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CG-ENG-Policy Letter
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From: 
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COMDT (CG-ENG)

To: Distribution

Subj: DESIGN GUIDANCE FOR LITHIUM-ION BATTERY INSTALLATIONS
ONBOARD COMMERCIAL VESSELS

Ref: (a) Title 46 Code of Federal Regulations (CFR) Subchapter J
(b) Standard Guide for Shipboard Use of Lithium-Ion Batteries, ASTM F3353-19

1. Purpose. There is increased interest in Lithium-ion (Li-ion) batteries and other new types of stored energy technology onboard U.S. flag inspected vessels. Unique safety concerns are associated with these technologies and the plan review process can be lengthy due to system complexities and the lack of published regulations or marine standards on the topic. This policy establishes design guidance for commercial vessels using Li-ion batteries within the existing regulatory framework. This document was drafted in collaboration with the Marine Safety Center in order to provide consistent guidance to designers of vessel electrical systems, and for USCG personnel reviewing those designs. The purpose of this guidance is to provide an acceptable method for using Li-ion battery technology that will result in a streamlined and consistent plan approval process. Other design concepts will be reviewed by the Marine Safety Center in collaboration with CG-ENG on a case-by-case basis.
2. Directives Affected. None.
3. Action. USCG Headquarters Units and Offices, Districts, and Sector Commanders may use this policy letter to ensure compliance with U.S. statutory and regulatory requirements.
4. Background.
 - a. Advances in energy storage technology have enabled new possibilities in shipboard power systems. Currently, lead-acid batteries comprise the vast majority of shipboard energy storage installations due to their low cost and predictable performance. Lithium based batteries are many times more energy dense, are becoming less expensive, and are making all-electric or hybrid electric power systems possible on some types of vessels.
 - b. Shipboard power systems can benefit from stored energy in a number of ways including, but not limited to, the following:

- i. Hybrid power systems incorporating load smoothing/peak shaving, where stored energy is incorporated in a power system during surges, without the need to place an additional generator online.
 - ii. All-electric propulsion or ship's service electrical power for vessels with limited duration voyages.
 - iii. Onboard battery storage systems as a shore power alternative in areas with environmental/engine emission controls.
 - iv. Accumulator batteries used as an emergency power source to comply with SOLAS Ch. II-1 reg. 42 and/or 46 CFR 112.
- c. The Coast Guard received technical input from industry and classification societies during the development of this policy letter.

5. Discussion.

- a. Applicability - This policy letter is applicable to Li-ion battery installations used for propulsion or electrical power on all commercial vessels.

NOTE 1: This policy is not applicable to transport of Li-ion batteries (batteries as cargo).

- b. Design guidance is found in Enclosure (1), which primarily incorporates the technical guidance found in Reference (b). The regulatory and technical basis for this guidance is found in the equivalency provisions of 46 CFR Subchapter J, Electrical Engineering, as well as in the individual subchapters for particular vessel types (e.g. 46 CFR Subchapters T and K). This design guidance will streamline the plan review process for new installations.
- c. The recommendations found in Enclosure (1) apply to the design and installation of the Li-ion battery bank and associated power and control systems. These guidelines do not address training or watchkeeping issues associated with Li-ion batteries.
6. Disclaimer. While the guidance contained in this document may assist the industry, public, Coast Guard, and other Federal and State regulators in applying statutory and regulatory requirements, the guidance is not a substitute for applicable legal requirements nor is it a regulation itself. It is not intended to nor does it impose legally binding requirements on any party. This guidance does not create any right or benefit, substantive or procedural, enforceable by law or equity, by any person against the Coast Guard, its officers or employees, or any other person. This guidance may be superseded, modified, or terminated at any time without prior notice.

7. Changes. This policy is available via the internet at <https://www.dco.uscg.mil/CG-ENG/>. Changes to this policy will be issued as necessary. Suggestions for improvements of this policy should be directed to Commandant (CG-ENG-3) at (202) 372-1372 or emailed to Kevin.L.Ralson@uscg.mil.

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Enclosure: (1) Design Guidance for Lithium Ion Battery Installations

Distribution: CG-CVC
CG-OES
CG-MSC
All Area/District (p)
All Sectors/MSUs/MSDs (p)

Design Guidance for Lithium Ion Battery Installations

1. References:
 - a. ASTM F3353-19: Standard Guide for Shipboard Use of Lithium-Ion (Li-ion) Batteries
 - b. Marine Safety Center Technical Note (MTN) 02-11, Review of Vital System Automation and Dynamic Positioning Systems
 - c. Marine Safety Center Plan Review Guide (PRG) E2-05, Guidelines for Design Verification Test Procedures
 - d. Marine Safety Center PRG E2-17, Guidelines for Periodic Safety Test Procedures
 - e. Marine Safety Center PRG E2-18, Guidelines for Qualitative Failure Analysis
2. Definitions: Refer to reference (a), ASTM F3353-19, for definitions related to Li-ion battery installations.
3. General:
 - a. Reference (a), ASTM F3353-19 provides an equivalent level of safety to the existing regulations in 46 CFR Subchapter J for Li-ion battery installations. ASTM F3353-19 provides guidance on the following issues associated with marine Li-ion installations:
 - i. Testing requirements – Battery design tests such as short circuit, impact, and overcharging.
 - ii. Operating environment – Control and monitoring of the shipboard battery operating environment.
 - iii. Fire safety – Measures to detect, contain, and mitigate emergency situations through battery temperature monitoring, structural fire protection, fire detection, and fire-fighting systems.
 - iv. Battery system design – Battery Management System (BMS) requirements.
 - v. Testing and maintenance – Testing procedures for automation systems installed in vessel propulsion, ships service electrical or emergency power applications.
 - b. Subject to the following, ASTM F3353 may be used as an acceptable method for installing Li-ion battery power systems onboard commercial vessels.
 - i. The Marine Safety Center may determine that other specific design criteria should be applied based on a risk assessment of the specific vessel.
 - ii. The Officer in Charge of Marine Inspection (OCMI) may determine that certain operational restrictions should be applied based on the vessel's route and operating conditions.
 - iii. Vessels subject to 46 CFR Subchapter T may propose a reduction in some of the requirements of ASTM F3353 for installations with an overall battery capacity less than or equal to 50 kWh. This proposal should include an engineering

analysis or a risk assessment that justifies that the reduction in requirements provides an equivalent level of safety.

- c. Other methods for achieving an equivalent level of safety will be considered on a case-by-case basis by the Marine Safety Center. Vessel designers are encouraged to communicate with the Marine Safety Center early in the conceptual design phase to identify any unique issues in the design process.

4. System verification and maintenance:

- a. Li-ion battery systems are complex and rely on automated systems for charging, monitoring, and control of emergency situations. Verification that a battery system is installed and maintained in accordance with approved plans is vital to safe and reliable operations. In alignment with ASTM F3353-19, the Coast Guard requires Li-ion plan submissions to include a Qualitative Failure Analysis (QFA), Design Verification Test Procedures (DVTP), and Periodic Safety Test Procedures (PSTP). Reference (b), MTN 02-11, covers vital system automation which is applied to Li-ion installations as described here:
 - i. Qualitative Failure Analysis is submitted with plans to the MSC and is intended to assist in evaluating the safety and reliability of the design. ASTM F3353 section 9.2 describes elements of a QFA related to Li-ion installations. Detailed criteria for QFA submission is found in reference (e), PRG E2-18.
 - ii. Design Verification Tests are conducted prior to the issuance of the initial Certificate of Inspection and are intended to verify each failure mode identified in the QFA as described in ASTM F3353 section 9.3. The DVTP is submitted with plans to the MSC in accordance with reference (c), PRG E2-05.
 - iii. Periodic Safety Tests conducted at annual inspections. The tests should be in accordance with Periodic Safety Test Procedures (PSTP) approved by MSC and in accordance with ASTM F3353 section 9.4. A formal PSTP program is required for Li-ion installations used as propulsion and should follow reference (d), PRG E2-17.
 - iv. The maintenance and operations manual should include step-by-step instructions detailing necessary actions to be taken by the crew in the event of an emergency. Instructions should include:
 - 1. Actions to be taken by the crew in the event of a Li-ion battery fire.
 - 2. Actions to be taken by the crew in the event of a Li-ion battery abnormal condition (e.g. under voltage, over voltage, high temperature, high discharge rate, or any other condition from the battery management system that would initiate an alarm or shutdown)
 - 3. Actions to be taken by the crew in the event of a fire external to the Li-ion battery but that affects the Li-ion battery compartment.