Shaft generator drive for marine
Decreasing emissions, improving safety
Decreasing emissions and fuel consumption

Today, fuel costs account for up to 60% of a vessel’s operating costs. In addition to the high cost of fuel and tightening competition, new global and regional environmental regulations are challenging ship owners and operators to make energy efficiency their top priority.

ABB is the world’s largest producer of electric motors and variable-speed drives, and regardless of the application we will ensure the optimal drive systems and configurations.

Shaft generator drive compared to traditional solutions
In the traditional fixed-speed shaft generator system, the shaft-generator is driven by the ship’s main engine, which is also driving the ship’s propeller. In such a solution, the ship network frequency is tightly tied to propeller rotational speed. Any change in speed has a direct impact on network frequency. Thrust and ship speed can therefore only be controlled by propeller pitch, leading to undesired loading of the main engine, decreased efficiency and increased CO₂ emissions.

A shaft generator drive (SGD) allows a wide speed range for the main engine. Propeller pitch and main engine speed can always be optimized for any desired sailing speed. The shaft generator drive maintains a stable voltage and frequency regardless of the main engine speed.

SGD is utilizing advanced and well proven ABB AC drive technology, being the right answer even for the most demanding requirements. ABB’s high power marine approved drives are built to be compact, robust and efficient with high reliability.

Lower specific fuel oil consumption
When the SGD is installed between the shaft generator output and the electric distribution system, the shaft generator can be used independently of the shaft speed, enabling a ship’s operations to be optimized for each route. The SGD also allows the shaft generator to run in parallel with the auxiliary generators.

This means that the full benefits of lower specific fuel oil consumption (SFOC) for the main engine compared with the auxiliary engine can be fully exploited. If the auxiliary engines use marine diesel oil (MDO) instead of heavy fuel oil (HFO), the difference is even greater: the costs of lubrication oil and maintenance are relatively higher for auxiliary engines than for main engines.
Improving safety and flexibility

In vessels where only one main engine drives propulsion, vulnerability to engine failure is an obvious issue. Integrating an in-line (or geared) electrical motor drive train into the shaft line can improve crew safety, as well as benefiting the environment, the payload and the ship itself.

The power take off (PTO) function can easily be extended to a combined PTO/PTI (power take in) when the shaft generator drive is installed between the electrical machine and the electric distribution system by allowing the machine to operate as either a motor or generator.

**Take-me-home when main engine fails**

In practice, the SGD controls the shaft generator speed (in motoring mode) using the power generated by the auxiliary engines. Therefore, the auxiliary engines can be used to rotate the main shaft if the main engine is malfunctioning. This feature, which allows the vessel to be maneuvered if the main engine fails, adds redundancy and a higher level of safety, making it possible for the vessel to reach port or to anchor safely on its own.

PTI mode also allows for more maintenance work to be done on the main engine during loading or unloading because the vessel can move to anchorage if it is required to leave its berth.

**Additional safety**

The need for an alternative means of propulsion is crucial, especially when a vessel must move through narrow straits, areas with high traffic and close to ports – or even during engine maintenance. In spite of this, alternative propulsion-drive systems are often not used due to additional installation costs.

However, SGD provides a system that is designed for multipurpose operations (such as multiple optimized speeds), and is also used during normal operations. This can improve fuel efficiency and increase the flexibility of a ship’s design and operations – in addition to improving safety.

**Flexible shore-to-ship connection**

Depending on the shore, there are different voltage levels available for ship connection. The shaft generator drive can be utilized for shore-to-ship connection. This drive is capable of connecting any shore network to the ship’s grid.

This addition gives the ship the possibility to shut down all the main and auxiliary generators when in port. This means fuel savings and reduced emissions.

**Multidrive configuration**

Shaft generator drive can be configured as multidrive to include supply inverters for example for cargo and ballast pumps.
Without having to make any excessive changes in a vessel’s design, it is feasible to install systems that improve safety through redundancy and the availability of propulsion, while at the same time allowing for flexible designs that reduce the costs of the main engines and fuel costs.

In summary, the benefits of shaft generator drive are:

- Increased safety with take-me-home capability
- Lower SFOC while auxiliary power is generated by main engine instead of auxiliary engine
- Reduced need for lubricating oil and reduced maintenance costs for auxiliary engine
- Lower installed auxiliary engine power or amount
- Reduced emissions
- Utilization of waste heat recovery system (WHRS) power to increase main engine efficiency
- More flexible solution to connect to onshore power supplies
- Redundancy in case of main engine or auxiliary engine malfunction
- Independent optimization of propulsion efficiency and electricity production
- Enables generator operation with combinatory curve
Multiple generator configurations

**Generator installation possibilities**
Generator can be installed in different places on the shaft line as shown in picture on the left.

1. Directly to the main shaft.
2. With gearbox to the main shaft.

**Modernization of old shaft generators**
Existing fixed speed shaft generators can be upgraded with SGD. This enables the optimization of the main engine speed for any sailing speed. At the same time SGD guarantees the ship’s network stability.

**Integration with automation and power management systems**
Shaft generator drive can be connected to the ship’s automation systems including power management system.

It is controllable directly from the bridge or automatically by PMS/CAMS.

**Compatible generator types**
Shaft generator drive supports wide range of generator types, eg, synchronous generators, permanent magnet generators and induction generators.
All operation modes in one drive

**PTO (island and parallel modes)**

In power take-off (PTO) operation, the shaft generator operates as a generator. The SGD can operate in island mode (single generator) or in parallel mode with other auxiliary generators.

SGD uses droop control to adjust voltage and frequency when operating parallel with other generators. The SGD is seen as one of the generators in the system.

In addition to basic features, the shaft generator drive includes extra functionality. The SGD can compensate unbalanced loads in the grid and also provides reactive power compensation.

**PTI (electric and hybrid modes)**

In power take-in (PTI) operation mode, the shaft generator functions as a motor. The power is taken from auxiliary generators and the SGD operates the motor.

The take-me-home feature can be used if the main engine has malfunctioned. The main engine can be decoupled from the shaft line so that the shaft generator can operate independently, allowing the main engine to be repaired.

The motoring power of the shaft generator can be used to boost main engine power. The SGD can drive the shaft generator/motor in synchronization with main engine.

**Shore-to-ship**

The shaft generator drive offers a flexible solution for onshore grid connection. It can be connected to 50 Hz or 60 Hz grids. Various voltage levels are supported.

The change between auxiliary generators and shore supply connection is seamless. Auxiliary generators can be left running while joining the shore connection to the shaft generator drive. After the SGD is synchronized with the auxiliary generators, they can be stopped and the SGD will provide the needed energy from the shore.
Global network, local presence

After-sales service is an integral part of providing the customer with a reliable and efficient drive system. The ABB Group of companies operates in more than 100 countries and has a worldwide network of service operations.

Testing
ABB is committed to ensuring the reliability of every drive it delivers. To verify that quality standards and customer requirements are fully met, every component of a drive is subjected to thorough testing in ABB’s modern test facilities.

Routine tests and functional tests form an integral part of the scope of supply of ABB’s drives. They are performed in accordance with international standards and ABB quality assurance procedures.

Additionally, ABB can perform a combined test with the complete drive system – including transformer, converter and motor – to verify its performance and to ensure a smooth integration into the customer’s facility.

Installation and commissioning
Proper installation and commissioning of the equipment carried out by qualified and certified commissioning engineers reduces startup time, increases safety and reliability and decreases life cycle costs. In addition, operators can be given practical training by experienced specialists on site.

Life cycle management
ABB’s drive life cycle management model maximizes the value of the equipment and maintenance investment by maintaining high availability, eliminating unplanned repair costs and extending the lifetime of the drive.

Training
ABB provides extensive training in the use of its drives. A range of training programs is offered, from basic tutorials to programs tailored to a customer’s specific needs.
For more information please contact your local ABB representative or visit:

www.abb.com/drives
www.abb.com/marine