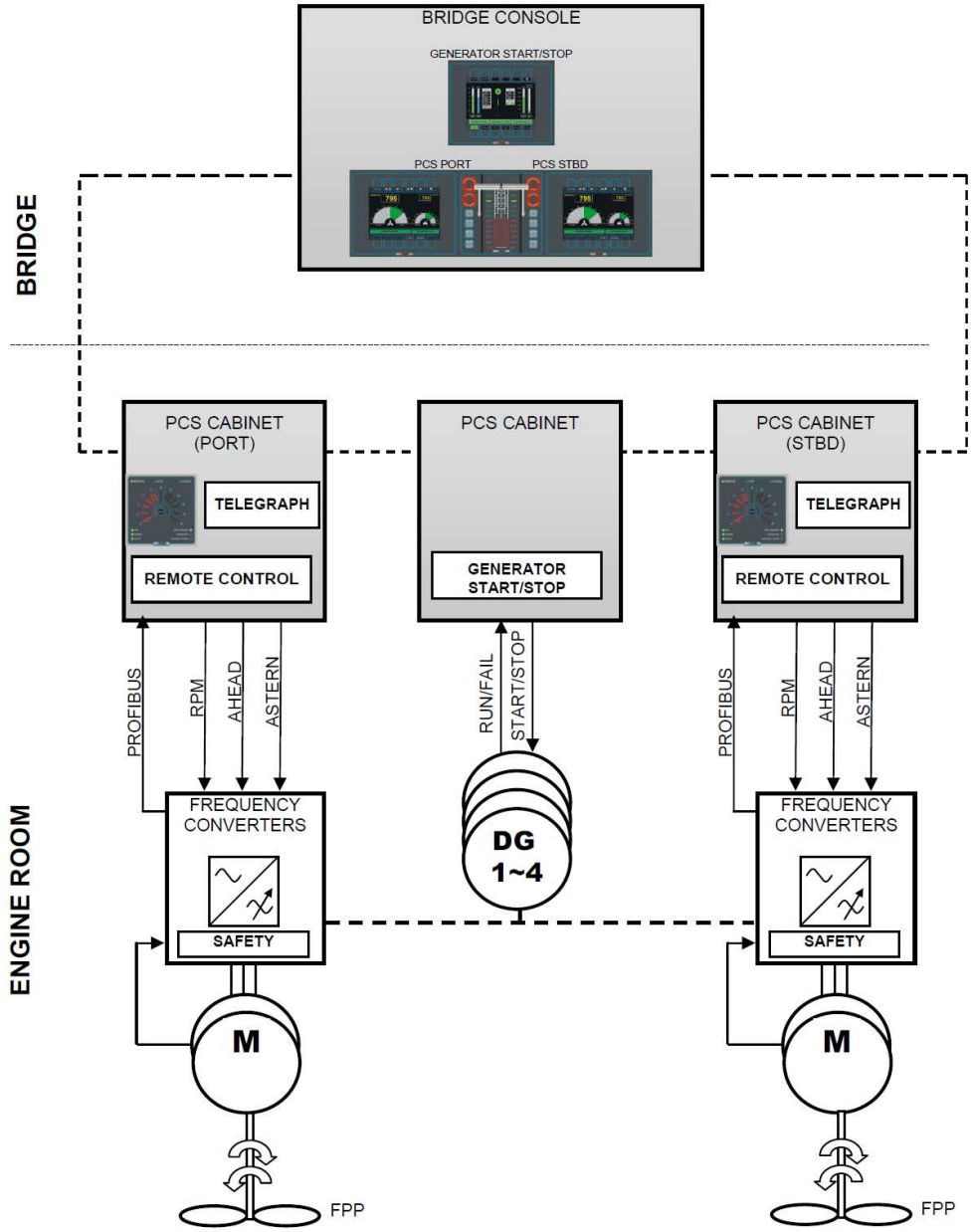
Innovative Propulsion Systeme

Überblick am Beispiel ENOK



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Torque motor

A **torque motor** is a gearless direct drive with very high torques and relatively small rotor speeds.

This creates totally new possibilities in the field of marine propulsion systems:

Over the entire range of rotor speeds (e.g. 0 – 300), the drive produces the same maximum torque that the engine is designed to produce at maximum speed.

This torque is available from the first turn of the motor.

Power	Qty.	Nominal speed	Rated torque	Qty.	Example
230 KWe	4x	330 RPM	6,656 Nm	4x	"ENOK" ddirect drive

In simplified terms, a torque motor can be viewed as an large servomotor with a hollow shaft, optimised to produce high torques. Physically and mathematically, calculations for such a motor are the same, by and large, as those for a multipole servomotor. In the past, torque motors have mainly been used for tasks involving fast, high-precision movement or positioning.

- The demand for highly compact and highly efficient drives, especially for propulsion systems, has advanced the development of TORQUE systems in recent years.

The firm of TORQUE Marine has developed the TORQUE drive system for shipping with its partners, RAMME + ARADEX. The brand name enjoys statutory trademark protection. International patent applications have been filed for special applications in combination with TORQUE generators, water-cooled frequency converters, DC intermediate circuit as common power supply, and the possibility of connecting the power generators immediately after starting up the aggregates, without the need for time-consuming synchronisation.

Torque Marine IPS GmbH sells these products under the registered produce name TORQUE Marine™.

In many fields of propulsion technology, demands for lightweight construction and maximum energy efficiency are currently being made that can only be satisfied with state-of-the-art drive systems.

Diesel engines with transmissions are often at a disadvantage here, because transmissions with little play are costly to build, and because the effective mass moment of inertia of a fast-running engine is transferred to the slow side in proportion to the square of the gear ratio.

- Torque motors overcome the known disadvantages of direct-transmission diesel drives (poor torque at low speeds below < 40% of the nominal speed), due to its high torque as from the first turn of the drive. The reversing mechanism and slipping clutch needed in a directly driven transmission are not required in a directly driven torque motor.

This makes it possible to build cutting-edge, energy-efficient propulsion systems with high redundancy, modular construction, and with low volume and weight for all kinds of ship propulsion systems (direct propeller drive, rudder propeller or Voith Schneider propeller).

- Only the energy that is needed at any given moment is delivered.

Properties

- Short, compact designs
- No transmission / toothed belts needed
- Cost savings (energy, maintenance, ..)
- Hollow shaft design
- No backlash
- Greater stiffness

Customer benefits

- Simple integration in engine
- Easy to maintain (no transmission oil)
- Improved total efficiency
- Advantages for installation and logistics
- Flexible installation concepts
- Better repeatability
- Better control characteristics
- Low-noise system
- Greater dynamics

Source: Mitteilungsblatt der Bundesanstalt für Wasserbau Nr. 85 (2002)
[Bulletin No. 85 issued by the Federal Waterways Engineering and Research Institute (2002)]

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Using diesel-electric marine propulsion systems

In the past, diesel-electric marine marine propulsion systems were of major importance for special ships, especially, despite their lower efficiency, greater weight, greater space requirements and higher investments costs compared to direct drive systems.

Those disadvantages contrast with the special advantages of direct-drive systems, e.g. when there are demands for energy shifts between high-power loads, for low-noise and low-vibration drive systems, highly varying performance needs for special operational profiles, greater demands for redundancy and availability, infinitely variable speed adjustment of drive motors down to smallest values, and for higher torques.

State-of-the-art, compact and affordable propulsion solutions will be needed in future for ships that are suitable for diesel-electric operation, and those solutions should offer the following options on account of the low power/weight ratios:

- Drive redundancy in single-shaft systems
- Dispensability of transmission solutions
- Low-noise
- High torques
- Low-maintenance operation

➢ Developing electric motors with permanent magnet-excited rotors provides excellent opportunities for achieving these aims.

The machine concept is characterised by:

- Small overall dimensions
- Excellent dynamics
- Low mass moment of inertia
- High overload capacity
- Very low power loss
- Mechanically separable stators
- Conventional production engineering

Diesel-electric marine propulsion systems are acquiring ever-increasing importance.
The pre-existing advantages of conventional electrical drives have been substantially enhanced by the possibilities of permanent-magnet technologies.

Advantages of the Torque system	**Customer benefits, advantages**
• High torques	Short reversal times
• Low-maintenance operation	Lower operating costs
• Space needs	Easier to integrate
• Flexible lengths and diameters	Better use of cargo hold
• Weight reduction	Optimised ship design
• No external excitation	Increased efficiency
• Tandem solution	Drive redundancy in single-shaft systems
• Reversible direct drive	No clutch, no transmission gearbox
• Low-noise	Reduced noise level

Special benefits also ensue from different requirements in connection with power supply for operations and for operations due to predefined profiles.

From the redundancy perspective, it is possible with this kind of propulsion system to split it into two systems each providing half the power, which is the better solution when compared to conventional systems, even though the total weight is greater and more space is required.

Sources

- Torque motor – Wikipedia
- Using diesel-electric marine propulsion systems Bulletin No. 85 issued by the Federal Waterways Engineering and Research Institute / 2002 Author DIPL.-ING. HARTMUT DOBINSKY