifier, inverter, and converter blocks
include their respective filters (not shown in diagram)
STBD

10,000 ton ship - "Threshold 240 Hz Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	240 Hz Filter		7.00	AC	450	8981	480	1	1	1	1.75	2	14.0	8,000
				Converter AC-AC		7.14	AC	450	9164	480	1	0.98	1.35	2.25	2	10.6	6,349
				Transformer		7.29	AC	480	8767	6900	1	0.98	0.44	0.6	2	33.1	24,295
	Z1L3	Mission load	5.6	Converter VFD AC-AC		5.71	AC	4160	793	4160	1	0.98	1.35	2.25	2	8.5	5,079
				Transformer		5.83	AC	4160	809	6900	1	0.98	0.44	0.6	2	26.5	19,436
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
														TOTAL ZONE 1		148.5	85,135
2	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	240 Hz Filter		4.00	AC	450	5132	480	1	1	1	1.75	2	8.0	4,571
				Converter AC-AC		4.08	AC	450	5237	480	1	0.98	1.35	2.25	2	6.0	3,628
				Transformer		4.16	AC	480	5010	6900	1	0.98	0.44	0.6	2	18.9	13,883
	Z2L3	Mission load	2.5	240 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	1	1.75	2	5.0	2,857
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	1000	26796	6900	1	0.98	3.33	6.67	1	8.0	4,017
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 2		215.9	115,104
3	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	240 Hz Filter		4.30	AC	450	5517	480	1	1	1	1.75	2	8.6	4,914
				Converter AC-AC		4.39	AC	450	5629	480	1	0.98	1.35	2.25	2	6.5	3,900
				Transformer		4.48	AC	480	5385	6900	1	0.98	0.44	0.6	2	20.4	14,924
	Z3L3	Mission load	2.5	240 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	1	1.75	2	5.0	2,857
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Power Generation	25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		121.8	75,031
4	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	240 Hz Filter		2.40	AC	450	3079	480	1	1	1	1.75	2	4.8	2,743
				Converter AC-AC		2.45	AC	450	3142	480	1	0.98	1.35	2.25	2	3.6	2,177
				Transformer		2.50	AC	480	3006	6900	1	0.98	0.44	0.6	2	11.4	8,330
	Z4L3	Mission load	1	240 Hz Filter		1.00	AC-DC	1000	1000	740	1	1	1	1.75	2	2.0	1,143
				Rectifier AC-DC		1.02	AC-DC	1000	1020	740	1	0.98	3.33	6.67	2	0.6	306
				Transformer		1.04	AC	740	812	6900	1	0.98	0.44	0.6	2	4.7	3,471
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
														TOTAL ZONE 4		50.3	29,119
														GRAND TOTAL		536.5	304,389
ALL				Cable	mission bus	29.00	AC	6900	2427								32,004
				Cable	propulsion bus	33.00	AC	6900	2761								8,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			40,485
														Total Weight Including Cable			344,874

Total GTG Weight	142,064
Total PCM Weight	176,197
Total Breaker/Disconnect Weight	6,356
Total Cable Weight	40,485
Total Weight	365,102



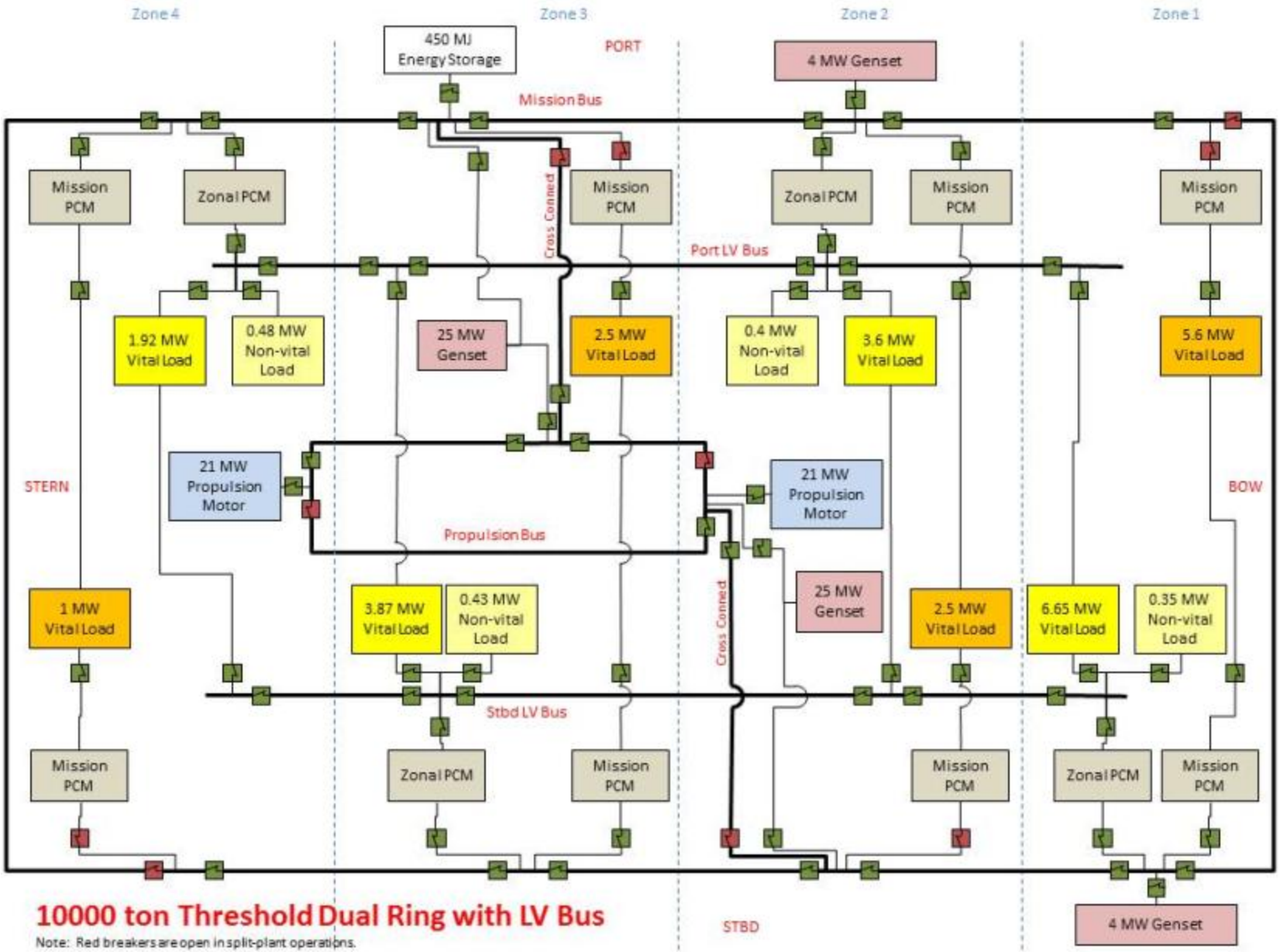
10000 ton Threshold Dual Ring MVDC

Note 1: Vb options: 4.16 kV, 6.9 kV, 13.8 kV
Note 2: All rectifier, inverter, and converter blocks include their respective filters (not shown in diagram)

10,000 ton ship - "Threshold dc Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	Inverter		7.14	DC-AC	450	9164	9300	1	0.98	0.75	1.5	2	19.0	9,524
	Z1L3	Mission load	5.6	Converter VFD DC-AC		5.71	DC-AC	4160	793	9300	1	0.98	1.4	3.2	2	8.2	3,571
1		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.03	8
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
														TOTAL ZONE 1		98.6	43,091
	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	Inverter		4.08	DC-AC	450	5237	9300	1	0.98	0.75	1.5	2	10.9	5,442
	Z2L3	Mission load	2.5	Converter DC-DC		2.55	DC-DC	1000	2551	9300	1	0.98	0.9	2	2	5.7	2,551
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
2			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				Rectifier AC-DC		30.02	AC-DC	9300	3228	6900	1	0.98	3.33	6.67	1	9.0	4,501
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.18	219
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 2		191.9	93,205
	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	Inverter		4.39	DC-AC	450	5629	9300	1	0.98	0.75	1.5	2	11.7	5,850
	Z3L3	Mission load	2.5	Converter DC-DC		2.55	DC-DC	1000	2551	9300	1	0.98	0.9	2	2	5.7	2,551
			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				Rectifier AC-DC		30.02	AC-DC	9300	3228	6900	1	0.98	3.33	6.67	1	9.0	4,501
3																	
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.18	219
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 3		103.3	55,611
	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	Inverter		2.45	DC-AC	450	3142	9300	1	0.98	0.75	1.5	2	6.5	3,265
	Z4L3	Mission load	1	Converter DC-DC		1.02	DC-DC	1000	1020	9300	1	0.98	0.9	2	2	2.3	1,020
4		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
														TOTAL ZONE 4		28.9	12,854
														GRAND TOTAL		422.7	204,760
				Cable	mission bus	29.00	DC	9300	3118								20,629
ALL				Cable	propulsion bus	33.00	DC	9300	3548								5,157
				Cable	cross connect	8.00	DC	9300	860								309
														Total Cable Weight			26,096
														Total Weight Including Cable			230,856

Total GTG Weight	142,064
Total PCM Weight	60,632
Total Breaker/Disconnect Weight	2,065
Total Cable Weight	26,096
Total Weight	230,856



10000 ton Threshold Dual Ring with LV Bus

Note: Red breakers are open in split-plant operations.

10,000 ton ship - "Threshold 60 Hz Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	Transformer		11.22	AC	450	14401	6900	1	0.98	0.44	0.6	2	51.0	37,415
	Z1L3	Mission load	5.6	Converter VFD AC-AC		5.71	AC	4160	793	4160	1	0.98	1.35	2.25	2	8.5	5,079
				Transformer		5.83	AC	4160	809	6900	1	0.98	0.44	0.6	2	26.5	19,436
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	2	0.1	150
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
														TOTAL ZONE 1		200.7	110,914
2	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	Transformer		11.22	AC	450	14401	6900	1	0.98	0.44	0.6	2	51.0	37,415
	Z2L3	Mission load	2.5	60 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	0.5	1	2	10.0	5,000
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
			25	LM2500+ GTG		30.64	AC	6900	2564		0.85	0.96	0.186	0.326	1	164.7	93,979
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	4	0.2	300
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 2		381.4	208,048
3	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	Transformer		6.84	AC	450	8772	6900	1	0.98	0.44	0.6	2	31.1	22,789
	Z3L3	Mission load	2.5	60 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	0.5	1	2	10.0	5,000
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Power Generation	25	LM2500+ GTG		30.64	AC	6900	2564		0.85	0.96	0.186	0.326	1	164.7	93,979
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	4	0.1	150
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		220.5	132,865
4	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	Transformer		6.84	AC	450	8772	6900	1	0.98	0.44	0.6	2	31.1	22,789
	Z4L3	Mission load	1	60 Hz Filter		1.00	AC-DC	1000	1000	740	1	1	0.5	1	2	4.0	2,000
				Rectifier AC-DC		1.02	AC-DC	1000	1020	740	1	0.98	3.33	6.67	2	0.6	306
				Transformer		1.04	AC	740	812	6900	1	0.98	0.44	0.6	2	4.7	3,471
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	25.00	AC	6900	2092		1	1	250	200	1	0.1	125
				60 Hz Breakers	mission bus	30.00	AC	6900	2510		1	1	250	200	4	0.5	600
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	2	0.1	75
				60 Hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
														TOTAL ZONE 4		68.2	42,040
														GRAND TOTAL		870.9	493,868
ALL				Cable	mission bus	29.00	AC	6900	2427								32,004
				Cable	LV Bus	15.00	AC	450	19245								64,800
				Cable	propulsion bus	33.00	AC	6900	2761								8,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			105,285
														Total Weight Including Cable			599,153

Total GTG Weight	284,075
Total PCM Weight	204,032
Total Breaker/Disconnect Weight	5,760
Total Cable Weight	105,285
Total Weight	599,153

10,000 ton ship - "Threshold 240 Hz Dual Ring LV Bus" variant

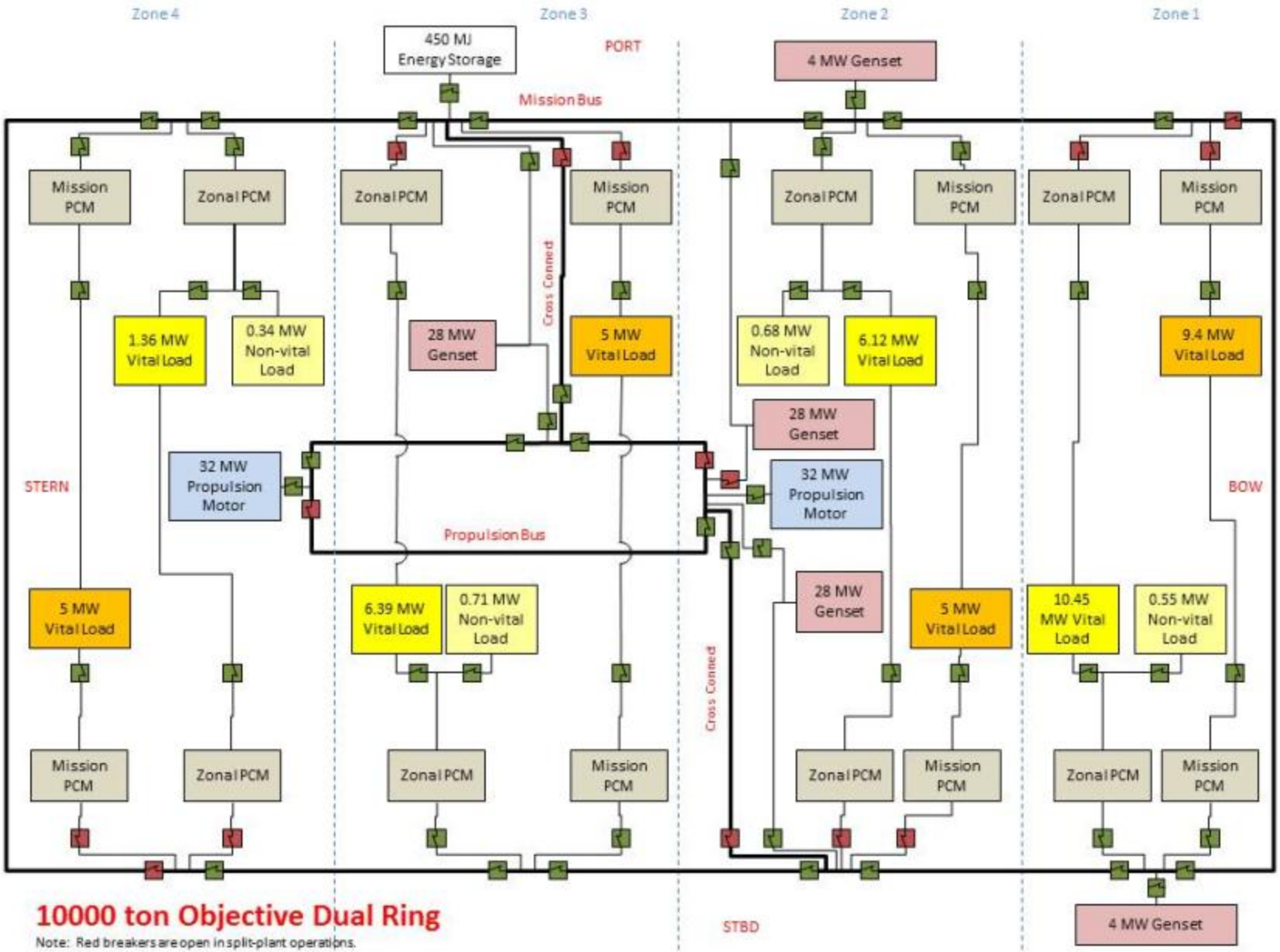
ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	240 Hz Filter		11.00	AC	450	14113	480	1	1	1	1.75	2	22.0	12,571
				Converter AC-AC		11.22	AC	450	14401	480	1	0.98	1.35	2.25	2	16.6	9,977
				Transformer		11.45	AC	480	13776	6900	1	0.98	0.44	0.6	2	52.1	38,179
	Z1L3	Mission load	5.6	Converter VFD AC-AC		5.71	AC	4160	793	4160	1	0.98	1.35	2.25	2	8.5	5,079
				Transformer		5.83	AC	4160	809	6900	1	0.98	0.44	0.6	2	26.5	19,436
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	2	0.1	150
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
														TOTAL ZONE 1		173.6	102,796
2	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	240 Hz Filter		11.00	AC	450	14113	480	1	1	1	1.75	2	22.0	12,571
				Converter AC-AC		11.22	AC	450	14401	480	1	0.98	1.35	2.25	2	16.6	9,977
				Transformer		11.45	AC	480	13776	6900	1	0.98	0.44	0.6	2	52.1	38,179
	Z2L3	Mission load	2.5	240 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	1	1.75	2	5.0	2,857
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	1000	26796	6900	1	0.98	3.33	6.67	1	8.0	4,017
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	4	0.2	300
				240 hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 2		259.9	146,048
3	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	240 Hz Filter		6.70	AC	450	8596	480	1	1	1	1.75	2	13.4	7,657
				Converter AC-AC		6.84	AC	450	8772	480	1	0.98	1.35	2.25	2	10.1	6,077
				Transformer		6.98	AC	480	8391	6900	1	0.98	0.44	0.6	2	31.7	23,254
	Z3L3	Mission load	2.5	240 Hz Filter		2.50	AC-DC	1000	2500	740	1	1	1	1.75	2	5.0	2,857
				Rectifier AC-DC		2.55	AC-DC	1000	2551	740	1	0.98	3.33	6.67	2	1.5	765
				Transformer		2.60	AC	740	2031	6900	1	0.98	0.44	0.6	2	11.8	8,677
		Power Generation	25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	4	0.1	150
				240 hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		136.9	85,688
4	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	240 Hz Filter		6.70	AC	450	8596	480	1	1	1	1.75	2	13.4	7,657
				Converter AC-AC		6.84	AC	450	8772	480	1	0.98	1.35	2.25	2	10.1	6,077
				Transformer		6.98	AC	480	8391	6900	1	0.98	0.44	0.6	2	31.7	23,254
	Z4L3	Mission load	1	240 Hz Filter		1.00	AC-DC	1000	1000	740	1	1	1	1.75	2	2.0	1,143
				Rectifier AC-DC		1.02	AC-DC	1000	1020	740	1	0.98	3.33	6.67	2	0.6	306
				Transformer		1.04	AC	740	812	6900	1	0.98	0.44	0.6	2	4.7	3,471
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Rectifier AC-DC		26.80	AC-DC	9300	2881	6900	1	0.98	3.33	6.67	1	8.0	4,017
				240 hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 hz Breakers	propulsion	25.00	AC	6900	2092		1	1	200	160	1	0.1	156
				240 hz Breakers	mission bus	30.00	AC	6900	2510		1	1	200	160	4	0.6	750
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	2	0.1	75
				240 hz Breakers	propulsion bus	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
														TOTAL ZONE 4		77.2	48,019
														GRAND TOTAL		647.6	382,551
ALL				Cable	mission bus	29.00	AC	6900	2427								32,004
				Cable	LV Bus	15.00	AC	450	19245								64,800
				Cable	propulsion bus	33.00	AC	6900	2761								8,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			105,285
														Total Weight Including Cable			487,836

Total GTG Weight	142,064
Total PCM Weight	273,913
Total Breaker/Disconnect Weight	7,031
Total Cable Weight	105,285
Total Weight	528,293

10,000 ton ship - "Threshold dc Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	6.65														
	Z1L2	Hotel non-vital	0.35														
		Total Hotel Load	7.00	Inverter		11.22	DC-AC	450	14401	9300	1	0.98	0.75	1.5	2	29.9	14,966
	Z1L3	Mission load	5.6	Converter VFD DC-AC		5.71	DC-AC	4160	793	9300	1	0.98	1.4	3.2	2	8.2	3,571
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.03	8
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	2	0.1	150
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
														TOTAL ZONE 1		109.6	48,683
2	Z2L1	Hotel vital	3.6														
	Z2L2	Hotel non-vital	0.4														
		Total Hotel Load	4.00	Inverter		11.22	DC-AC	450	14401	9300	1	0.98	0.75	1.5	2	29.9	14,966
	Z2L3	Mission load	2.5	Converter DC-DC		2.55	DC-DC	1000	2551	9300	1	0.98	0.9	2	2	5.7	2,551
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				Rectifier AC-DC		30.02	AC-DC	9300	3228	6900	1	0.98	3.33	6.67	1	9.0	4,501
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.18	219
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				60 Hz Breakers	LV bus	15.00	AC	450	19245		1	1	250	200	4	0.2	300
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 2		211.2	103,029
3	Z3L1	Hotel vital	3.87														
	Z3L2	Hotel non-vital	0.43														
		Total Hotel Load	4.30	Inverter		6.84	DC-AC	450	8772	9300	1	0.98	0.75	1.5	2	18.2	9,116
	Z3L3	Mission load	2.5	Converter DC-DC		2.55	DC-DC	1000	2551	9300	1	0.98	0.9	2	2	5.7	2,551
			25	LM2500+ High Speed GTG		30.64	AC	6900	2564		0.85	0.96	0.408	0.729	1	75.1	42,026
				Rectifier AC-DC		30.02	AC-DC	9300	3228	6900	1	0.98	3.33	6.67	1	9.0	4,501
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.18	219
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	4	0.1	150
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 3		110.0	59,026
4	Z4L1	Hotel vital	1.92														
	Z4L2	Hotel non-vital	0.48														
		Total Hotel Load	2.40	Inverter		6.84	DC-AC	450	8772	9300	1	0.98	0.75	1.5	2	18.2	9,116
	Z4L3	Mission load	1	Converter DC-DC		1.02	DC-DC	1000	1020	9300	1	0.98	0.9	2	2	2.3	1,020
		Propulsion Load	21	Motor		25.74	AC	6900	2153	6900	0.85	0.96					
				VSD		26.26	DC-AC	6900	2197	9300	1	0.98	1.4	3.2	1	18.8	8,206
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	25.00	DC	9300	2688		1	1	180	650	1	0.1	38
				Disconnects	mission bus	30.00	DC	9300	3226		1	1	180	650	4	0.7	185
				60 Hz Breakers	LV bus	7.50	AC	450	9623		1	1	250	200	2	0.1	75
				Disconnects	propulsion bus	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
														TOTAL ZONE 4		40.6	18,779
														GRAND TOTAL		471.4	229,517
ALL				Cable	mission bus	29.00	DC	9300	3118								20,629
				Cable	LV Bus	15.00	AC	450	19245								64,800
				Cable	propulsion bus	33.00	DC	9300	3548								5,157
				Cable	cross connect	8.00	DC	9300	860								309
														Total Cable Weight			90,896
														Total Weight Including Cable			320,413

Total GTG Weight	142,064
Total PCM Weight	84,713
Total Breaker/Disconnect Weight	2,740
Total Cable Weight	90,896
Total Weight	320,413



10000 ton Objective Dual Ring

Note: Red breakers are open in split-plant operations.

10,000 ton ship - "Objective 60 Hz Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	Transformer		11.22	AC	450	14401	6900	1	0.98	0.44	0.6	2	51.0	37,415
	Z1L3	Mission load	9.4	Converter VFD AC-AC		9.59	AC	4160	1331	4160	1	0.98	1.35	2.25	2	14.2	8,526
				Transformer		9.79	AC	4160	1358	6900	1	0.98	0.44	0.6	2	44.5	32,625
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	15.00	AC	6900	1255		1	1	250	200	4	0.2	300
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
														TOTAL ZONE 1		224.6	127,770
2	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	Transformer		6.94	AC	450	8902	6900	1	0.98	0.44	0.6	2	31.5	23,129
	Z2L3	Mission load	5	60 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	5799	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
			28	LM2500+G4 GTG		34.31	AC	6900	2871		0.85	0.96	0.191	0.354	2	359.3	193,863
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	250	200	1	0.1	175
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	4	0.6	700
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 2		594.3	314,871
3	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	Transformer		7.24	AC	450	9295	6900	1	0.98	0.44	0.6	2	32.9	24,150
	Z3L3	Mission load	5	60 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Power Generation	28	LM2500+G4 GTG		34.31	AC	6900	2871		0.85	0.96	0.191	0.354	1	179.7	96,931
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		260.7	151,750
4	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	Transformer		1.73	AC	450	2226	6900	1	0.98	0.44	0.6	2	7.9	5,782
	Z4L3	Mission load	5	60 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	5799	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	250	200	1	0.1	175
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
														TOTAL ZONE 4		96.6	54,748
														GRAND TOTAL		1,176.3	649,139
				Cable	mission bus	41.00	AC	6900	3431								40,005
ALL				Cable	propulsion bus	36.00	AC	6900	3012								10,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			50,486
														Total Weight Including Cable			699,625

Total GTG Weight	386,911
Total PCM Weight	255,532
Total Breaker/Disconnect Weight	6,695
Total Cable Weight	50,486
Total Weight	699,625

10,000 ton ship - "Objective 240 Hz Dual Ring" variant

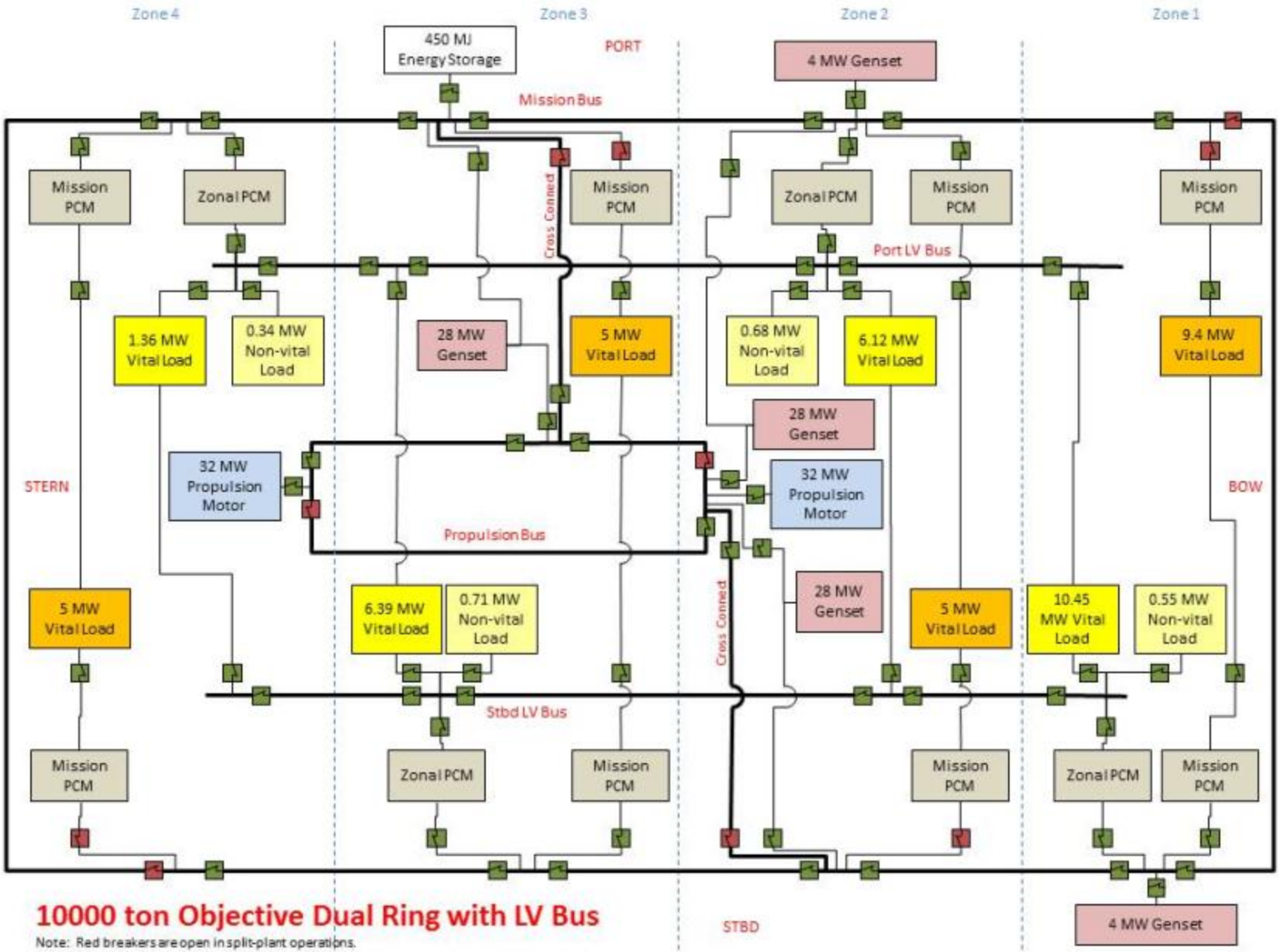
ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	240 Hz Filter		11.00	AC	450	14113	480	1	1	1	1.75	2	22.0	12,571
				Converter AC-AC		11.22	AC	450	14401	480	1	0.98	1.35	2.25	2	16.6	9,977
				Transformer		11.45	AC	480	13776	6900	1	0.98	0.44	0.6	2	52.1	38,179
	Z1L3	Mission load	9.4	Converter VFD AC-AC		9.59	AC	4160	1331	4160	1	0.98	1.35	2.25	2	14.2	8,526
				Transformer		9.79	AC	4160	1358	4160	1	0.98	0.44	0.6	2	44.5	32,625
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 Hz Breakers	loads	15.00	AC	6900	1255		1	1	200	160	4	0.3	375
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
														TOTAL ZONE 1		197.6	119,744
2	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	240 Hz Filter		6.80	AC	450	8724	480	1	1	1	1.75	2	13.6	7,771
				Converter AC-AC		6.94	AC	450	8902	480	1	0.98	1.35	2.25	2	10.3	6,168
				Transformer		7.08	AC	480	8516	6900	1	0.98	0.44	0.6	2	32.2	23,601
	Z2L3	Mission load	5	240 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	1000	40833	6900	1	0.98	3.33	6.67	1	12.3	6,122
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
			28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	2	160.0	89,011
				240 Hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	200	160	1	0.2	219
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	4	0.7	875
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 2		351.4	193,898
3	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	240 Hz Filter		7.10	AC	450	9109	480	1	1	1	1.75	2	14.2	8,114
				Converter AC-AC		7.24	AC	450	9295	480	1	0.98	1.35	2.25	2	10.7	6,440
				Transformer		7.39	AC	480	8892	6900	1	0.98	0.44	0.6	2	33.6	24,643
	Z3L3	Mission load	5	240 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Power Generation	28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	1	80.0	44,505
				240 Hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		162.8	102,417
4	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	240 Hz Filter		1.70	AC	450	2181	480	1	1	1	1.75	2	3.4	1,943
				Converter AC-AC		1.73	AC	450	2226	480	1	0.98	1.35	2.25	2	2.6	1,542
				Transformer		1.77	AC	480	2129	6900	1	0.98	0.44	0.6	2	8.0	5,900
	Z4L3	Mission load	5	240 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	200	160	1	0.2	219
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
														TOTAL ZONE 4		89.6	52,486
														GRAND TOTAL		801.4	468,545
ALL				Cable	mission bus	41.00	AC	6900	3431								40,005
				Cable	propulsion bus	36.00	AC	6900	3012								10,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			50,486
														Total Weight Including Cable			519,032

Total GTG Weight	191,528
Total PCM Weight	299,049
Total Breaker/Disconnect Weight	8,369
Total Cable Weight	50,486
Total Weight	549,432

10,000 ton ship - "Objective dc Dual Ring" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	Inverter		11.22	DC-AC	450	14401	9300	1	0.98	0.75	1.5	2	29.9	14,966
	Z1L3	Mission load	9.4	Converter VFD DC-AC		9.59	DC-AC	4160	1331	9300	1	0.98	1.4	3.2	2	13.7	5,995
1		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	15.00	DC	9300	1613		1	1	180	650	4	0.3	92
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.03	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
														TOTAL ZONE 1		115.4	51,070
	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	Inverter		6.94	DC-AC	450	8902	9300	1	0.98	0.75	1.5	2	18.5	9,252
	Z2L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
2			28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	2	160.0	89,011
				Rectifier AC-DC		33.63	AC-DC	9300	3616	6900	1	0.98	3.33	6.67	2	20.2	10,083
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion	35.00	DC	9300	3763		1	1	180	650	1	0.2	54
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	4	0.8	215
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.35	438
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 2		312.0	156,858
	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	Inverter		7.24	DC-AC	450	9295	9300	1	0.98	0.75	1.5	2	19.3	9,660
	Z3L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
		Power Generation	28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	1	80.0	44,505
3				Rectifier AC-DC		33.63	AC-DC	9300	3616	6900	1	0.98	3.33	6.67	1	10.1	5,042
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.18	219
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 3		122.9	65,077
	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	Inverter		1.73	DC-AC	450	2226	9300	1	0.98	0.75	1.5	2	4.6	2,313
	Z4L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
4		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	35.00	DC	9300	3763		1	1	180	650	1	0.2	54
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
														TOTAL ZONE 4		46.2	20,368
														GRAND TOTAL		596.5	293,373
ALL				Cable	mission bus	41.00	DC	9300	4409								25,786
				Cable	propulsion bus	36.00	DC	9300	3871								6,447
				Cable	cross connect	8.00	DC	9300	860								309
														Total Cable Weight			32,542
														Total Weight Including Cable			325,915

Total GTG Weight	191,528
Total PCM Weight	99,067
Total Breaker/Disconnect Weight	2,779
Total Cable Weight	32,542
Total Weight	325,915



10000 ton Objective Dual Ring with LV Bus

Note: Red breakers are open in split-plant operations.

10,000 ton ship - "Objective 60 Hz Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	Transformer		18.16	AC	450	23303	6900	1	0.98	0.44	0.6	1	41.3	30,272
	Z1L3	Mission load	9.4	Converter VFD AC-AC		9.59	AC	4160	1331	4160	1	0.98	1.35	2.25	2	14.2	8,526
				Transformer		9.79	AC	4160	1358	6900	1	0.98	0.44	0.6	2	44.5	32,625
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
				60 Hz Breakers	loads	15.00	AC	6900	1255		1	1	250	200	4	0.2	300
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
														TOTAL ZONE 1		215.1	120,827
2	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	Transformer		18.16	AC	450	23303	6900	1	0.98	0.44	0.6	1	41.3	30,272
	Z2L3	Mission load	5	60 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	5799	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
		Power Generation	4	RR4500 GTG		4.90	AC	6900	410		0.85	0.96	0.043	0.102	1	114.0	48,058
			28	LM2500+G4 GTG		34.31	AC	6900	2871		0.85	0.96	0.191	0.354	2	359.3	193,863
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	250	200	1	0.1	175
				60 Hz Breakers	generators	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	4	0.6	700
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 2		604.3	322,414
3	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	Transformer		8.98	AC	450	11521	6900	1	0.98	0.44	0.6	1	20.4	14,966
	Z3L3	Mission load	5	60 hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Power Generation	28	LM2500+G4 GTG		34.31	AC	6900	2871		0.85	0.96	0.191	0.354	1	179.7	96,931
				60 Hz Breakers	loads	7.50	AC	6900	628		1	1	250	200	4	0.1	150
				60 Hz Breakers	storage	5.00	AC	6900	418		1	1	250	200	1	0.0	25
				60 Hz Breakers	generators	35.00	AC	6900	2929		1	1	250	200	2	0.3	350
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
				60 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	250	200	2	0.1	80
														TOTAL ZONE 3		248.5	142,966
4	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	Transformer		8.98	AC	450	11521	6900	1	0.98	0.44	0.6	1	20.4	14,966
	Z4L3	Mission load	5	60 Hz Filter		5.00	AC-DC	1000	5000	740	1	1	0.5	1	2	20.0	10,000
				Rectifier AC-DC		5.10	AC-DC	1000	5102	740	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC	740	4062	6900	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	5799	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
				60 Hz Breakers	loads	5.00	AC	6900	418		1	1	250	200	4	0.1	100
				60 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	250	200	1	0.1	175
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				60 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	250	200	4	0.7	820
				60 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	250	200	2	0.3	360
														TOTAL ZONE 4		109.3	64,132
														GRAND TOTAL		1,177.2	650,339
ALL				Cable	mission bus	41.00	AC	6900	3431								40,005
				Cable	LV bus	20.00	AC	450	25660								86,400
				Cable	propulsion bus	36.00	AC	6900	3012								10,001
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			136,886
														Total Weight Including Cable			787,225

Total GTG Weight	386,911
Total PCM Weight	255,532
Total Breaker/Disconnect Weight	7,895
Total Cable Weight	136,886
Total Weight	787,225

10,000 ton ship - "Objective 240 Hz Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	240 Hz Filter		17.80	AC	450	22837	480	1	1	1	1.75	1	17.8	10,171
				Converter AC-AC		18.16	AC	450	23303	480	1	0.98	1.35	2.25	1	13.5	8,073
				Transformer		18.53	AC	480	22293	6900	1	0.98	0.44	0.6	1	42.1	30,890
	Z1L3	Mission load	9.4	Converter VFD AC-AC		9.59	AC	4160	1331	4160	1	0.98	1.35	2.25	2	14.2	8,526
				Transformer		9.79	AC	4160	1358	6900	1	0.98	0.44	0.6	2	44.5	32,625
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				240 Hz Breakers	loads	15.00	AC	6900	1255		1	1	200	160	4	0.3	375
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.03	31
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
														TOTAL ZONE 1		184.6	110,751
2	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	240 Hz Filter		17.80	AC	450	22837	480	1	1	1	1.75	1	17.8	10,171
				Converter AC-AC		18.16	AC	450	23303	480	1	0.98	1.35	2.25	1	13.5	8,073
				Transformer		18.53	AC	480	22293	6900	1	0.98	0.44	0.6	1	42.1	30,890
	Z2L3	Mission load	5	240 Hz Filter		5.00	AC-DC	1000	5000	1000	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	AC-DC	1000	5102	1000	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	DC	1000	5206	740	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	1000	40833	6900	1	0.98	3.33	6.67	1	12.3	6,122
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
			28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	2	160.0	89,011
				240 Hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	200	160	1	0.2	219
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	4	0.7	875
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 2		364.8	201,491
3	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	240 Hz Filter		8.80	AC	450	11290	450	1	1	1	1.75	1	8.8	5,029
				Converter AC-AC		8.98	AC	450	11521	450	1	0.98	1.35	2.25	1	6.7	3,991
				Transformer		9.16	AC	450	11756	480	1	0.98	0.44	0.6	1	20.8	15,271
	Z3L3	Mission load	5	240 Hz Filter		5.00	DC	1000	5000	1000	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	DC	1000	5102	1000	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC-DC	1000	5206	740	1	0.98	0.44	0.6	2	23.7	17,354
		Power Generation	28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	1	80.0	44,505
				240 Hz Breakers	loads	7.50	AC	6900	628		1	1	200	160	4	0.2	188
				240 Hz Breakers	storage	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
				240 Hz Breakers	cross connect	8.00	AC	6900	669		1	1	200	160	2	0.1	100
														TOTAL ZONE 3		146.3	90,997
4	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	240 Hz Filter		8.80	AC	450	11290	450	1	1	1	1.75	1	8.8	5,029
				Converter AC-AC		8.98	AC	450	11521	450	1	0.98	1.35	2.25	1	6.7	3,991
				Transformer		9.16	AC	450	11756	480	1	0.98	0.44	0.6	1	20.8	15,271
	Z4L3	Mission load	5	240 Hz Filter		5.00	DC	1000	5000	1000	1	1	1	1.75	2	10.0	5,714
				Rectifier AC-DC		5.10	DC	1000	5102	1000	1	0.98	3.33	6.67	2	3.1	1,530
				Transformer		5.21	AC-DC	1000	5206	740	1	0.98	0.44	0.6	2	23.7	17,354
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Rectifier AC-DC		40.83	AC-DC	9300	4391	6900	1	0.98	3.33	6.67	1	12.3	6,122
				240 Hz Breakers	loads	5.00	AC	6900	418		1	1	200	160	4	0.1	125
				240 Hz Breakers	propulsion	35.00	AC	6900	2929		1	1	200	160	1	0.2	219
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				240 Hz Breakers	mission bus	41.00	AC	6900	3431		1	1	200	160	4	0.8	1,025
				240 Hz Breakers	propulsion bus	36.00	AC	6900	3012		1	1	200	160	2	0.4	450
														TOTAL ZONE 4		106.7	64,506
														GRAND TOTAL		802.4	469,745
ALL				Cable	mission bus	41.00	AC	6900	3431								40,005
				Cable	porpulsion bus	36.00	AC	6900	3012								10,001
				Cable	LV bus	20.00	AC	450	25660								86,400
				Cable	cross connect	8.00	AC	6900	669								480
														Total Cable Weight			136,886
														Total Weight Including Cable			606,632

Total GTG Weight	191,528
Total PCM Weight	299,049
Total Breaker/Disconnect Weight	9,569
Total Cable Weight	136,886
Total Weight	637,032

10,000 ton ship - "Objective dc Dual Ring LV Bus" variant

ZONE	LOAD	Type	MW	Equipment	Use	MVA	Type	Output Volts	Output Current	Input Volts	PF	Assumed Efficiency	Assumed MVA/m3	Assumed kVA/kg	Quantity	Volume	Weight
								[V]	[A]	[V]			MVA/m3	kVA/kg		m^3	kg
1	Z1L1	Hotel vital	10.45														
	Z1L2	Hotel non-vital	0.55														
		Total Hotel Load	11.00	Inverter		18.16	DC-AC	450	23303	9300	1	0.98	0.75	1.5	1	24.2	12,109
	Z1L3	Mission load	9.4	Converter VFD DC-AC		9.59	DC-AC	4160	1331	9300	1	0.98	1.4	3.2	2	13.7	5,995
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
				Disconnects	loads	15.00	DC	9300	1613		1	1	180	650	4	0.3	92
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
														TOTAL ZONE 1		109.9	48,413
2	Z2L1	Hotel vital	6.12														
	Z2L2	Hotel non-vital	0.68														
		Total Hotel Load	6.80	Inverter		18.16	DC-AC	450	23303	9300	1	0.98	0.75	1.5	1	24.2	12,109
	Z2L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
		Power Generation	4	RR4500 High Speed GTG		4.90	AC	6900	410		0.85	0.96	0.071	0.169	1	69.0	29,006
				Rectifier AC-DC		4.80	AC-DC	9300	517	6900	1	0.98	3.33	6.67	1	1.4	720
			28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	2	160.0	89,011
				Rectifier AC-DC		33.63	AC-DC	9300	3616	6900	1	0.98	3.33	6.67	2	20.2	10,083
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	propulsion	35.00	DC	9300	3763		1	1	180	650	1	0.2	54
				Disconnects	generators	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				240 Hz Breakers	generators	5.00	AC	6900	418		1	1	200	160	1	0.0	31
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	4	0.8	215
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	2	0.4	438
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 2		318.1	160,115
3	Z3L1	Hotel vital	6.39														
	Z3L2	Hotel non-vital	0.71														
		Total Hotel Load	7.10	Inverter		8.98	DC-AC	450	11521	9300	1	0.98	0.75	1.5	1	12.0	5,986
	Z3L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
		Power Generation	28	LM2500+G4 High Speed GTG		34.31	AC	6900	2871		0.85	0.96	0.429	0.771	1	80.0	44,505
				Rectifier AC-DC		33.63	AC-DC	9300	3616	6900	1	0.98	3.33	6.67	1	10.1	5,042
				Disconnects	loads	7.50	DC	9300	806		1	1	180	650	4	0.2	46
				Disconnects	storage	5.00	DC	9300	538		1	1	180	650	1	0.0	8
				Disconnects	generators	35.00	DC	9300	3763		1	1	180	650	2	0.4	108
				240 Hz Breakers	generators	35.00	AC	6900	2929		1	1	200	160	1	0.2	219
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	4	0.3	400
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
				Disconnects	cross connect	8.00	DC	9300	860		1	1	180	650	2	0.1	25
														TOTAL ZONE 3		115.9	61,803
4	Z4L1	Hotel vital	1.36														
	Z4L2	Hotel non-vital	0.34														
		Total Hotel Load	1.70	Inverter		8.98	DC-AC	450	11521	9300	1	0.98	0.75	1.5	1	12.0	5,986
	Z4L3	Mission load	5	Converter DC-DC		5.10	DC-DC	1000	5102	9300	1	0.98	0.9	2	2	11.3	5,102
		Propulsion Load	32	Motor		39.22	AC	6900	3281	6900	0.85	0.96					
				VSD		40.02	DC-AC	6900	3348	9300	1	0.98	1.4	3.2	1	28.6	12,505
				Disconnects	loads	5.00	DC	9300	538		1	1	180	650	4	0.1	31
				Disconnects	propulsion	35.00	DC	9300	3763		1	1	180	650	1	0.2	54
				Disconnects	mission bus	41.00	DC	9300	4409		1	1	180	650	4	0.9	252
				60 Hz Breakers	LV bus	20.00	AC	450	25660		1	1	250	200	2	0.2	200
				Disconnects	propulsion bus	36.00	DC	9300	3871		1	1	180	650	2	0.4	111
														TOTAL ZONE 4		53.7	24,241
														GRAND TOTAL		597.5	294,573
ALL				Cable	mission bus	41.00	DC	9300	4409								25,786
				Cable	propulsion bus	36.00	DC	9300	3871								6,447
				Cable	cross connect	8.00	DC	9300	860								309
				Cable	LV Bus	20.00	AC	450	25660								86,400
														Total Cable Weight			118,942
														Total Weight Including Cable			413,515

Total GTG Weight	191,528
Total PCM Weight	99,067
Total Breaker/Disconnect Weight	3,979
Total Cable Weight	118,942
Total Weight	413,515