



# Energy Storage Solutions – for the Most Efficient Use of Energy

For hybrid and fully electric systems on ships, the energy storage is an essential part and has to be designed in regard to the respective challenging application performance. Thus, we offer you customised solutions with a well-established and safe energy storage system (ESS) that is already in use in numerous projects – from fish farming vessels and ferries to offshore supply vessels and also on mega yachts, not to mention the numerous onshore industrial applications.

Our ESS solution is based on liquid cooled, encapsulated high power battery modules and is currently one of the safest in the world. The modular system concept makes it easy to customise your energy storage solution exactly to your application. The batteries come as „plug & play“ modules and are installed in modular racks. This ensures an easy installation and replacement and reduces purchase and maintenance costs. And even when the system is outdated, it is not necessary to acquire a new system, because it can be easily renewed by replacing the components – a cost-effective and sustainable solution.

## Application and Features

- Power Mode: Providing high energy in short time
- Energy Mode: Providing constant energy level over long time
- Peak Shaving Mode: Providing punctually energy to avoid load peaks
- Harbour Mode: Generate power without running your Diesel generators or without shore connection – clean and silent!
- “Bring me to harbour” Mode: Your redundant system for propulsion – no noise, no pollution.

## Your benefits at a glance

- Individual consulting for your application from experts
- Safe and reliable energy storage due to *PBES CellCool™ Liquid Cooling*
- High performance XALT Lithium-ion cells (3C rating) for maximum power and performance
- Simple integration into both new buildings and retrofits
- Modular concept (*CellSwap™*) ensures customisable power and easy maintenance
- Simple installation in various configurations due to modular racks
- Reduced blackout risk through operating ESS
- Optimised fuel consumption and lower engine maintenance costs through efficient energy usage
- Reduced number of generator start/stops or even saves space due to the fact that less generators are necessary
- Project-specific class approval for any of the major classes (ABS, BV, DNV-GL, LR)



NORIS Automation GmbH is a registered solution partner of PBES  
<http://www.pbcs.com/>

## CellSwap™ Advantages

Traditional battery systems require the entire system to be replaced at end of life – but not with *CellSwap™*: The process is simple and safe. The cell stack easily separates from the electrical controls. The new cell stack is pre-assembled in the PBES factory in Norway and shipped to the vessel for installation. Old cell stacks are refurbished in the factory and reused and thus, *CellSwap™* helps to protect the environment.

- Provides a more efficient and cost effective solution
- Reduces battery system size and weight
- Reduces capital investment
- Reduces operational and installation costs
- Reduces installation time and effort
- Reduces electronic waste due to refurbishing aged components
- No changes in power management necessary
- Avoids system over sizing for cell aging

## BBU Module

The BBU modules are available in two variants: *Power 65 (P65)* and *Energy 100 (E100)*. *Power 65* has been designed for high discharge power applications requiring high C-rates and faster cycling. *Energy 100* has been designed for applications requiring lower discharge rates and greater energy density.

Single BBU Module	Power 65	Energy 100
Engineered Design Life	5/10 years	5/10 years
C Rate RMS (Continuous)	3C	1.4C
Cycle Life @ 80% DoD	15000 cycles	TBF
Cell Chemistry	NMC	NMC
Energy	6.5 kWh	10 kWh
Capacity	75 Ah	112 Ah
Voltage Range	77-100 VDC	77-100 VDC
Nominal Voltage	88.8 VDC	88.8 VDC
RMS Continuous Current	225 A	160 A
Max. Discharge Current	450 A	336 A
Max. Charge Current	225 A	112 A



BBU Module

## PBES CellCool™ Liquid Cooling

Traditional ESS are based on air cooled batteries. Disadvantages of these batteries are increased aging and thus, a reduced life cycle and also the problem of overheating and inflammation in case of peak loads. The *PBES CellCool™ Liquid Cooling* ensures a uniform temperature across the battery cells and thus, a uniform battery aging. Furthermore a temperature sensor on each cell is used for overheating monitoring and allows to observe bad cell behaviour developing over time. An external air conditioning system, as it is used for air cooled solutions, is also not necessary. This is the safest way for your application.

## Individual consulting for your application

No matter whether new building or retrofit: We guide you through the whole project. From the planning phase in regard to project scope, system architecture and specification up to system installation and configuration. Even after sales, maintenance and service support is guaranteed.



MBU Rack

## MBU Rack

Up to 15 BBU modules are interconnected in series and can be installed in one MBU rack. Here is an example: With 2 BBU modules, the rack can generate a power of 200 VDC/13 kWh. A rack with 15 BBU modules generates a power of 1500 VDC/97.5 kWh.

## PBU Array

Up to 12 MBU racks are interconnected parallel in a PBU array to meet your energy requirements. Here is an example: 2 MBU racks with 10 BBU modules generate a power of 1000 VDC/130 kWh. 10 MBU racks of 15 BBU modules generate a power of 1500 VDC/975 kWh.



PBU Array