7000

tonnes per year less CO_2 emission after transition to electric-driven ferries

ENGINEERING TOMORROW

Danfoss

Case story | VACON® NXP Grid Converter

Where smart ferry charging begins with a **smart grid**

The situation

NORWAY: The Hareid-Sulesund ferry operator has reduced CO_2 emissions by 7000 tonnes annually with the introduction of electric vessels. In transitioning ferries from diesel to pure electric power, powerful onshore support is essential, in the form of reliable infrastructure for rapid charging capacity and stable grid supply. The systems on board and on shore act as a single system – a sophisticated and competitive system developed by Norwegian Electric Systems (NES) using Danfoss technology.

Norwegian Electric Systems AS is a total supplier of low-emission, sustainable energy design and smart control for a wide range of vessels for the global marine market.
NES designs optimal propulsion systems for vessels and control systems to ensure safety via smart and easy operation.

The challenge

The electric ferry “Suloey” is about to dock at Hareid ferry terminal. The crossing from Sulesund has been made in strong headwind, with high electricity consumption during the crossing. Below decks, the electric ferry “Suloey” is equipped with propulsion, automation and charging systems from Norwegian Electric Systems (NES). “There is a need for proper charging after such a trip”, explains the captain of “Suloey”.

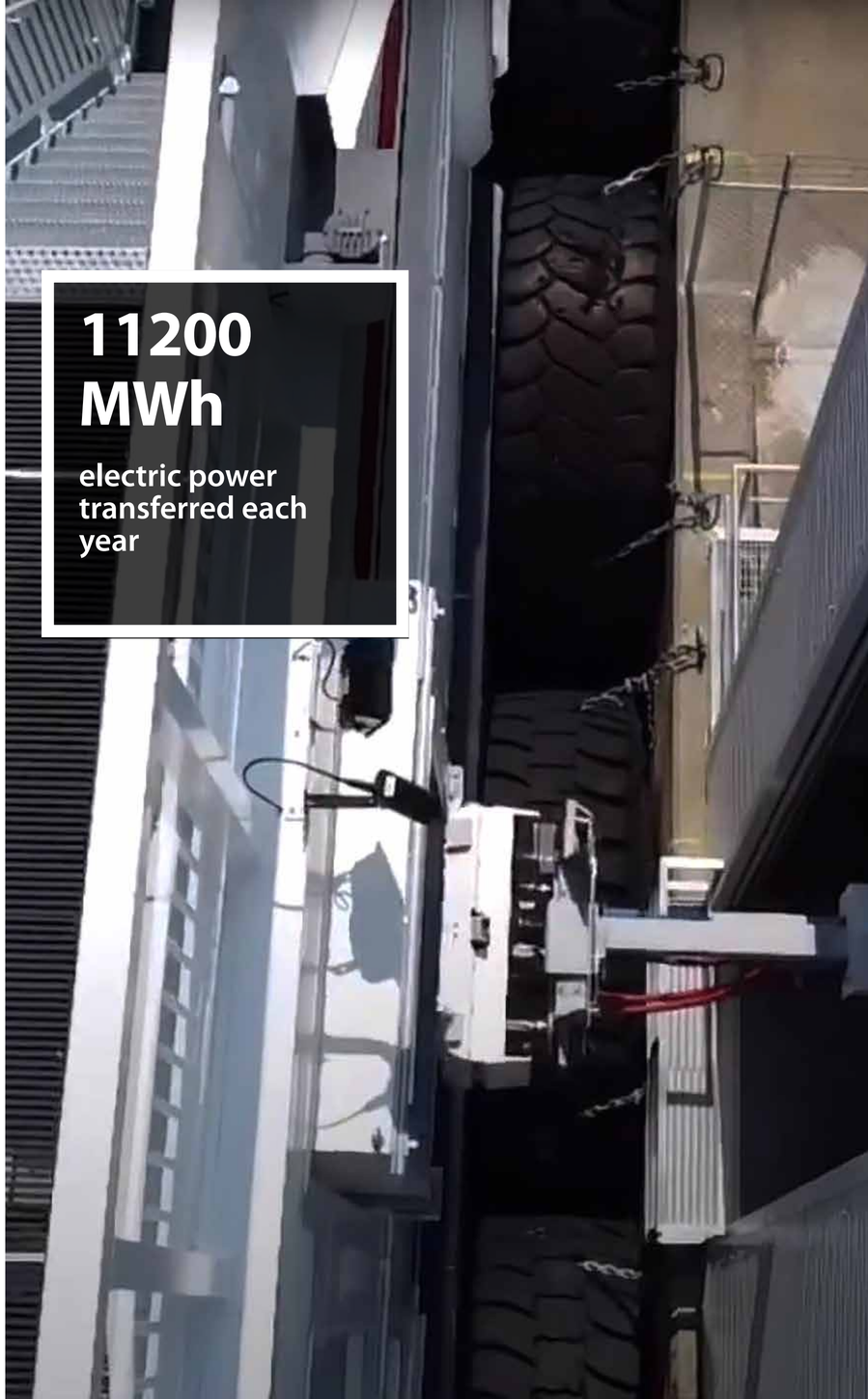
With a simple touch on the charging display, the fully-automated charging tower on shore connects to the ferry within a few seconds. Charging power close to five million watts ensures that the batteries on board are rapidly recharged. After 6 minutes, the charging system disconnects and “Suloey” sets course over to Sulesund again.

Suloey, together with her sister ferries Hadaroey and Giskoey, currently makes an important contribution to reducing maritime emissions. The transition from diesel-driven to all-electric ferries on the Hareid-Sulesund crossing ensures annual reduction in CO_2 emissions by as much as 7,000 tonnes, based on 32,000 vessel charging sessions every year.

Calculations at both ferry terminals showed that the existing power grid required extra power to achieve the necessary charging power. NES strengthened the power grid on both sides, and retrofitted vessels with batteries and the newest converter and power control technology, for the optimal electric-powered solution.

“During charging, the system ensures that charging power adjusts to transfer exactly the energy required, no more and no less. By ensuring optimal charging power, the system avoids unnecessary wear on batteries and power electronics, both on board and on shore.”

Torbjørn Haugland,
Vice-President of Energy Design
at Norwegian Electric Systems



11200 MWh

electric power transferred each year

The solution

NES and Danfoss have the answers to all these engineering challenges. Håvard Wolden from Danfoss explains: “The electric ferry charges 350 kWh of power in just 6 minutes. This scale of charging places stringent demands upon the smart grid onshore in Hareid and Sulesund, which supports reliable power supply for the electric vessel rapid charging system.

NES supplemented the onshore power supply with battery storage systems powered by Danfoss grid converters, to ensure adequate charging capacity and speed. The electricity used to supply the system is supplied from renewable sources, to minimize losses and optimize operating costs. “

Stabilizing voltage by feeding reactive power back to the grid

The charging stations at Hareid and Sulesund are operated by Norway’s largest ferry company, Fjord1. The charging system is based on the latest power conversion and transmission technology, developed by NES.

Onshore: The grid system is based on NES-built energy storage systems using VACON® NXP Grid Converter. During charging, the vessel accumulates 5 MW power, comprising 3 MW from the local AC grid and 2 MW from the combined power of onshore batteries.

On board: VACON® NXP Grid Converter in the machine room converts the shore AC-voltage to stable DC-voltage on board. A VACON® NXP DC/DC Converter charges the batteries from the onboard DC-grid.

NES supports the crew by remotely monitoring performance from Bergen, providing technical support if challenges arise. Operational data feeds continuously to a cloud-based solution, supplying the ferry operator Fjord 1 with a full overview of electricity consumption and operational performance.

The outcome

In total, the charging stations on this ferry route perform about 32,000 charging operations and transfer approximately 11200 MWh of electric power per year.

The systems on board and on shore are fully integrated. When the ferry approaches the charging station, information about the energy consumed on the trip is communicated to the shore station. The system also checks the power grid and compensates to ensure no voltage disturbances arise. The charging system is designed to minimize voltage disturbances, feeding reactive power back to the grid during charging to maintain stable grid voltage. This in turn enables the local grid to deliver even more energy during charging of the vessel.

By actively controlling, monitoring, and supporting the grid from local batteries on shore side, the system supplies the high peak power crucial to rapid charging, with no need to scale up grid infrastructure. Instead of extra capital investment, the system relies on peak shaving functionality. Peak shaving optimizes the energy flow between the incoming supply and local onshore storage to meet spikes in demand without disrupting the supply grid. Excess energy is stored when demand and electricity prices are low.

norwegian electric systems
part of HAV group

“The charging system reduces peak power consumption by drawing on shore battery power instead of energy from the grid, for short intervals of time, for example when the electricity price is high.”

Torbjørn Haugland,
Vice-President of Energy Design
at Norwegian Electric Systems