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# Solutions for large batteries for waterborne transport

GRANT AGREEMENT No. 963560

# D3.2 – Integrated safe, modular & flexible battery system architecture

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## Document History

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| V01 | 20/05/2022 | Jonathan Baake | Draft for internal review |
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## Project Abstract

The goal of the SEABAT project is to develop a full-electric maritime hybrid battery concept that is based on:

- Modularly combining high-energy batteries and high-power batteries,
- novel converter concepts and
- production technology solutions derived from the automotive sector.

The modular approach will reduce component costs (battery cells, convertors) so that unique ship designs can profit from economies of scale by using standardized low-cost components. The concept will be suitable for ships requiring up to 1 MWh of storage or more.

## Public summary

The main goal of SEABAT is to develop a cost-effective hybrid energy storage system (HESS) architecture for large marine applications that is scalable to 1 MWh and beyond and validated at a level of 300 kWh. For this purpose, a suitable system architecture is required for a mix of high-energy and high-power batteries that allows a balanced compromise between ship energy and power requirements. Based on deliverable D3.1, that compared different hybrid topologies, the novel power converter concept was selected by all SEABAT partners at the first year general assembly meeting. This concept incorporates a low-voltage DCDC-converter for every battery module in the system, allowing these units to be placed in series to achieve a controlled DC-voltage and in parallel lines to scale total HESS energy capacity.

Within this deliverable, the description of the chosen HESS topology is expanded to a detailed HESS architecture. The architecture will be outlined by means of high-level and domain specific requirements. For each domain, a motivation will be given that elaborates on the specific architectural decisions that were taken.

The architecture as developed has considered TCO (total cost of ownership) and scalability on all domains. Electrical component placement as well as DCDC-converter design has taken production costs into consideration. Scalability of current and energy capacity, cooling and mechanical configuration of the system have been evaluated while establishing the architecture. Special attention was given to the control architecture, which can pose a critical limit to system scalability. This risk was mitigated by using several levels of controllers in the implementation. In the developed architecture, no practical HESS sizing limits exist for the developed control architecture.

For reliability and safety of the HESS architecture, the safety requirements were queried across all domains to ensure they were met across domains.

With the detailed description of the architecture now outlined, all necessary information is available to proceed with the preliminary design of the HESS realization within the SEABAT project. This preliminary design, along with its design decisions and cost-evaluation will be presented in the upcoming deliverable D3.3.

# 1 Acknowledgements and disclaimer

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Project partners:

| # | Partner | Partner Full Name |
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| 1 | FM | FLANDERS MAKE |
| 2 | DAMEN | SCHEEPSWERF DAMEN GORINCHEM BV |
| 3 | FCSI | FINCANTIERI SI SPA |
| 4 | RINA | RINA SERVICES SPA |
| 5 | SOERMAR | FUNDACION CENTRO TECNOLOGICO SOERMAR |
| 6 | VARD | VARD ELECTRO AS |
| 7 | ABEE | AVESTA BATTERY & ENERGY ENGINEERING |
| 8 | IMECAR | IMECAR ELEKTRONIK SANAYI VE TICARET LIMITED SIRKETI |
| 9 | UNR | UNIRESEARCH BV |
| 10 | CEA | COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES |
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