From Bridge to Propeller

Diesel-electric propulsion systems are used on ships with special requirements. These systems are based on the principle of speed controlled AC or DC motors driving the propeller directly or by gearing. The most reliable and low noise design is the direct drive.

Electric propulsion systems are designed according to the „power station principle". That means that under normal conditions all alternators are feeding a common bus bar system. The main propulsion drives, thruster and other drives and the mains consumers are connected directly or via transformers to this bus bar.

Depending on power, characteristic and noise requirement converter fed propulsion systems are used with synchronous, asynchronous or DC motors.

DC motors are well proven as especially low vibration and low noise propulsion drives of research vessels and other special ships.

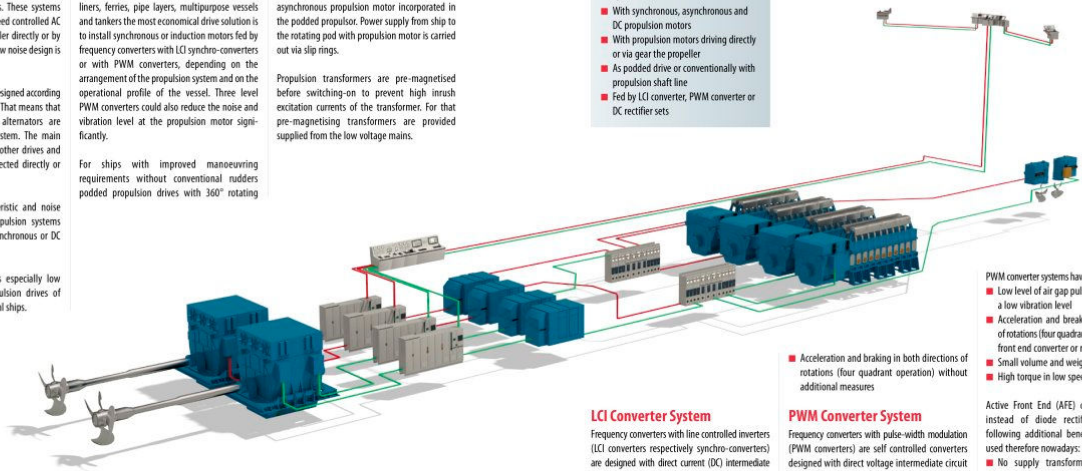
For propulsion power on board of e.g. cruise liners, ferries, pipe layers, multipurpose vessels and tankers the most economical drive solution is to install synchronous or induction motors fed by frequency converters with LCI synchro-converters or with PWM converters, depending on the arrangement of the propulsion system and on the operational profile of the vessel. Three level PWM converters could also reduce the noise and vibration level at the propulsion motor significantly.

For ships with improved manoeuvring requirements without conventional rudders podded propulsion drives with 360° rotating angle are provided with synchronous or asynchronous propulsion motor incorporated in the podded propulsor. Power supply from ship to the rotating pod with propulsion motor is carried out via slip rings.

Propulsion transformers are pre-magnetised before switching-on to prevent high inrush excitation currents of the transformer. For that pre-magnetising transformers are provided supplied from the low voltage mains.

Since 1966 SAM Electronics is carrying on the technology and industry traditions of its predecessor AEG Marine branch (AEG Schiffbau) and has delivered more than 200 converter fed propulsion drives for more than 85 ships in all configurations and powers:

- With synchronous, asynchronous and DC propulsion motors
- With propulsion motors driving directly or via gear the propeller
- As podded drive or conventionally with propulsion shaft line
- Fed by LCI converter, PWM converter or DC rectifier sets



LCI Converter System

Frequency converters with line controlled inverters (LCI converters respectively synchro-converters) are designed with direct current (DC) intermediate circuit and consist of thyristor rectifiers at the mains side, thyristor inverter at the motor side, DC reactor in the intermediate circuit, excitation converter and control system. LCI converters are provided for supply of synchronous motors.

Synchro-converter based systems were also used in SAM Electronics' former shaft alternator system design with more than 385 delivered units since 1967.

LCI converter systems have following advantages:

- For highest power available
- Acceleration and braking in both directions of rotations (four quadrant operation) without additional measures

PWM Converter System

Frequency converters with pulse-width modulation (PWM converters) are self controlled converters designed with direct voltage intermediate circuit and consisting (in the standard solution) of diode rectifier at the mains side, insulated gate bipolar transistor (IGBT) or integrated gate commutated thyristor inverter (IGCT) at the motor side, DC capacitors in the intermediate circuit and control system. For improved mains quality and for reverse power characteristics the diode rectifier at the mains side is replaced by an IGBT rectifier (active front end AFE design). PWM converters are provided for supply of asynchronous or synchronous motors. In case of synchronous motor supply an excitation converter is provided additionally.

PWM converter systems have following advantages:

- Low level of air gap pulsation which results in a low vibration level
- Acceleration and breaking in both directions of rotations (four quadrant operation) with active front end converter or reverse power resistor
- Small volume and weight
- High torque in low speed ranges

Active Front End (AFE) converters with PWM instead of diode rectifier input offer the following additional benefits and are typically used therefore nowadays:

- No supply transformer for 12-pulses or 24-pulses configuration, no chopper with control system and breaking resistor for reverse power consumption necessary
- Much better mains quality with THD < 5 % without additional measures
- More economic operation by better efficiency

PWM converters are also used in SAM Electronics' actual shaft alternator system design for low as well as for high voltage application in latest state-of-the-art technology.

Propulsion motor 15 MW, 135 rpm on cruise liner "Norwegian Sun"

Propulsion motor 8.5 MW, 150 - 160 rpm on cruise liner "Silver Spirit"

Main alternator 6920 kVA, 720 rpm on cruise liner "Seabourn Odyssey"