MSC Guidelines for Review of Electrical Load Analysis

Procedure Number: E2-6 Revision Date: 04/21/00

References

a. Title 46 CFR 111.10

b. International Electrotechnical Commission (IEC) 92-302, "Electrical Installations on Ships"

c. Navigation and Inspection Circular (NVIC) 2-89, "Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units", can be found at: http://www.uscg.mil/hq/g-m/nvic/2_89/n2-89.htm

d. Safety Of Life at Sea (SOLAS), Consolidated Editions, 1997, Chapter II-1, Part D

e. American Bureau of Shipping (ABS), "Rules for Building and Classing Vessels under 90 Meters in Length", 1997

f. MSC Procedure E2-8, "Emergency Generator and Switchboard"

Disclaimer

These guidelines were developed by the Marine Safety Center staff as an aid in the preparation and review of vessel plans and submissions. They were developed to supplement existing guidance. They are not intended to substitute or replace laws, regulations, or other official Coast Guard policy documents. The responsibility to demonstrate compliance with all applicable laws and regulations still rests with the plan submitter. The Coast Guard and the U. S. Department of Transportation expressly disclaim liability resulting from the use of this document.

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General Review Guidance

Note: Ship's service loads are defined as all auxiliary services necessary for maintaining the vessel in a normal operational and habitable condition.

- ❑ Verify that the emergency switchboard conforms to the general switchboard requirements of reference (a). See procedure E2-8 for guidance.

- Verify that there are two power-generating sources in addition to an emergency source. (46 CFR 111.70-3). Note: this requirement may not apply to smaller vessels, such as those covered under Subchapter K or T.

- Check to see if the generators can supply the ship's service loads. This should be demonstrated in the load analysis (required to be submitted by 46 CFR 110.25-1(b)). Electrical propulsion, drilling, cargo refrigeration and transfer are not included. See NVIC 2-89 for guidance. One must verify that:

  - The individual load factors are reasonable. Use Table 1, Appendix 2 of NVIC 2-89 for guidance. If the load factors are significantly lower that "typical", it could result in an undersized generator.

  - Two types of loads are generally listed on a load analysis. They are the "connected" load and the "computed" load. The "connected" load is the amount of KW the equipment draws when energized to full capacity. The "computed" load includes the "load factor". To get the computed load, multiply the "connected" load times the "load factor".

    - The "computed" load of a motor (in KW) is : (HP x .746)/Efficiency
    - The efficiency of power converters (rectifiers, transformers etc.) should be considered. Divide the total load side KW of the transformer /converter by the efficiency to obtain "connected" load.
    - On loads that have primary and standby units (e.g. steering pump #1/#2), a demand factor of 0 for the standby unit is acceptable.
    - Remotely operated emergency loads are assigned a demand factor of 1 (e.g fire pump).

  - With the largest power source off, the remaining power sources should be able to supply the loads associated with "normal operating conditions for propulsion, safety, and habitability". This includes cooking, heating, air conditioning, refrigeration, ventilation, sanitation and fresh water. (46 CFR 111.10-4 (b))

  - Loads vary with the operating conditions of the vessel. For instance, "normal sea load" would be different than "at anchor" or "maneuvering". Load analyses are typically submitted at "normal sea load", "maneuvering" and "emergency conditions". To determine ship's service generator requirements, pick the condition that results in the greatest demand.

- Speed or throttle changes in the ship's propulsion should not cause a power interruption (46 CFR 111.10-4 (d)). This applies to vessels whose power generating capability is tied in with their propulsion system.

  - If the vessel has two or more constant voltage generators that supply both the ship's service and propulsion loads, it doesn't need an additional generator as long as one of the constant voltage generators can supply the load when the other is not operating. (46 CFR 111.10-4 (e))

  - A generator driven off the main propulsion engine must provide continuous electric power regardless of vessel speed or throttle changes if it is to be considered one of the vessel's generating sets. This requirement is does not apply if the vessel can show that the other generator(s) will be automatically brought on line prior to the tripping of the main engine dependent generator. This is typically accomplished with throttle command delay. This delay maintains engine speed long enough to maintain power while the other generator comes up. Current office policy is this delay may be no longer than 10 - 15 seconds. (46 CFR 111.10-4 (f))

- Failure of any one generating set energy source (e.g. boiler, fuel cell) must not cause all of the generating sets to fail. (46 CFR 111.10-5).

- If transformers are used to supply the distribution system, then there must be at least two transformers. If one of the transformers goes down then the other(s) must be able to pass the ship's service loads. This applies to ships with medium voltage (e.g. 4.16 KV or lower) generator buses that are stepped down to low voltage (e.g. 480/277 V) distribution systems. This arrangement is typical for vessels that have electric propulsion. Low voltage transformers (e.g. 480D to 208/120) are not subject to this requirement.

- Compare the load factors for the vessel you are reviewing to existing data on this class of vessel. Adjust the load factors as necessary and attach to this procedure. These attachments will be used for future load analysis reviews.

Attachments:

NVIC 2-89, Appendix 2 Table 1, Typical Operating Load Factors
NVIC 2-89, Appendix 2 Table 2, Sample Load Analysis

APPENDIX 2

TABLE 1

TYPICAL OPERATING LOAD FACTORS

LOAD DESCRIPTION	NAVY FACTORS		MAR. ENG. FACTORS		SNAME
	Sea	Emerg.	Sea	Emerg.	Sea
Main Steering gear pump	.3	.3	.1		.2
Stby. steering gear pump	0	0			
Steering gear servo. pump	.5	.5			
Steering control	.5	.5	.1		
Steering aux. heater	0	0			
Shaft turning gear	0	0			
Stern tube bearing lube oil pump			.5		
Main cond. pump	.9	0	.4		.75
Main circ. pump	.9	0	1.0		.9
Aux. cond. pump					.9
Aux. circ. pump	.6	0			.9
Main feed pump					.8
Main feed boost pump	.9	.5			
Emer. feed boost & transfer pump	0	0			0
Reserve feed transfer pump	.2	0			.5
Aux. condenser condensate pump			0		
Atm. clean drain tank pump			.6		
L.P. Heater drain pump					.65
L.P. Steam gen. feed pump			.9		
Aux. boiler	0	0			
Main turb. gland exhauster	.9	0	.9		.9
Aux. turb. gland exhauster	.5	0			
F.W. Drain coll. tank pump	.6	0			.6
Main L.O. purifier	.3	0	.9		.35
Main feed L.O. pump	.9	0	.9	.3	.9
Stby. L.O. serv. pump	0	.2		1	
L.O. transfer pump	.1	0			0
L.O. cooler circ. pump					.9
L.O. heater					.1
F.O. service pump	.9	0	.4		.85
F.O. transfer pump	.1	0	.1		.1
F.O. stripping pump	0	0			
F.O. stripping drain and transfer pump	.3	0			
Red. gear L.O. stby. pump	0	0			
Prop. hyd. stby. pump	0	0			
Elec. prop. exciter	.9	0			
Elec. prop. equip. heater	0	0			
Prop. motor vent fan	.9	0			
Prop. motor L.O. service pump	.9	0			

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TABLE 1 (cont'd)

LOAD DESCRIPTION	NAVY FACTORS		MAR. ENG. FACTORS		SNAME
	Sea	Emerg.	Sea	Emerg.	Sea
T/G circ. pump	.5	0			
T/G cond. pump	.5	0			
T/G start L.O. pump	0	.9		.9	
Sea valves	0	0			
Emer. gen. S.W. booster	0	.9			
S.W. boost pump	.3	0			
Air preheater					.9
S.W. service pump	.1	0	.6		.8
Bilge and fuel stripping pump	.1	0	.1		
Bilge pump	.1	0	.1		.1
Flushing pump	.1	0			.4
Fire pump	.2	.4	0		0
Bilge & ballast priming pump		0	.1		
Fire & bilge pump					0
Fire & general service pump			0		
Bilge & ballast pump					.2
Ballast pump					.2
Fog/Foam sys. pump	0		0		
Forced draft blower			.5		
H.W. circ. pump	.6	0	.1		.7
H.W. heater	.5	.1			.5
Cargo stripping pump	0	0			
Liq. cargo transfer pump	0	0	0		0
Cargo brine circ. pump			.7		
Cargo air coolers			.9		
Cargo dehumidifier					.5
Window defrosters and wipers	0	0			
Generator space heaters	0	0		1	
Anchor windlass	0	0			
Capstan	.0	0			
Personnel elevators	.2	0			
Cranes	0	0			
Cargo elevators	0	0			
Shop tools	.1	0	.1		.1
Welder	.1	0			
Test board	.1	0	0	0	.2
Battery charger	.2	0			.2
I.C. battery charger				1	
Ventilation	.9	.4	.9		.85
Duct & space heaters	.4	0			.4
Deck mach. heaters					1
I.C. system	.4	.4		1	.4
Radar	.5	.5		1	
Gyro				.5	.4

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TABLE 1 (cont'd)

LOAD DESCRIPTION	NAVY FACTORS		MAR. ENG. FACTORS		SNAME
	Sea	Emerg.	Sea	Emerg.	Sea
Radio	.4	.4			
Searchlights	0	0			
Mech. space ltg.	.9	.9			.9
General ltg.	.6	.4	.4		.6
Emergency ltg.	.6	.4		.9	
Navigation ltg.	.6	.2		.4	.5
Service area ltg			.4		.35
SS. reefer circ. pump					.4
SS. reefer compressor	.3	0	.1		.4
Cargo reefer cmp.	.3	0	.6		
A.C. compressor	.7	.4	.8		.75
A.C. chill wtr. pump	.7	.4	.9		.75
A.C. S.W. circ. pump	.7	.4			.75
A.C. Fan					.75
A.C. S.W. circ. pump			.6		.75
Unit coolers	.2	0			
Oven/range	.4	0			
Galley equip.	.3	0			.3
Refrig/freezer	.5	0			
Refrig. small	.3				.3
Pantry equip.	.2	0			.3
Laundry equip.	.2	0			.2
Hospital equip.	.1	.1			.2
Electronics	.5	.2	.5		.45
Distiller plant	.7	0			
Distiller brine ovbd.			.8		.75
Distiller cond. pump			.3		.6
Distiller feed pump			.8		.75
F.W. transfer pump			0		
Ice water circ. pump			1		.7
Potable water pump	.3		.2		
Drinking fountain	.4				
H.P. air compressor	.1				
S.S. air compressor	.1		.1		.3
Control air compressor	.6		.2		.4
Sewage pump	.1		1.0		.2
Sewage macerator	.1		1.0		
Sewage blower			1		
Cathodic protection			.7		
Ice water circ. pump			1.0		.7
Brine circ. pump			1.0		
Reefer container recept.			.9		
Winches					
Bow thruster					
Main control console			.6		
Boiler console			.6		
R.A.I., E.O.T., alarms			1		

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APPENDIX 2

TABLE 2

SAMPLE LOAD ANALYSIS

NOTE: All figures used are purely hypothetical.

DISTRIBUTION A	ATTACHED LOAD	DEMAND FACTOR	DEMAND LOAD
Bilge Pump	5 KW	0	0
Ballast Pump	10 KW	0.1	1 KW
A/C - Heater	10/20 KW	0.8	8/16 KW *
Cargo Circ. Pump	15 KW	0.6	9 KW
	Dist. A Total 0 + 1 + 16 + 9 =		26 KW

DISTRIBUTION B			
Steering Pump #1	10 KW	0.9	9 KW
Steering Pump #2	10 KW	0	0 **
Steering Control	1 KW	0.9	.9 KW
Bow Thruster	40 KW	0.4	16 KW
	Dist. B Total 9 + 0 + .9 + 1' =		25.9 KW

DISTRIBUTION C			
Main Deck Ltg. Fwd.	4 KW	0.5 ***	4 KW
Main Deck Ltg. Aft	4 KW	0.5	
Eng. Rm. Ltg. Port	2 KW	0.9 ***	3.6 KW
Eng. Rm. Ltg. Stbd.	2 KW	0.9	
	Dist. C Total 4 + 3.6 =		7.6 KW

DISTRIBUTION D			
Range	12 KW	0.4	4.8 KW
Water Heater	15 KW	0.6	9.0 KW
	Dist. D Total 4.8 + 9.0 =		13.8 KW

TRANSFORMER #1

Dist. C 7.6 KW
Dist. D 13.8 KW
1.0 @ .95 Efficiency ****
Transformer 1 Total is 1.05 (1.0)(7.6 + 13.8) = 26.9 KW

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