Maritime & Coastguard Agency

Guidance

MGN 550 (M+F) Amendment 1: Electrical installations - guidance for safe design, installation and operation of lithium-ion batteries

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Summary

The intent of this Marine Guidance Note (MGN) is to provide the marine industry with best practice guidance to facilitate safe and environmentally friendly battery solutions for vessels utilising lithium-ion marine batteries as part of an energy source, hybrid power system or as the sole source of propulsion power. Topics include:

- Introduction;
- Battery System Design;
- Battery Replacement;
- Battery Management System;
- Battery Space and Storage;
- Ventilation;
- Cooling Systems;
- Operation and Handling;
- Fire Detection and Fire Fighting; and
- Disassembly and Recycling.

1. Introduction/background

1.1 The need to reduce emissions is driving battery use within the marine industry. Battery technology is rapidly evolving, enabling the production of more efficient batteries for the use of energy, hybrid and sole propulsion on board vessels.

1.2 Lithium-ion battery technologies have become a viable energy storage option, due to greatly improved energy density. However, these do not come without risks.

1.3 Thermal runaway is one of the main concerns in relation to lithium-ion batteries; where an increase in temperature can cause venting of gases and/or chemicals with corrosive and flammable vapours, cascading from a cellular level through a module, leading to a fire or explosion. Lithium-ion batteries are high-energy devices and should be considered as hazardous, at all times, including during transportation.

1.4 This guidance does not supersede any other guidance or statutory instruction, sound engineering practice and manufacturer guidance should be considered when developing designs for battery power systems. The contents of this guidance will not cover every eventuality and each case should be considered separately.

1.5 The design of a battery system within a vessel should anticipate future changes. These changes might relate to the operational tasking of the vessel, modifications to the electrical equipment and upgrades to the battery. It should be highlighted that any modification which changes the requirements upon an existing battery system should be thoroughly assessed against the original requirements of the battery and its current state of health and action taken appropriately to ensure safe use and operation.

1.6 The use of hazard identification and risk assessment techniques should be performed to understand the potential safety issues for personnel, the environment, the vessel and the vessel's operations. Suitable mitigations or safeguards should be implemented to reduce risks to an acceptable level.

1.7 A risk assessment of all components and systems should be carried out and be submitted to the vessel's Certifying Authority or Recognised Organisation. The risk assessment should consider the components of the batteries and connected systems both individually and as an entire operating unit, and should be carried out either as part of, or in addition to, any other risk assessment required. Risk Assessments should be regularly reviewed as part of the Safety Management System.

1.8 Lithium-ion batteries and associated components intended for powering a vessel should comply with a recognised standard meeting the approval of the Administration (see Annex 1 of this MGN). Where lithium-ion batteries are to be used for propulsion, the design and capacity of the electrical energy storage system should be appropriate for the intended operation of the vessel, including capacity for an energy reserve, such as higher power demand in adverse weather or for emergency operations.

1.9 An intention to test lithium-ion batteries should be notified to the Certifying Authority or Recognised Organisation and Administration with reasonable notice, and the Certifying Authority or Recognised Organisation may require that a surveyor witness the battery tests.

1.10 The Administration may appoint an MCA surveyor, or other designated person, to witness tests.

2. Battery System Design

2.1 A battery system or Electrical Energy Storage (ESS) is a device that stores energy and is made up of cells, cell assemblies, modules, packs, electrical circuits and associated electronic equipment, such as a Battery Management System

(BMS). A battery system could also include associated cooling or propagation prevention technology.

2.2 A key hazard of lithium-ion battery installation is that a single cell defect may cascade through a module, and an entire battery system, quickly turning into a thermal runaway event and a full fire incident. Therefore, battery system design should be considered at cellular and module levels.

2.3 The design and installation of the propulsion system and batteries should be suitable for marine use and should comply with the latest standard (see Annex 1 of this MGN).

2.4 It is recommended that all cells are tested taking into consideration the appropriate United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations (see section 8) (UN38.3, UN3840 and UN3841) and the batteries should be certified to the applicable United Nations Dangerous Goods regulations. It is also recommended to obtain the cell manufacturer's Material Safety Data Sheet and/or cell Technical Specification which may detail maximum charge/discharge currents, maximum state of discharge, temperature limits for separators or current intercept devices (CID), acceptable values of cell drift, etc.

2.5. Battery manufacturers should ensure that batteries are designed with due consideration to safe design. It is strongly recommended that batteries are built by the cell manufacturer or by a manufacturer with a detailed knowledge of the cell chemical properties and the overarching requirements of the battery and its intended use. Modifications to a cell, battery or power management systems should always be in accordance with the manufacturer's recommendations. Where a battery module manufacturer has incorporated battery cells from a different manufacturer, certification for the cells should be appropriate (IEC 62133-2) in addition to certification for the battery module (IEC 62619).

2.6 The chemistry of lithium-ion cells can vary considerably between manufacturers and may even vary between production runs from a single manufacturer and therefore, battery cells of different physical characteristics, chemistries, and electrical parameters should have special consideration by manufacturers.

2.7 Batteries can only safely operate within the operating limitations of the lowest common denominator of the cells and therefore, it should be ensured that the selected cells (and any replacements or spares) have compatible cell chemistries if mixed within one battery.

2.8 Battery systems, including any back up battery system, should satisfy the designed electrical requirements of the vessel. Fuses, cables and circuit breakers should comply with a recognised standard (see Annex 1 of this MGN).

2.9 Battery enclosures/casings and connected systems should be designed to remain in a safe state in event of exposure to seawater. Batteries and their connections should have an Ingress Protection (IP) rating which is appropriate to the risks associated with the:

2.9.1 fire-fighting medium within the battery module;

2.9.2 location in which the batteries are installed; and

2.9.3 risk of ingress.

An IP rating as a minimum should be an IP44 rating, however, in many circumstances, a higher IP rating would be advised.

2.10 Exposed battery casing should be constructed of adequately durable, flame-resistant, moisture-resistant materials which are suitable for use in the marine environment.

2.11 Materials and arrangement of battery cells, modules and packs should be given due consideration to the prevention of thermal runaway, pressure and explosion.

2.12 A battery design should have an emergency shut-down mechanism that is recommended to be independent of any control, alarm or monitoring systems and should be accessible remotely and from the battery room/space. The BMS should have appropriate alternative power to allow its operation to monitor and control the batteries in the event of power failure to the main battery.

2.13 Battery cooling systems should be designed to maintain battery cells within their required operational range, including during fault events, where cell temperature spikes but remains within operational limits. Cooling systems should be designed effectively to prevent thermal runaway due to a single overheating cell, module, or entire battery.

2.14 A vessel which uses batteries as a source of power for propulsion and/or can be charged by an onshore mains power source, should have adequate number of electric charging points installed in an appropriate location on the vessel. Consideration should be given to IEC PAS 80005-3:2014, material, protection from water ingress, height above deck and position of ventilation or exhaust vents for hybrid propulsion systems.

2.15 In the case of a hybrid propulsion vessel, there should be a spare battery to provide back-up power for starting of the propulsion system, (for example, where the sole means of starting the propulsion is by batteries, i.e. for a diesel-electric). Charging facilities for the spare battery should be available. The vessel owner/operator should have a contingency plan in place which details actions to be taken if the designated back-up power source fails.

2.16 The BMS should ensure that lithium-ion cells should not exceed overcharge and over discharge. Generally, lithium-ion batteries are charged between 20% and 90% to avoid any uncertainties in the measurement of state of charge, both of which can destabilise the battery causing failure of the electrodes and possible thermal runaway. Therefore, the battery system should be designed to prevent over charging and discharging.

2.17 Batteries and the BMS should:

2.17.1 be fully compatible with the electromagnetic emissions they will be exposed to during a vessel's anticipated range of operating conditions;

2.17.2 not produce electromagnetic emissions that will affect the operation of all other equipment on board the vessel; and

2.17.3 be certified to an appropriate standard for EMC emissions and EMC impact from other sources (i.e. IEC 6180-3:2017).

2.18 Batteries should be positioned so that all parts requiring inspection or replacement, if appropriate, whilst in service can be safely accessed.

2.19 Consideration should be given to protecting batteries against the risks of overheating of batteries even when disconnected from a power source or isolated.

2.20 Means shall be provided to fully isolate a battery, and to electrically isolate a battery at the pack level for maintenance, or to address a fault, with means to lock the system off or otherwise ensure that it cannot be reactivated during maintenance.

2.21 Outgoing circuits from batteries should have switchgear or equivalent means to electrically isolate the circuits, the granularity of isolation should be dependable on electrical system architecture.

2.22 An emergency power-off circuit should be installed to allow isolation and remote isolation of batteries from outside, or remotely to, the battery box or battery room.

2.23 All electrical equipment associated with batteries and connected systems should:

2.23.1 operate in all expected operating conditions;

2.23.2 minimise the risk of initiating fire or explosion;

2.23.3 have an appropriate IP rating (see section 2.9);

2.23.4 enable maintenance and repair; and

2.23.5 be appropriately protected against humidity, temperature, and degradation due to seawater and vibration [footnote 1].

2.24 Equipment and spares used for maintenance of batteries, connected systems and electrical equipment should be manufacturer approved and to the satisfaction of the Certifying Authority or Recognised Organisation.

3. Battery Replacement

3.1 A battery module or system should be replaced when there are safety concerns, it has reached an end-of-life state or, the batteries state of health (SOH) or C-rate has declined below the minimum level needed to deliver required vessel performance.

3.2 Where batteries are replaced, they should ensure full compatibility with all on-board systems.

3.3 Where batteries used as a source of power for propulsion are replaced with a type which is not equivalent, the system should be treated as a new installation, with a new safety case provided to the Certifying Authority/Recognised Organisation to ensure that the revised system remains safe.

3.4 Requirements for end-of-life disassembly and recycling of lithium-ion batteries are detailed in Section 10.

4. Battery Management System

4.1 All vessels which use batteries as a source of power for propulsion should have an approved Battery Management System and a Power Management System/Energy Management System installed. If a Battery Management System is replaced (unless replaced with identical equipment), or has its programming significantly altered, section 3.3 of this MGN should apply, and a revised safety case would be required for approval by the Certifying Authority or Recognised Organisation.

4.2 The Battery Management System (BMS) is required to maintain the condition of the battery by monitoring and protecting the battery cells. The BMS should be tested and trialled as per the manufacturer's requirements and Certifying Authority or Recognised Organisation and should meet the IEC 62619 standard.

4.3 A Battery Management System should maintain balancing of cell voltage at module and system levels.

4.4 The Battery Management System manufacturer should provide testing and inspection requirements for maintenance and a Battery Management System should provide an indication at the control position(s) when any servicing is due. Any maintenance should be clear from the State of Health (SOH) report.

4.5 A Battery Management System should, as a minimum, calculate, transmit and display the State of Charge (SOC), Sate of Health (SOH) estimate and key warnings such as 'overtemperature' at key locations (including the control position(s)).

4.6 The BMS should detect, respond, and produce an auditory and visual alarm to any fault or equipment failure within the battery. Such detections should include but are not limited to:

4.6.1 Operational conditions:

- voltage (at cell, module and system level);
- temperature (at cell, module and system level); and;
- current (at string level);

4.6.2 Loss of communication;

4.6.3 Fault or failure of:

- BMS;
- battery cell;
- cooling system;
- ventilation system;

4.6.4 low remaining battery;

4.6.5 poor state of health;

4.6.6 temperature threshold exceeds requirements; and

4.6.7 a build up of explosive gases are detected as per the ventilation detection system.

4.7 Where a Battery Management System acts to isolate a battery string(s) or module(s) this should be communicated with the Energy Management System or Power Management System to ensure that the battery system is not overloaded and the correct remaining range is displayed at the control position(s).

4.8 For battery-hybrid propulsion systems, the Power Management System should balance both the conventional fuel and battery power sources appropriately as per the design and use.

4.9 The BMS should be compatible with the requirements of the battery system, other battery components and the vessel's electrical equipment.

4.10 The BMS should identify when the battery is sufficiently charged and discharged.

4.11 The BMS should have access to continuous power and an alarm should sound in the event of power failure.

4.12 A Battery Management System should log battery usage history, warnings and faults.

5. Battery Space and Storage

5.1 Battery boxes and battery rooms should be located away from high risk factors including, critical components, fuel tanks, fire hazards, escape routes and life-saving apparatus, and should not be located in front of a collision bulkhead. Special consideration should also be given when choosing the location of the battery room or box to the battery use, vessel use, crew quarters, proximity to outer hull/shell or potential impact points, nearby heat sources and areas not likely to flood during normal operation or in event of minor damage.

5.2 Batteries used for a source of power for propulsion should be stored in battery boxes or battery rooms. Battery boxes and battery rooms should be adequately ventilated to prevent the build-up of explosive or toxic gases (see section 6 for ventilation).

5.3 Storage and location of the battery space should consider equipment failure or emergency conditions. The battery should be arranged within the battery space so that it is readily accessible for inspection, testing and/or replacing.

5.4 Batteries should be secured firmly (such as within mounting frames) to avoid movement either during normal conditions, or when the vessel is subjected to sudden acceleration, deceleration, or a large angle of heel or trim. They should be positioned and secured to minimise exposure to mechanical damage or excessive vibration.

5.5 Gas detection, fire detection and firefighting equipment within the battery space should be appropriate to detect, prevent, suppress and fight a fire, taking into account the ventilation system(s) on board, and to avoid the formation of a vapour cloud.

5.6 Any detection of gas or heat above manufacturer's specified limits within the battery room or battery box, should activate an auditory and visual alarm at the control position(s).

5.7 Construction standards for battery boxes and battery rooms should be in accordance with the battery manufacturers recommendations, and be located within either a:

5.7.1 steel, or equivalent, plated battery box; or

5.7.2 dedicated steel, or equivalent, plated battery room.

Both with A60 fire integrity, or equivalent.

5.8 Risk assessments should be carried out when designing and positioning the battery room and/or battery box.

5.9 Any penetrations through battery box or battery room insulation should be of an equal fire rating to the insulation it passes through.

5.10 Lithium-ion batteries approved by the battery manufacturer to be safely co-located with other equipment within a battery box or battery room may be co-located with the following:

5.10.1 critical equipment;

5.10.2 fuel tanks;

5.10.3 fire hazards; and

5.10.4 electrical equipment,

subject to completion of a risk assessment carried out by the vessel owner/operator, and submitted via the Certifying Authority or Recognised Organisation to the Administration for consideration and approval.

5.11 Only electrical equipment required either for operational reasons or for lighting within the space itself should be installed within battery boxes, battery rooms or ventilation exhaust ducts, and should not contribute any additional overall fire risk. Such equipment should be Ex-rated and IIC atmosphere certified.

5.12 Electrical equipment should be located appropriately in relation to the battery box or battery room ventilation outlets, ideally not within 1.5m. Electrical equipment should, as far as practicable, be located in non-hazardous areas.

5.13 Light fittings in a battery box or battery room should be appropriately protected (e.g. by glass) to reduce the risk of sparking, and be Ex-rated. Light fittings should be isolated if the protection fails.

5.14 If a risk of static in the battery box or battery room is identified, and cannot be suitably mitigated, it is strongly recommended that the walls of the box or room be painted with anti-static paint.

5.15 Openings to battery boxes or battery rooms where exhaust gas build-up is a risk should be gas tight. Openings should not be located next to spaces containing combustible or flammable materials.

5.16 The ambient temperature of a battery box or battery room should be monitored by the Battery Management System, Energy Management System or Power Management System, as appropriate, to allow management of the battery system and should be displayed at the control position(s).

5.17 A walk-in battery room should meet the means of escape requirements for Category A machinery spaces from the vessel specific requirements.

5.18 Battery boxes and battery rooms should not form a means of access to any other compartment, or form part of an escape route.

5.19 Where battery modules or systems are contained within gastight containers, a safety pressure relief valve or weak point should be included within the container design.

5.20 It is recommended that person(s) working in in a battery room, or in a space containing a battery box, should carry an Emergency Escape Breathing Device (EEBD).

5.21 The following information should be clearly displayed in or on, both the battery box or battery room and in its immediate vicinity. Internationally recognised signage should be used where appropriate:

5.21.1 battery cell chemistry;

5.21.2 high voltage equipment;

5.21.3 fire suppression system requirements and method of operation;

5.21.4 maximum charging and discharging characteristics;

5.21.5 safe upper and lower ambient temperature;

5.21.6 what protective device(s) and/or safety feature(s) are installed, if applicable;

5.21.7 battery manufacturer's name; and

5.21.8 any other appropriate warning signs.

6. Ventilation

6.1. Ventilation of battery boxes and battery rooms should be appropriate to risks, battery size and battery storage location:

6.1.1 batteries located in a battery box may be ventilated by either:

- passive ventilation, where battery off-gas would not produce an explosive atmosphere; or
- active ventilation.

6.1.2 batteries located in a battery room should be ventilated by active ventilation.

6.2 The number of air changes per hour required for a battery box or battery room should not be less than 6 and should be calculated [footnote 2] taking into account, at a minimum, the following variables:

6.2.1 battery box or battery room volume;

6.2.2 distance between vent and battery box roof or battery room ceiling;

6.2.3 maximum volume of battery gas released during a thermal runaway event;

6.2.4 battery size(s); and

6.2.5 design pressure of the bulkhead or deck.

6.3 If a fire is detected ventilators should stop automatically, except in the presence of an explosive atmosphere or detection of vapour cloud [footnote 3]. Ventilators should be able to continue operating safely in the presence of an explosive atmosphere or vapour cloud and in the event of equipment failure or emergency conditions. Active ventilation is essential for the disposal of gas rich atmospheres and mitigation of vapour cloud explosion.

6.4 For active ventilation, air inlet(s) and an exhaust outlet(s) should be positioned to ensure effective distribution of air through the space.

6.5 Exhaust ducts should, during normal operations, prevent exhaust gases, rainwater or seawater from being drawn through air intakes.

6.6 Ventilation of the battery space should be considered to appropriately accommodate battery size and location.

6.7 Ventilation and discharges should be led to a safe place above deck where such discharges will not cause fire or pose as a hazard to personnel. Vent discharges should always be kept away from areas with crew and passengers.

6.8 Any failure or fault in a ventilation system should activate an auditory and visual alarm at the control position(s).

6.9 Ventilators and ventilation fans located within, or feeding, battery boxes and battery rooms should be composed of Ex-rated and non-static materials and components and should be of a construction suitable for the battery box or battery room, and for any corrosive gases which may be produced by the batteries.

6.10 Active or passive ventilation of battery boxes and battery rooms should be separate from other on-board heating, ventilation, or air conditioning systems.

6.11 Dedicated active ventilation ducting should be used to discharge off-gassing from batteries to the open air and should be located at a height above deck sufficient to prevent inadvertent down flooding if the vessel is heeled.

6.12 Back-up batteries that power active ventilators during emergency conditions should be stored separately from the area(s) they ventilate.

7. Cooling Systems

7.1 Batteries may be cooled by air or liquid cooling means and should be cooled by either:

> 7.1.1 passive or active ventilation of the battery box or battery room (see section 6 of this document); or
>
> 7.1.2 direct cooling (such as liquid cooling) from a dedicated battery cooling system.

7.2 Battery cooling systems should be able to maintain battery cells within their required operational temperature range, including during fault events where cell temperature spikes but remains within operational limits as per IEC 62619:2022 and the manufacturer’s guidelines.

7.3 Auditory and visual alarms should be activated at the control position(s) if the cooling system fails or develops a fault, including where high coolant temperature or reduced coolant flow is detected.

8. Operation and Handling

8.1 Appropriate personal protective equipment should be worn at all times when handling or servicing batteries. When applicable, safety management procedures (such as Permit To Work) should be enforced prior to working on batteries.

8.2 Lithium-ion batteries should be safely handled, and this includes but is not limited to, never throwing batteries in a fire or exposing to high temperatures, not exposing batteries to strong oxidisers, not exposing batteries to mechanical shock and puncture from sharp objects and never disassembling, modifying or deforming batteries.

8.3 United Nation’s Model of Regulations should be considered for all aspects of transportation of lithium-ion batteries, specifically the Recommendations on the Transport of Dangerous Goods. Transporting and storing of lithium-ion batteries should be tested according to UN transportation UN DOT 38.3 as per the requirements for UN3480 or UN3481. In addition, consideration should be given to the following:

> 8.3.1 Damaged cells/batteries require special precautions to be taken prior to transportation.
>
> 8.3.2 When in storage, cells should be stored as per manufacturer’s instructions – this is likely to require: the protection of live terminals, a well ventilated area with low humidity and out of direct sunlight, and a consistent ambient temperature as many cells experience a longer shelf life when kept cool.
>
> 8.3.3 Cells should be stored in an isolated area away from combustible materials or dangerous goods. Depleted cells should be stored separately.
>
> 8.3.4 Care should be taken to ensure that heavy items to not crush or puncture the cell cases.

8.3.5 All risks to the cells, the storage area and other stored goods should be considered prior to storage.

8.3.6 The number of cells stored in any storage area should be monitored and limited as necessary.

8.4 Training and operational work related to the battery, BMS or other battery components, should be carried out as per the manufacturer's specification.

8.5 Consideration should be given to the specific firefighting method of an individual vessel fitted with a battery, taking into account persons on board, vessel use, manufacturer guidance, ventilation system/s and the location and size of the battery; appropriate firefighting training should be given to those working on board.

8.6 Charging and discharging should be done as per the manufacturer's specifications, avoiding overcharge or over discharge and should always be undertaken under BMS control. Crew that are responsible for the charging/discharging of the vessel should be given appropriate training.

8.7 All batteries should be charged under the control of the BMS. Battery chargers used should meet the requirements of the battery manufacturer's specification.

8.8 All crew on board a vessel should have an awareness of the vessel's emergency procedures relating to batteries and associated systems.

8.9 There should be at least one person on board the vessel who is trained in the range alarms produced by the battery, BMS and PMS/EMS, the meaning of the alarms and any required action(s).

9. Fire Detection and Fire Fighting

9.1 Lithium-ion cells can store significant quantities of potential energy and a fire incident can develop very quickly; therefore, the detection and fighting of a lithium-ion fire requires thorough attention in design and on-board procedures. This includes the detection of gases produced from the battery and detection of vapours. When gas vents from the cells it takes with it small droplets of organic solvent which may form a vapour cloud.

9.2 The hazards associated with a lithium-ion fire emphasise that it may not be feasible to access a battery compartment during a fire and therefore structural fire protection and fixed fire suppression systems may be relied upon.

9.3 An installed fire extinguishing system should be suitable for lithium-ion battery fires. All vessels should have a fixed fire suppression system installed for battery boxes and battery rooms in accordance with the battery manufacturer's requirements, taking into account but not limited to, the following:

9.3.1 Battery size

9.3.2 System design;

9.3.3 Battery use/purpose;

9.3.4 Vessel use;

9.3.5 Ventilation system; and

9.3.6 Cooling system.

9.4 Suitable fire detection equipment, gas and vapour detectors should be fitted in a battery room or battery box giving due consideration to the following:

9.4.1 Battery size;

9.4.2 Battery power;

9.4.3 Ventilation system;

9.4.4 Location of detectors;

9.4.5 Cooling system; and

9.4.6 Fixed fire extinguishing system.

These should include smoke, heat, gas, vapour and flame detectors which should activate auditory and visual alarms in the affected space and at the control position(s).

9.5 The location of fire, gas and vapour detectors should give due consideration to the following:

9.5.1 Battery size;

9.5.2 Ventilation system ducts;

9.5.3 Varying density of a vapour cloud; and

9.5.4 Gas detectors in battery room(s) large enough to be entered should have gas detectors positioned at breathing height.

9.6 It is recommended that gas detector(s) able to detect the gases likely produced by the battery's specific chemistry, or type, should be fitted in battery boxes and battery rooms, as per the manufacturer's instructions.

9.7 Gas detectors in battery boxes and battery rooms should be located where gas may accumulate and in the ventilation outlets (a gas dispersal analysis or physical smoke test may be used to identify the most suitable locations for gas detectors).

9.8 The vessel owner/operator should develop a risk assessment which informs the development of safe systems of work to protect crew from toxic gases.

9.9 As firefighting equipment varies widely dependant on battery use, size and ventilation system fitted, all crew should have training on the specific firefighting equipment on board and how to use it to include regular training drill as part of on-board emergency preparedness.

9.10 A fixed fire suppression system should be of an approved type appropriate to the battery box or battery room. The system may also be able to prevent heat propagation at battery pack level.

9.11 A powered fixed fire suppression system should be powered by both main and emergency power. The emergency power source should not be located in the space(s) it serves. Control and power, where appropriate, for a fixed fire suppression system should be located outside of the battery box or battery room.

9.12 A fixed fire suppression system should meet the manufacturer's installation and maintenance requirements and be serviced at minimum on an annual interval or as per manufacturer's recommendations, whichever is more frequent.

9.13 Visual and auditory alarms should be activated in the affected space and at the control position(s) prior to release of suppression material, if practicable.

9.14 The use of portable fire extinguishers should not be considered as an alternative to a fixed fire suppression system.

9.15 Any portable fire extinguishers intended for use in battery boxes or battery rooms should be suitable for such purposes and have appropriate risk assessments for use as to not impose risk to crew using them in aiding in the suppression of a fire.

9.16 A minimum of two portable fire extinguishers with an appropriate fire rating (in addition to the requirements of the vessel specific requirements) should be readily accessible for the battery box or battery room.

9.17 Vessel owners/operators should follow the battery manufacturer's requirements regarding the types of portable fire extinguishers permitted to be used in battery boxes and battery rooms.

10. Disassembly and Recycling

10.1 The energy storage system of a battery after its intended first life can have capacity of up to 80% of the equivalent new energy storage system, subject to use and state of health. Therefore, recycling of a marine battery for other use is essential in the sustainable efforts towards greenhouse gas reductions in shipping.

10.2 Wherever possible, batteries should be recycled or returned to the manufacturer by agreement. This should be done using a UK certified battery recycler [footnote 4] and according to the Waste Batteries and Accumulators Regulations 2009[footnote 5].

10.3 A risk assessment should be undertaken for the removal and replacement process and should only be done by an appropriately skilled and experienced technician, using the correct equipment and following the Permit to Work systems, ensuring all other control measures are provided for, as required by the associated risk assessment. Removal of a lithium-ion battery should be undertaken according to manufacturer's instructions, taking into account the method by which the battery was fitted.

10.4 Handling of lithium-ion batteries should be done with due care taking into account The Ship Recycling (Requirements in relation to Hazardous Materials on Ships) (Amendment etc.) Regulations 2018.

More information

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> Maritime and Coastguard Agency
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> Spring Place
> 105 Commercial Road
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Please note that all addresses and telephone numbers are correct at time of publishing.

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1. IEC 60092 Electrical installations in ships
2. UL 9540A Battery Energy Storage System (ESS) Test Method
3. NFPA 855 Standard for the Installation of Stationary Energy Storage Systems
4. To be a certified battery recycler in the UK an organisation must first obtain official approval from the Environment Agency to treat lithium-ion batteries
5. For information - EU rules on batteries aim to make batteries sustainable throughout their entire life cycle introduced through Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries

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