



FLEXSHIP - Electrification and Digital Twins for Green Shipping

Electric Waterborne Transport: Regulatory Frameworks and Policies for BESS

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**For additional details ref. to FLEXSHIP D1.3
“Standardisation and regulations”**

1. IMO - International regulations



IMO – the International Maritime Organization – is the United Nations specialized agency with responsibility for safety and security of shipping and prevention of marine and atmospheric pollution by ships



The use of batteries in ships is not in the short-term IMO agenda. Future additions to the IGF Code (presently addressing LNG only) might ultimately provide regulatory requirements



In the absence of applicable IMO and national Administration requirements, the safety of ships using battery installations may be addressed using **MSC.1/Circ.1455 “Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments”** (2013) which:



is intended for application when approving alternative and/or equivalent designs according to the provisions given for alternative design and arrangements in applicable IMO instruments.



outlines the methodology for analysis and approval of an alternative and/or equivalent design.



Few national Administrations took individual action to put something in place, but the vast majority has no requirements. The approach and maturity of requirements varies significantly.



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2. EMSA – Non-mandatory Guidance on the Safety of Battery Energy Storage Systems (BESS) on board ships (2023)



applies to lithium-ion battery energy storage systems (BESS) installations on ships.



refers to ships engaged in international or domestic voyages for which a BESS based on lithium-ion technologies serves any of the following functions or combination:



main propulsion, auxiliary services, emergency propulsion, emergency services and/or other ancillary services.



addresses BESS functions:



fully electrical ships operation for which the BESS is the only source of power.



hybrid powering (peak shaving, backup/reserve, loads optimization) for which the BESS is an energy source.



emergency powering or other electrical services entailing primary and secondary essential ship services, as well as habitability services as per MSC.1/Circ.1572, and SOLAS regulations II-1/8-1, II-2/21 and II-2/22 (flooding and fire for Safe Return to Port, as applicable) and/or other non-essential ship services.

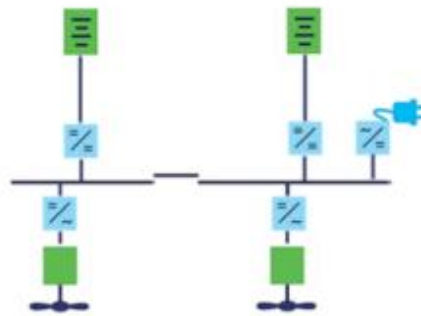
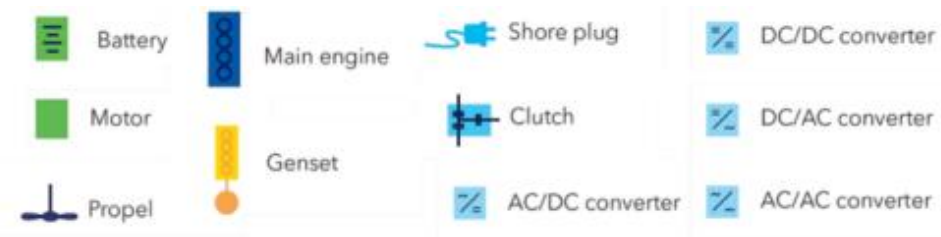


other services of BESS as power source for embarked systems.

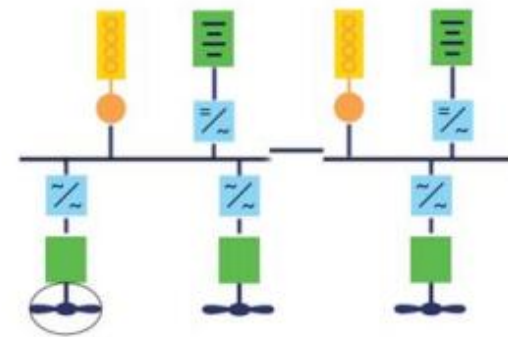
2.1 EMSA

Ship configurations:

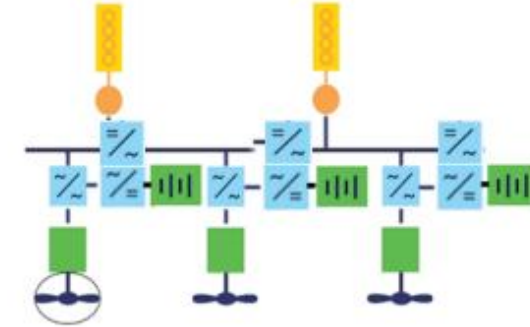
1. All-electric propulsion
2. Battery hybrid propulsion
3. Battery hybrid propulsion with distributed batteries
4. Mechanical propulsion with battery hybrid electric power plant
5. Electrical/mechanical hybrid with DC and AC power distribution
6. Auxiliary power supply for other services



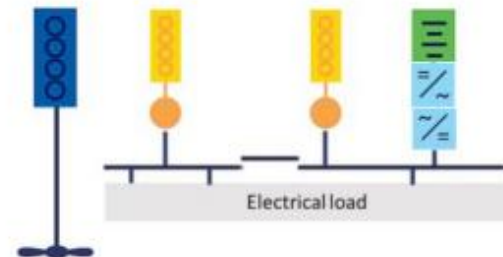
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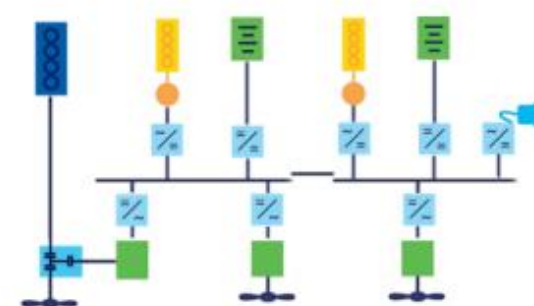
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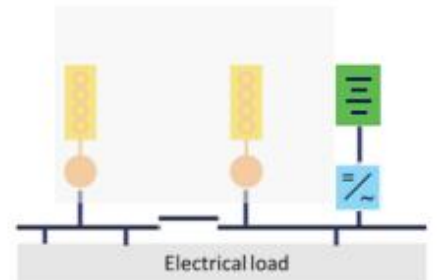
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4.



5.



6.

2.2 EMSA – Non-mandatory Guidance on the Safety of Battery Energy Storage Systems (BESS) on board ships (2023)

EMSA non-mandatory Guidance:



Addresses the following topological configurations:



Fixed (stationary) batteries installation



Containerized batteries



Distributed energy storage on-board



Is not applicable to installations of less than 5 kWh and does not refer to second life batteries, which may pose different safety concerns particularly related to aging, wear and tear.



Is goal based, setting Goals and Functional Requirements for design, construction, installation, operation and maintenance of BESS on board ships as source of power, ensuring the safety of the crew, passengers and the ship.



Refers to applicable standards in each chapter (IEC, ISO, UL...)

“The safety, availability, reliability and maintainability of the BESS and its on-board arrangement and installation should be equivalent to that achieved with new and comparable conventionally fuelled main and auxiliary machinery”.

2.3 EMSA – Non-mandatory Guidance on the Safety of Battery Energy Storage Systems (BESS) on board ships (2023)

EMSA non-mandatory Guidance builds on the following general principles:

-  Availability of power supply
-  Fire safety
-  Safety of electrical installations
-  Operational safety

General requirements for the risk assessment:

-  Section 6 contains the main principles and high-level instructions on **how to conduct a risk-assessment for BESS**. Relevant standards include:
 -  ISO 31000:2018 Risk management – Guidelines
 -  IEC/ISO 31010:2019 Risk management - Risk assessment techniques, with particular focus on section 7 (Selecting risk assessment techniques)
 -  IEC 60812:2018 Failure modes and effects analysis (FMEA and FMECA)
 -  IEC 61025:2007 Fault tree analysis (FTA)
 -  IEC 61508:2010 Functional safety of electrical/electronic/programmable safety-related systems

2.4 EMSA – Non-mandatory Guidance on the Safety of Battery Energy Storage Systems (BESS) on board ships (2023)

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2.5 EMSA – Non-mandatory Guidance on the Safety of Battery Energy Storage Systems (BESS) on board ships (2023)

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3. Classification Rules for BESS installations



BESS imply complex technology, with safety implications for ships and seafarers.



The acceptability of BESS is reviewed and enforced by Classification societies focusing on safety and engineering design, considering new and rapidly changing technology. Class experience helps ship designers and owners not having much experience or knowledge of BESS.



Classification societies have invested to build the necessary technical competence and knowledge to effectively assess any specific BESS technology. This ultimately yields a very necessary understanding of the goals, functional requirements and risks management to evaluate any proposed BESS installation.



There are significant variations in different ships, with a wide range of BESS and engineering approaches that must be holistically evaluated.



A Classification Society role is to be a hands-on knowledgeable partner in BESS integration process on board, to safeguard safety, reliability and availability.

3.1 Example - RINA Rules for BESS installation



RINA Rules Part C “Machinery, system and fire protection”:

- RINA Rules, Pt C, Ch. 2, Sec. 3, 7, 11 and 12: general requirements for electrical installation, including but not limited to system design, protection, storage, location and installation.
- RINA Rules, Pt C, Ch. 2, App. 2: requirements for battery powered ships.
- RINA Rules, Pt F, Ch. 13, Sec. 28: Additional Class Notation HYB-... for ships equipped with a hybrid propulsion system.



4. Simplified process for BESS installation on board

Goals and functional requirements

- Safeguard ship safety - no additional hazards are to be introduced
- Any single failure in BESS is not to cause loss of propulsion or of other ship essential services
- Fire safety: Safeguards against internal failure and fire from outside battery spaces
- Safeguards of operational requirements – power availability, monitoring and control of the energy capacities, ESD, etc.

Regulatory compliance for BESS installation

- Identification of applicable regulatory requirements (statutory + class)
- Requirements for Type Approval / certification of BESS
- Detailed documentation to be submitted, including all data, environmental conditions, test report of all tests from an approved Test Program
- Identification of hazardous areas on board, location and detailed arrangement of BESS, including accessibility and escape requirements
- Verification of construction requirements, electrical protection - Control, Monitoring, Alarm & Safety Systems and relevant sources of power

BESS risk assessment - HAZID, HAZOP, FMEA

- Identification of risks and risk mitigation measures

BESS tests and commissioning

- Equipment test by the Manufacturer at the presence of a Class surveyor
- Marinization - BESS functional and safety tests in compliance with IEC standards
- Test of battery chargers - communication between charger and BMS
- Functional tests (alarm system, safety system, control system, etc.) and any further test resulting from the Risk Assessment

Installation of BESS on board and integration with other ship systems

- Onboard tests and sea trials

Ship lifecycle compliance

- BESS performance evaluation / optimization in operation
- Evaluation of battery ageing
- Periodic surveys

Q&A