NEMOSHIP

WP2 - Multi-layer digital platform development and implementation

D2.2: Virtual platform for ESS design and optimization - Public Summary:

The ambition of the NEMOSHIP project is to develop, test and demonstrate innovative technologies, methodologies and guidelines to accelerate large BESS deployment and optimal exploitation toward 2030 on both hybrid and fully electric configurations. To help achieve this ambition, NEMOSHIP will develop a 1 MWh modular and standardised battery energy storage solution 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 is part of WP2 which focuses on the NEMOSHIP digital platform development and implementation. This WP includes the development of digital twins for each of the NEMOSHIP use cases, namely an offshore vessel from Solstad, a cruise vessel from Ponant and two semi-virtual full electric use cases. Simulation in the context of the NEMOSHIP project involves the creation of detailed, dynamic models that replicate the behavior of vessel energy systems under various conditions. These simulations are essential for predicting performance, identifying potential issues, and optimizing operations without the risks and costs associated with physical testing.

By involving advanced simulation tools and techniques, the digital twin can emulate the complexities of hybrid ship configurations, including aspects such as energy storage, distribution, and consumption.

This report describes the virtual platform for modelling and design which has been developed for the simulation and evaluation of ships with large BESS. This marine virtual platform is common to all use cases and is based on 0D/1D modelling of the ship's components. The virtual platform consists of several sub-software modules for different optimization objectives. Firstly, Simcenter Amesim marine libraries to model the ships and use cases are created for dedicated interface modules enabling co-simulation with other partner's models and environment.

Secondly, different chemistry-related battery models including ageing effects are standardized for these models (inputs, outputs, parameters) compatible to the requirements of the whole virtual platform and digital twins, as well as modelling of

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power electronics converters based on efficiency maps. Then, a co-design optimization framework and tool based on low- and medium-fidelity models of system components and local micro-grid architecture (AC or DC) is developed, jointly with a subprogram to optimize the size of the battery according to operating conditions.

Finally, the co-simulation between MATLAB®/Simulink/Simcenter Amesim is detailed in order to set the framework for integrating the abovementioned models and tools into the full digital twin simulations.