

ENGINEERING  
TOMORROW

*Danfoss*

Case story | VACON® NXP Grid Converter

## Danfoss shaft generators **drive down emissions** on board Korean research vessel

The South Korean National Institute of Fishery Science is enjoying great fuel savings and 20-30% less emissions from its newest research vessel. Danfoss Drives supported the South Korean ship engine experts STX Engine in designing an innovative drive solution to optimize generator and engine performance on board.

The Danfoss Drives solution was instrumental in helping the shipbuilder to comply with the IMO environmental regulations effective in 2020.

**30%**

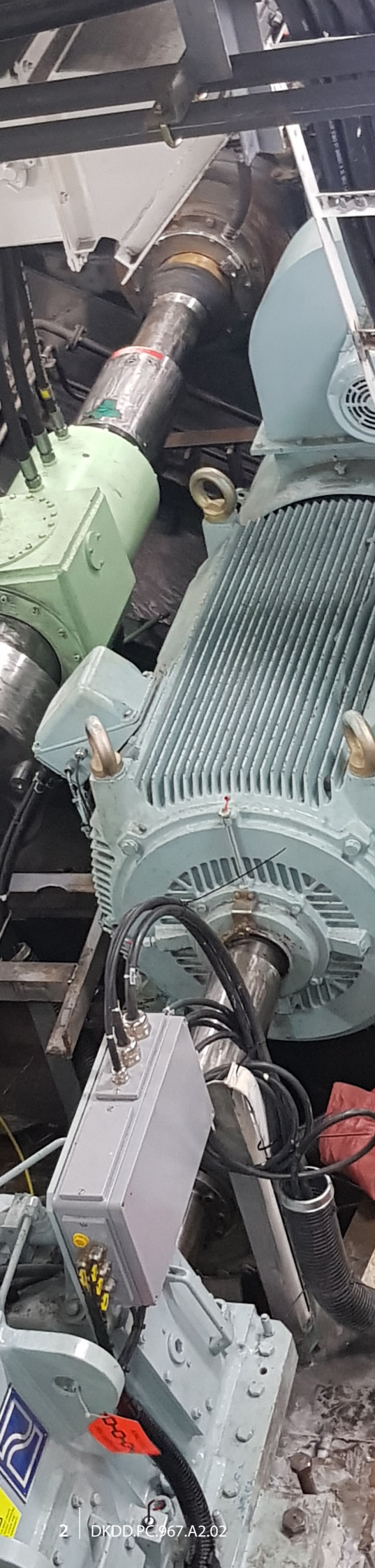
less fuel  
consumption than  
conventional shaft  
generators



**VACON®**

[drives.danfoss.com](https://drives.danfoss.com)





## Surmounting design hurdles

Initially the project was awarded to an engine supplier who had difficulty meeting requirements in the design phase. A challenge in this project was to use the European synchronous generator as stated in the specification. Meeting this requirement involved overcoming significant hurdles in commissioning cost, control and performance.

Therefore, the customer invited Danfoss Korea into the project, for its variable speed drives expertise and reputation for high-level design support.

There were many challenges in achieving the task, and Danfoss was the only supplier in Korea able to meet the customer requirements.

## Optimal drive dimensioning saves space

In vessels, shaft generators are classified as generators. The design challenge was to double the standard shaft generator capacity, to meet the short circuit current requirements.

Local on-site technical consultation between Danfoss Korea, Danfoss Center of Excellence team, and STX Engine enabled the parties to finally agree

on optimal AFE dimensioning and capacity, with standard overloadability. For this project, Danfoss was able to deliver a less complex, more high-performance shaft generator design. Installing a shaft generator onboard helped to meet emission targets by improving operational efficiency, and enabling designers to downsize the engine.

## Electric propulsion for **lower emissions**

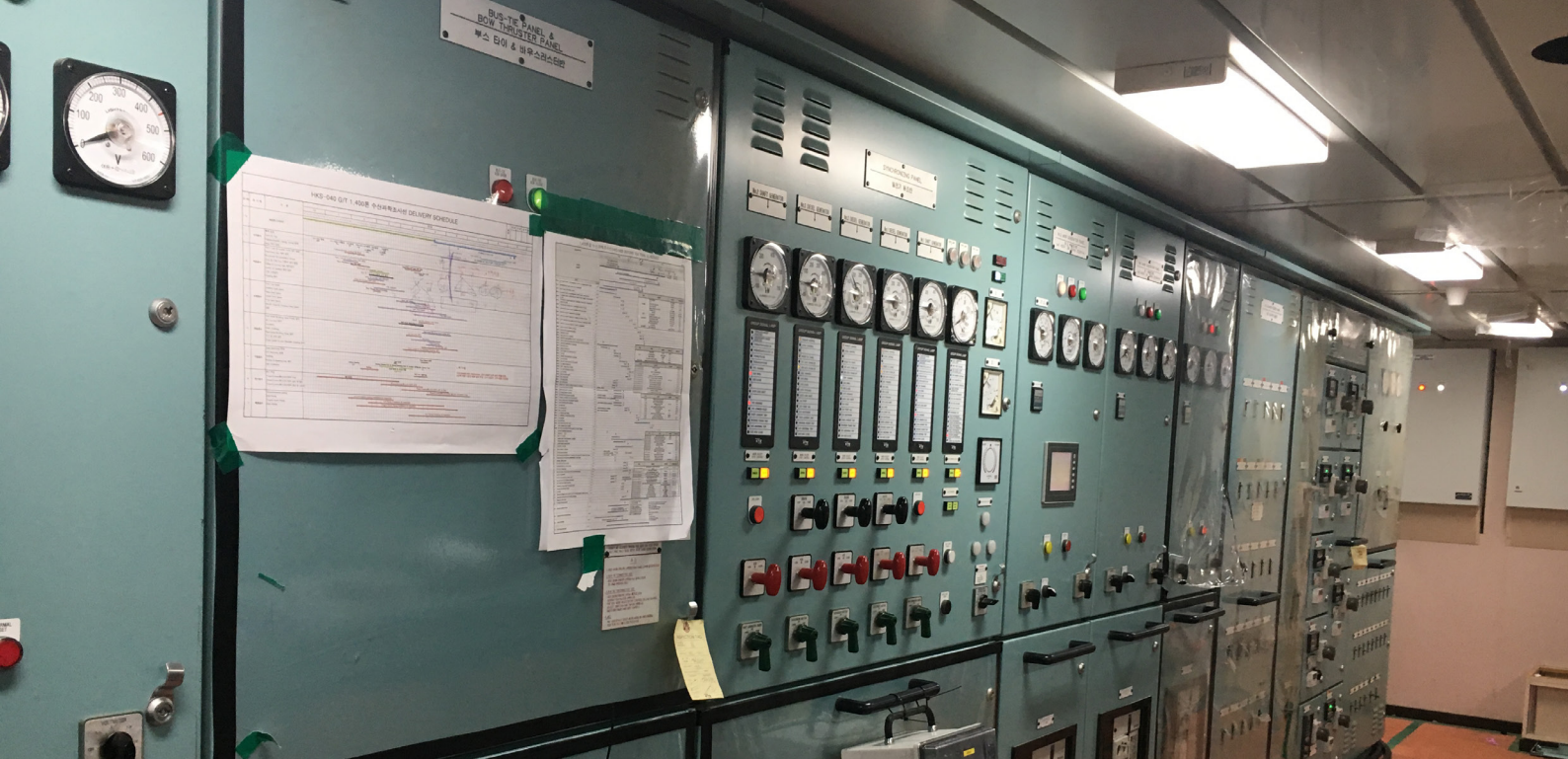
The Danfoss Drives shaft generator solution offers many advantages for ocean-going vessels:

1. The Danfoss Drives solution uses asynchronous generators. This meant that specifications needed conversion from synchronous to asynchronous mode, made possible by the local engineering and site trials
2. Since the generator and engine are powered up via the Danfoss drive to provide power to navigation and ships, the result is an eco-friendly standard of operation with less noise, low vibration, lower energy consumption and lower

CO<sub>2</sub> and NO<sub>x</sub> emissions compared to ordinary ships

3. During low-speed or part load operation, ships can run in electric propulsion mode without starting up the engine, for lower noise levels and reduced energy consumption
4. When operating the winch onboard a vessel, electric propulsion mode also protects the generator from overload. This approach helps to maintain the stability of the vessel, and improves reliability by avoiding overload which could lead to blackouts. In turn this extends component life expectancy.





## Installation

Danfoss conducted local engineering, project management, local engineering commissioning, and ran a shaft generator demo system made by Danfoss Korea showing how to create an end-to-end system, and how to adapt the hybrid solution to this specific installation.

Since the shaft generator is classified as a generator onboard the ship, the conditions required for the general generator were applied.



*The shaft generator demonstration system built by Danfoss Korea*

## Makeup of the shaft generator

The 500 kW shaft generator system is built up of these products:

- VACON® NXP Grid Converter with LC sine filter
- VACON® NXP generator converter with dU/dt filter
- Liquid-cooling station HXM-M-120-N-S
- Engineering cabinet
- Transformer
- Motor/generator

Application: 500 kW shaft generator system







## How does the **shaft generator** work?

The operation principle of conventional shaft generators used for controllable pitch propellers is to generate an electromagnetic field between stator and rotor using automatic voltage regulation (AVR) and an excitation unit.

However, when running at low speed, the output voltage and frequency can reach such low levels that rated output voltage and frequency cannot be

generated. Thus in order to drive the generator at rated speed, an excitation unit with an additional drive is required to boost the excitation voltage - and ensure the correct frequency.

An additional requirement of this project was power take in (PTI) functionality for the electric propulsion in order to control the speed of the propeller, which required an AC drive.

Using an induction motor as generator combined with a Danfoss AC drive, the complexity of the synchronous generator with excitation system was eliminated, resulting in significant cost savings for commissioning and maintenance.

## STX Engine

STX Engine is a subsidiary of STX Corporation, founded in 1976 in South Korea. It is a specialized general engine maker as well as a global leader in the field of electronic communication, supplying markets in Europe, Asia, and South America. It produces marine engines for large container ships, LNG vessels, and oil tankers, as well as industrial engines including engines for onshore plants, gas engines, railroad vehicles, and more. Its technologies are based on defense industry engines for naval vessels and coastguard patrol vessels. STX Engine also develops ship automation systems, navigation and communication systems. <http://www.stxengine.co.kr/eng/>