

# MSC Guidelines for Review of Emergency Generator/Switchboard

Procedure Number: E2-8

Revision Date: 10/28/99

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## References:

- a. Title 46 CFR 111
- b. Title 46 CFR 112
- c. IEEE Standard 46-1983, "Recommended Practice for Electrical Installations on Shipboard"
- d. International Electrotechnical Commission (IEC) 92-302, "Electrical Installations on Ships"
- e. Navigation and Inspection Circular (NVIC) 2-89, "Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units".  
{See <http://www.uscg.mil/hq/g-m/nvic/index.htm>}
- f. Safety Of Life at Sea (SOLAS), Consolidated Editions, 1997, Chapter II-1, Part D
- g. American Bureau of Shipping (ABS), "Rules for Building and Classing Vessels under 90 Meters in Length", 1996

## 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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## Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center by e-mail or phone. Please refer to the Procedure Number: E2-08.

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## MSC Guidelines for Review of Emergency Generator/Switchboard (cont'd)

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### General Review Guidelines

- ❑ The emergency generator and associated equipment must be located aft of the collision bulkhead and above the main deck. The emergency generator and associated equipment shall not be located in **or** adjacent to category A machinery spaces. (Title 46 CFR 112.05-5(d) & (e))
- ❑ The emergency generator shall be collocated with the emergency switchboard. The control/starting circuits shall be independent of the ship's service electrical system. Emergency generator starting must not be inhibited in the event of a fire in the main machinery space. (Title 46 CFR 112.05-5(b) & (h))
- ❑ The stop control for the emergency generator must be only in the space in which the emergency generator is located. Remote operators for fuel shutoff valves are acceptable. (Title 46 CFR 112.05-5(b))
- ❑ The generator shall be rated for 50° C ambient temperature otherwise the generator shall be derated. (Title 46 CFR 111.01-15(e))
- ❑ Generator excitation shall be in accordance with section 4/5C2.19.1 of reference (g). A static exciter is not acceptable unless provided with a permanent or residual magnetism type exciter capable of voltage buildup after two months of no operation. (Title 46 CFR 111.12-3)
- ❑ Prime movers shall conform to design requirements of the following section of reference (g) as applicable: 4/5C2.15 (gas turbines), 4/5C2.17 (diesel engines) or 4/3.21 (MODUs). (Title 46 CFR 111.12-1(a))
- ❑ If the generator is directly coupled to the prime mover, the prime mover must automatically shutdown in the event of loss of lube oil pressure to the generator bearing. (Title 46 CFR 111.12-1(c))
- ❑ The prime mover shall be a diesel engine or gas turbine capable of starting at an ambient temperature of 32 degrees F. Manufacturer's certification is acceptable. (Title 46 CFR 112.50-1(d))
- ❑ The prime mover must shut down upon loss of lube oil pressure, overspeed or operation of a fixed fire extinguishing system in the emergency generator room. Alarms shall be provided for low lube oil pressure and high cooling water temperature. (Title 46 CFR 112.50-1(g) & (h))

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- ❑ The prime mover shall have a self-contained cooling system that enables operation in 100 degree F air. (Title 46 CFR 112.50-1(a))
- ❑ Each emergency generator shall be protected by an individual, trip-free circuit breaker located on the emergency switchboard with a longtime overcurrent trip set at 115% (maximum) of the continuous generator rating or 115% of the overload for a unit with a 2 hour or greater overload rating. (111.30-29(e))
- ❑ The emergency generator shall start automatically for passenger vessels > 100 gross tons, cargo vessels > 500 gross tons or cargo vessels > 1600 gross tons on other than ocean Great Lakes, or coastwise routes and not on international voyages. For all other vessels, manual starting of the emergency generator is acceptable. (Title 46 CFR 112.05-5(a))
- ❑ If automatic starting is required, the emergency generator shall start under a no-load condition after a reduction in the normal source potential by 15 – 40 percent. The transfer of emergency loads shall occur within 45 seconds after failure of the normal source of power. (Title 46 CFR 112.25-5 & 10)
- ❑ Starting systems shall have sufficient capacity for at least six starts, three of which may be provided by a second, separate source capable of being provided within 30 minutes. (Title 46 CFR 112.50-3, NVIC 2-89)
- ❑ For low voltages (<600 volts), the switchboard shall conform to the location, installation and construction requirements listed in sections 17.1 & 17.2 of reference (c) or IEC 92-302, as applicable. For medium voltages (>600 volts), the switchboard shall conform to section 17.3 of reference (c) or IEC 92-503, as applicable. (Title 46 CFR 111.30-1)
- ❑ The switchboard circuit breakers shall comply with article 240 and 380 of the NEC or IEC 92-302, as applicable. The breakers shall have an interrupting rating sufficient to withstand the maximum asymmetrical short circuit current available.
- ❑ Molded circuit breakers conforming to UL 489/489SA or IEC 947-2 are acceptable for voltages of 600 volts or less. Breakers for voltages greater than 600 volts shall conform to IEEE C37.13, IEEE Std 331 or IEC 947-2, part 2. (Title 46 CFR 111.54-1(c))

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- ❑ The switchboard circuit breakers must be mounted or arranged to allow removal from the front of the switchboard without unbolting bus or cable connections or de-energizing the supply unless the switchboard is divided into sections capable of providing power to the vessel. (Title 46 CFR 111.30-4))
- ❑ The emergency switchboard shall be capable of energizing the temporary and final emergency loads listed in Title 46 CFR 112.15-1 and 112.15-5.
- ❑ The emergency generator shall be capable of supplying power to 100% of the emergency switchboard connected loads at a service factor of 1. Alternatively, automatic load shedding may be provided. (Title 46 CFR 112.05-1(c) & 112.05-5(a))
- ❑ The emergency switchboard must be equipped with the following components: (Title 46 CFR 111.30-29(e) & (g))
  - ❑ Neutral disconnect link or switch (as applicable)
  - ❑ Generator power pilot lamp
  - ❑ Ammeter/switch capable of indicating the separate phase currents
  - ❑ Voltmeter capable of indicating phase, bus and shore power voltages
  - ❑ A voltage regulator and voltage regulator cutout switch
  - ❑ Ground detection (If neutral grounded system, a meter is required)
  - ❑ Frequency meter
  - ❑ Exciter field rheostat
  - ❑ Shore power breaker or fused switch
  - ❑ Shore power pilot light
- ❑ The bus-tie shall be arranged to prevent parallel operation of the emergency power source with any other power source except for momentary transfer of loads. (Title 46 CFR 112.05-3(b))
- ❑ If capable of parallel operation (for momentary transfer of loads), the emergency switchboard shall be equipped with the following components: (111.30-25(d))
  - ❑ Speed control for each generator prime mover
  - ❑ Wattmeter for each generator
  - ❑ Synchroscope, synchronizing lamps and switch arrangement

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- If capable of parallel operation (for momentary transfer of loads), reverse power or reverse current relays shall be provided for the emergency generator. (Title 46 CFR 111.30-29(e))
  - Bus-ties between the emergency switchboard and main switchboard must not have automatic feedback of power to the main board. If operating in feedback mode, the bus-tie must open automatically upon overload condition prior to the emergency generator tripping off line. (Title 46 CFR 112.05-3)
  - A test switch, located at the emergency switchboard, shall be provided for simulating failure of the normal power source. Activation shall cause the emergency loads to be supplied from the emergency power source. (Title 46 CFR 111.30-29(b))
  - Visual indication shall be provided at the control station when the automatically controlled emergency power source is supplying the emergency load. (Title 46 CFR 112.45-1(b))
  - Except for cable for connecting the emergency power source to equipment in the engineroom, cable supplied from the emergency switchboard shall not penetrate the boundaries of the engine room. (Title 46 CFR 112.05-5(f))
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### **General Notes**

#### Attachments:

- Switchboard diagrams make use of “American Standard Device Function Numbers”. Other standards (e.g. European) are used, but the ASDFN are most prevalent in the U.S. These numbers are shorthand for common device functions that appear next to the device. For example, the marking “12” means “over speed device” and the marking “52” means “AC circuit breaker”. These codes often have prefixes and suffixes. A prefix typically differentiates between multiple generators, e.g. “152” means “#1 ship’s service generator breaker” and “E52” means “Emergency generator breaker”. A suffix usually denotes an auxiliary function, e.g. “E52Y” may stand for an auxiliary contact in the emergency generator that activates the “breaker closed” light.

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- Switchboard diagrams are typically zoned (similar to a road map). These zones are a necessity because of the numerous relays found in the circuits. A relay coil and its associated contact are mapped to each other using these zones; e.g. the number “F25” above a relay coil is the location of the contact closed by that coil.
  
- In addition to the “American Standard Device Function Numbers”, switchboard diagrams often employ other shorthand notation. For example “CBTD” may stand for “circuit breaker close time delay” and “MCT” may stand for “metering current transformer”. Such shorthand notation is not standard and a legend should be included in the submission. Sometimes revisions of submittals do not include legends such as these-- they only include the revised pages. In this case the legend can hopefully be found in the project folder.
  
- While relays are typically taught and more easily understood as DC devices, AC relays are commonly used. These relays typically employ shaded poles, similar to the shaded pole induction motor. A shaded pole is a colbop which is not separately excited by the relay source; it is excited by the flux on the main relay coil. This coil then produces an opposing current, flux and voltage (Faraday’s and Lenz’s law) which holds the contact during zero voltage intervals on main coil. Failure of the shaded pole leads to “relay chatter”—a 120 Hz clicking that occurs as every time the main relay voltage crosses the zero point.
  
- Opening of the circuit breaker upon shutting down of the prime mover (required by Title 46 CFR 111.12-11), is typically accomplished with an undervoltage relay.