NEMOSHIP

WP4 - Multi-level management systems development

D4.5: ESS life extension predictive and diagnostic approaches - Public Summary:

The ambition of the NEMOSHIP project is to develop, test and demonstrate innovative technologies, methodologies, and guidelines to better optimise large electric battery power technology within hybrid and fully electrically powered ships. To help achieve this ambition, NEMOSHIP will develop a 1 MWh modular and standardised battery energy storage solution (BESS) that is able to exploit heterogeneous storage units and a cloud-based digital platform to enable data-driven, optimised and safe exploitation. The project will demonstrate the maturity of these innovations at TRL 7 for hybrid ships as well as their adaptability towards fully electric ships.

The present deliverable relates to WP4 “Multi-level management system development” and more specifically to Task 4.3 “Predictive maintenance and diagnostic indicators based on AI algorithms”.

The report details innovative diagnostic and predictive approaches for extending the life of battery energy storage systems (ESS) onboard ships, including power converters. This work is closely linked to the NEMOSHIP digital platform developed in WP2 which aims to implement a cloud infrastructure enabling secure online and bidirectional data exchange between digital threads of data, digital twins, advanced algorithms and 3rd party software for an optimised and secure operation of the BESS.

Two deliverables are due as part of Task 4.3. This first report focuses on the vessel Le Commandant Charcot (LCC), used as a demonstration in NEMOSHIP.

By using a cloud-based digital platform, the system continuously collects high-resolution operational data (such as voltage, current, temperature, and state of charge) from onboard sensors of the vessel LCC. This data is then analysed using artificial intelligence and machine learning techniques to predict battery performance and health.

The present report outlines methods for estimating the State of Health (SOH) of batteries, RUL (Remaining Useful Life) and predictive maintenance, including reliability assessment of the power electronics converters. By analysing discharge capacity and other parameters, the approach forecasts battery degradation, enabling ship operators to schedule maintenance proactively and reduce the risk of unexpected failures.

Through comprehensive data analysis, including capacity tests and statistical evaluation of temperature profiles, the project demonstrates a robust method to monitor battery performance over time. Initial results indicate that the diagnostic tool provides realistic and coherent SOH estimation, with recent measurements showing SOH values around 92 %.

Moreover, the Battery Health Management (BHM) system enables remote maintenance by supporting decision-making processes aimed at extending the lifespan of battery systems and power electronics conversion stages. It establishes diagnostic and predictive maintenance indicators based on both collected data and anticipated battery usage. Additionally, the BHM helps optimize daily battery operation to promote longer service life.

The advancements described in this report will be deployed on the NEMOSHIP demonstration vessels, starting with LCC. The project outcomes are expected to contribute significantly to the electrification of the European maritime fleet. By optimizing battery use and extending their operational life, the NEMOSHIP project supports the European Union’s goals for reducing greenhouse gas emissions in shipping and aligns with the broader roadmap for zero-emission waterborne transport.

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