

U.S. COAST GUARD MARINE SAFETY CENTER PLAN REVIEW GUIDELINE



REVIEW OF LITHIUM-ION BATTERY SYSTEMS

Procedure Number: E2-29

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Purpose

This Plan Review Guideline (PRG) is to establish a consistent process for reviewing lithium-ion battery system submittals for compliance with the requirements of 46 CFR.

Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center (MSC) by e-mail or phone. Please refer to Procedure Number E2-29.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to all certificated vessels using lithium-ion batteries as a source of power.

2. Background

With recent advances in battery technology, it has become possible to power vessels with lithium-ion battery banks. These batteries have associated hazards that are not explicitly addressed in existing regulations. MSC reviews plans associated with these installations, but there are no current design constraints related to other use of lithium-ion batteries onboard vessels, such as in commercial electronics charged through vessel outlets. This topic is addressed in reference (a), and questions about such issues should be referred to the Coast Guard Office of Commercial Vessel Compliance (CG-CVC), who can be reached at cgcvc@uscg.mil.

3. References

- (a) [CG-CVC Policy Letter 20-03, “CARRIAGE OF LITHIUM-ION BATTERIES ON SMALL PASSENGER VESSELS”](#)
- (b) [CG-ENG Policy Letter 02-19, “DESIGN GUIDANCE FOR LITHIUM-ION BATTERY INSTALLATIONS ONBOARD COMMERCIAL VESSELS”](#)

4. Review

- a. The Coast Guard Office of Design and Engineering Standards promulgated reference (b), which contains direction for the design of lithium-ion battery systems on vessels. This policy letter should be followed for those vessels whose construction started after October 2, 2019.
- b. Subchapter M uses design verification rather than plan approval for vessels that comply with the regulations as written. However, 46 CFR 143.210 states that systems of a novel design that cannot be reviewed in accordance with this part must be approved by MSC as providing an equivalent level of safety. This is typically accomplished by meeting the requirements for a Subchapter T vessel in reference (b). If you would like to propose an alternative, we recommend discussing that with MSC as early in the process as possible, ideally before construction even begins. Also, for subchapter M vessels, although 46 CFR 143.210 states that MSC must approve the equivalency, 46 CFR 136.115 also requires that equivalencies be submitted via the cognizant OCMI. We recommend that you discuss your project with the cognizant OCMI, again as early as possible in the process.
- c. For vessels whose construction started before October 2, 2019, while reference (b) does not apply, various regulations (e.g. 46 CFR 183.200, 46 CFR 111.01-1) still require vessel installations to be generally safe. Due to the unique safety concerns associated with the use of lithium-ion batteries, which are not explicitly addressed elsewhere in the regulations, compliance with those general safety regulations can only be confirmed by an in-depth review of the system arrangements. MSC will, in accordance with the equivalency provisions in the applicable subchapter (e.g. 46 CFR 175.540(a)), accept an arrangement which provides a level of safety equivalent to that provided by those

regulations for lead-acid batteries. Although there may be multiple ways to fulfill that criteria, the comments in enclosure (1) demonstrate one method which may be employed to mitigate the risks associated with this vessel's Li-ion battery installation.

5. Disclaimer

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact MSC, the unit responsible for implementing this guidance.

Encl: (1) Design Considerations for Use of Lithium-Ion Batteries aboard Small Passenger Vessels

Design Considerations for Use of Lithium-Ion Batteries aboard Small Passenger Vessels

Operator Documentation

1. A Maintenance Plan and Operations Manual is to be developed for the vessel lithium-ion battery system, to record system status and alarms, and prescribe necessary actions to take in the event of an emergency.

Battery Modules

2. The battery module installation is to be in accordance with the manufacturer's requirements and recommendations.

3. Each battery module is to be located as high above the bilge as practicable, secured to protect against shifting with the roll and pitch of the vessel, and free from exposure to water splash or spray.

Battery Management System (BMS)

4. The battery charging and discharging is to be controlled by a BMS, and sized in accordance with the manufacturer recommendation.

5. The battery monitoring system is to be able to sense dangerous temperatures for each cell, or pair of cells if so configured.

6. The BMS is to produce an alarm before a battery cell reaches its maximum rated temperature (typically 95%), and is to automatically shutdown if a battery cell reaches 100% of its maximum rated temperature.

7. The BMS is to produce an alarm and automatically shutdown if cell(s) report an abnormal voltage or high deviation between cells in accordance with the manufacturer's design standards.

Ventilation

8. Compartments containing lithium-ion batteries are to have sufficient ventilation and environmental conditioners to maintain the ambient temperature in accordance with the manufacturer's recommendations.

9. A temperature sensor is to be installed in each compartment containing lithium-ion batteries, which alarms at the operating station when the ambient temperature in the compartment exceeds the maximum operating temperature recommended by the battery manufacturer.

10. The ventilation for each compartment containing lithium-ion batteries are to be such that any gases released are routed to the open deck, away from passenger spaces and egress routes.

11. Ventilation duct work in each compartment containing lithium-ion batteries is to be made of steel (same as the hull) and shall not route through passenger spaces.

12. The ventilation closure device required under 46 CFR 119.465(h) or 46 CFR 182.465(h), as applicable, is to seal the vent duct as close as practicable to the compartment boundary, in order to minimize heat exposure in the event of a fire.

Fire Detection & Suppression

13. Fixed fire detection and extinguishing systems are to be installed in each compartment containing lithium-ion batteries. The systems are to be installed in accordance with 46 CFR 118 Subpart D or 46 CFR 181 Subpart D, as applicable.

Battery Compartment

14. The battery compartment boundaries are to provide adequate protection to other parts of the vessel in the event of a battery fire. At a minimum, structural fire protection insulation is to be A-60 in the overhead of the battery compartment, with adequate protection of any fuel tanks within or adjacent to the battery compartment. As such, the boundary between the battery compartment and any fuel tanks is to either be an A-0 bulkhead with an 18" cofferdam or an A-60 barrier. This could potentially be relaxed with an analysis of maximum credible fire intensity and duration and its effect on the proposed arrangement. Proposed arrangements are to take into account the size and type of the battery installation and hull and tank material.

15. An emergency shutdown switch is to be located outside of each compartment containing lithium-ion batteries, and on the bridge, to disconnect the batteries from the DC circuit.

Vital System Automation Testing Documents (required for all electric propulsion systems)

16. In accordance with 46 CFR 119.220(a), the propulsion system must meet the applicable requirements of 46 CFR Subchapters F and J. This will include the requirements under 46 CFR 61.40 for a:

- a. Qualitative Failure Analysis (QFA) per 46 CFR 62.20-3(b),
- b. Design Verification Test Procedure (DVTP) per 46 CFR 61.40-3, and
- c. Periodic Safety Test Procedure (PSTP) per 46 CFR 61.40-6.

17. In order for the MSC to evaluate the QFA, DVTP, and PSTP, please submit the following plans as supporting documentation:

- a. A block diagram showing vessel automation system(s) architecture, to include Programmable Logic Controllers, communications, and all Input-Output (I/O) channels,

- b. Automation equipment layouts with bill of materials,
- c. Power management system plans,
- d. Propulsion control system plans, and
- e. Description of operation for automation system(s).

This information outlines basic guidance for lithium-ion battery installations. There may be considerations that are not addressed in this document that should be evaluated based on the specific design of the subject vessel to ensure the safety of passengers and crew. This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact the Marine Safety Center (MSC), the unit responsible for implementing this guidance.