Shore power can be a game changer

Short sea solution

A new breed of battery operated short sea vessels offer opportunities to eliminate all environmental emissions, especially if batteries can be charged on shore.

On-going advances in high power and energy dense battery technology are opening the doors to emission free operation for ferries and other short sea vessels. Hybrid solutions enable charging at sea, yet compromise in terms of environmental performance. For optimal emission and fuel results, on shore charging is the answer.

Shore side power utility infrastructure for vessel battery charging is an ideal solution for emissions free short sea ships, but several crucial factors must be considered. Most vessels with batteries on-board have short port calls, typically between 5-15 minutes, and this sets boundaries for on shore connection technology. Amongst key criteria for consideration are:

- Shore side availability of power
- AC or DC energy transfer technology
- High Voltage or Low Voltage
- Standards to be followed
- Automatic or manual connection

Time and power

From the above, the most critical consideration is whether to establish an automatic or manual connection. When this choice has been made, the remaining factors need to be assessed based on the available infrastructure and energy demand for battery charging.

A first evaluation point for choosing either an automatic or manual connection is time. How many minutes does the customer have to charge their batteries? Two examples can be seen in tables 1 & 2 where the total energy to be transferred is 1.2 MWh & 120 kWh, respectively. Comparing the peak power and the current demand from the grid, there is a major difference in required power. For the example used in table 1, we also need to evaluate the size of the electronic systems linking shore side and the batteries. With a charging power of 7.2MW, the physical size of the equipment and the power demand can be reduced by 30%. As this type of vessel is typically limited in size, the available space for equipment cabinets is at a premium. In addition to this physical size and demand for space, manual connections also have additional implications for the potential risks they pose to personnel.

Automatic shore connection enabled by the ABB Robotic solution

Highs and lows

The second factor to be evaluated is the use of high or low voltage for energy transfer. Power equals voltage multiplied by current. If one goes up the other must go down, and vice versa, in order to reach the same power level. In AC systems the limit between low voltage (LV) and high voltage (HV) is set at 1 kV. Low voltage connections and procedures are less regulated than high voltage solutions. Crews operating with HV systems are required to have high voltage permits. Furthermore, safety systems, precautions and procedures are more complicated, meaning more time is needed to establish a connection.

As can be seen in the tables, there is a significant variation in the amperage required at the different voltage levels. In practice, LV currents from 5 to 1.5 kA are challenging, meaning a HV solution should be considered for power transfer.

Current rating naturally affects the cable cross-section and weight. High amperage low voltage cables are heavy and difficult to handle, due to the amount of copper needed. In many cases a bundle of lighter cables must be used to make them easier to pull and connect. The availability of flexible cables in high cross sections is also limited. In high voltage solutions the current is much less, whereas the voltage level requires more insulation. This in turn makes the cables less flexible.

The answer is automatic

Taking into consideration the above factors, as well as the typical charging profile for a vessel operating exclusively on batteries, choosing an automatic shore connection, rather than a manual one, is the natural choice.

Automatic shore connection systems, such as the ABB Robotic solution illustrated above, offer greater flexibility for selecting a voltage level that best suits the vessel's charging profile. In addition, automatic connections eliminate the need for manual interfaces, reducing the demand for high voltage training while minimising risk for personnel.

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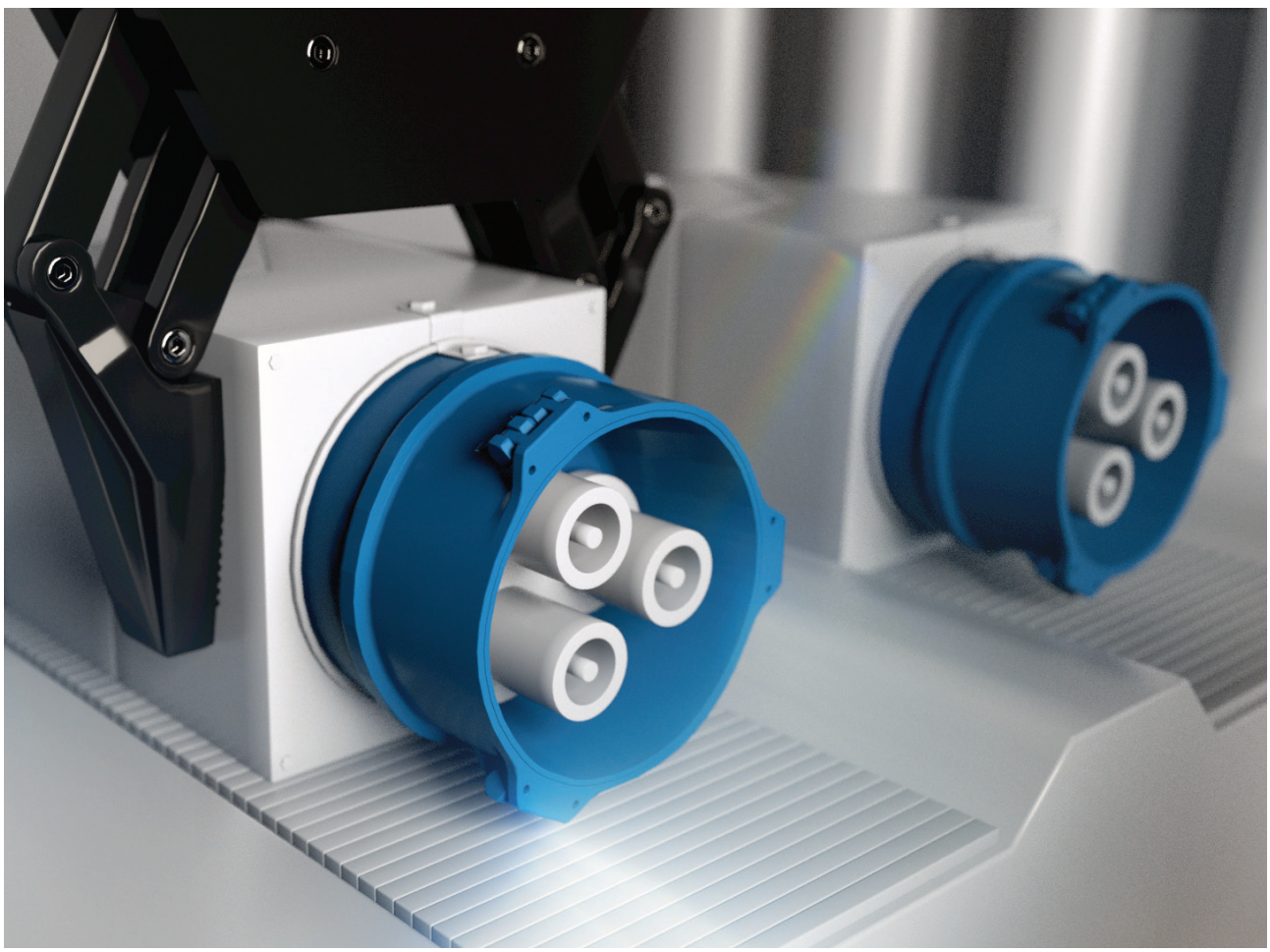
Energy transferred: 1.2 MWh	
Automatic connection charging time: 10 min	Manual connection charging time: 7 min
Charging power: 7.2 MW	Charging power: 10.3 MW
Charging current	
0.4 kA @ 10 kV	0.6 kA @ 10 kV
10.4 kA @ 400 V	14.9 kA @ 400 V

Table 1



Automatic shore connection

Energy transferred: 120 kWh	
Automatic connection charging time: 10 min	Manual connection charging time: 7 min
Charging power: 720 kW	Charging power: 1030 kW
Charging current	
40A @ 10 kV	60 A @ 10 kV
1040 kA @ 400 V	1490 A @ 400 V

Table 2

Automatic shore connection