

RID

SPECIALE IL MISSILE TESEO EVO

R I V I S T A I T A L I A N A D I F E S A

MENSILE - N°3 MARZO 2022 - PREZZO € 8,00 Poste Italiane s.p.a. - Spediz. in Abb. Post. - D.L. 353/2003 (conv. in L. 27/02/2004 n. 46) art. 1, comma 1, LOBS



- IN GUERRA CON GLI "UNMANNED"
- LA MARINA SUDCOREANA: I PROGRAMMI E LE PROSPETTIVE DI EVOLUZIONE
- IL DETERRENTE NUCLEARE AEREO FRANCESE
- SHOT SHOW 2022
- STORIA: LE ULTIME DECADI



9 771122 760004
Prima immissione: 25.02.2022 (L.198/2016)

www.rid.it



Polish minehunter KORMORAN is equipped with 2 Voith Schneider propellers.

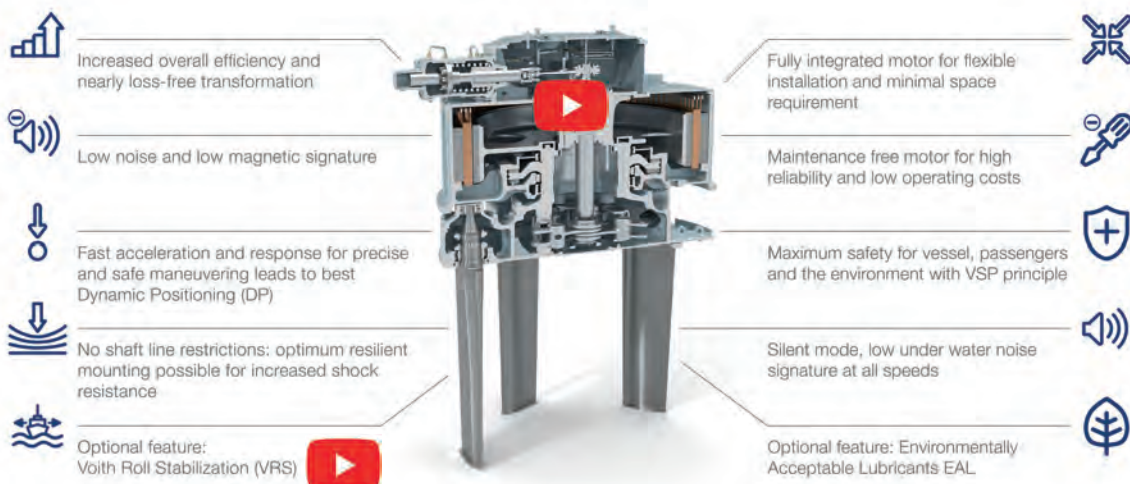
Dirk Jürgens

Electric Voith Schneider Propeller (eVSP) for MCMV vessels

Latest generation of electric Voith Schneider Propeller offers many advantages for use onboard MCMV vessels. The “traditional” Voith Schneider propulsion system is for a long time installed onboard over 70 minehunters of 15 countries with remarkable reliability. Recently Voith developed the eVSP (electric Voith Schneider Propeller), a new generation of electrical propellers, successfully installed onboard civil shipping for high-quality offshore vessels and passenger ships. Today Voith offers the eVSP for military applications too, in particular for the new generation minehunters.

Dr. Dirk Jürgens
Manager R&D at Voith Turbo Marine

Minehunters have to overcome numerous challenges: maneuvering accurately and quickly, spreading minimal dangerous signatures (noise, magnetic and electrical) and also guaranteeing high shock resistance. In addition, modern MCMVs can still operate in rough weather in high seas and winds to increase mission capability. The ability to operate better in rough weather is also becoming increasingly important for vessels in the civil offshore industry; increasing the operability means increasing the turnover. Therefore, two features of the eVSP became particularly prominent: the fast thrust adjustment enables a first-class Dynamic Positioning (DP) capability and, in addition, the very uncomfortable rolling motion can be significantly reduced (and in many cases eliminated) with the Voith Roll Stabilization System (VRS). The new gene-



Advantages of eVSP (electric Voith Schneider Propeller) for minehunting operations.



Top: Modern MCMV vessel with VSP. Bottom left: Voith Schneider Propeller (transparent view). Bottom right: Blade size of a 4MW Voith Schneider Propeller.



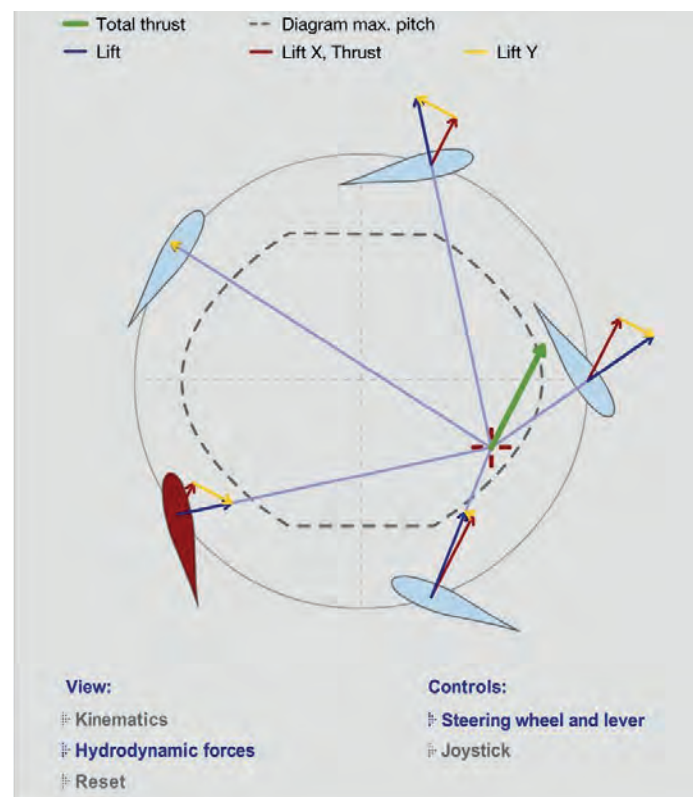
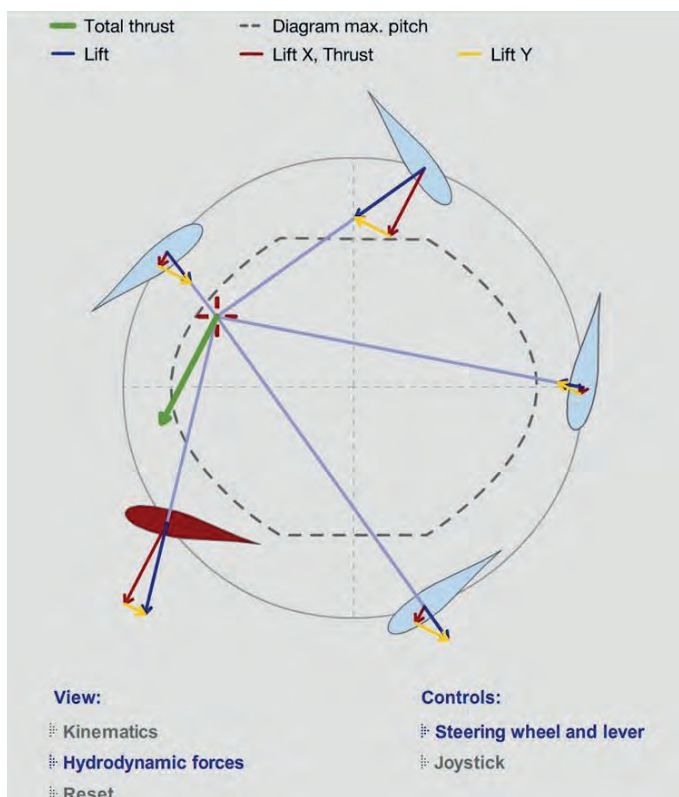
ration of Voith Schneider Propellers enables MCMVs to operate at 18 knots and more and the new VSP blades are optimized by CFD (Computational Fluid Dynamics) to provide a very smooth sailing. Moreover the new eVSPs will have a 6-bladed rotor, which is a significant improvement over the old generation with 5 blades.

Voith Schneider Propeller (VSP) - functional principle

The Voith Schneider Propeller is a propulsion system which integrates three important tasks in one unit: Propulsion, steering and sea keeping stabilization (especially reduction of rolling motion). The drawing on top of the alongside page shows a modern MCMV vessel with VSP. The Voith Schneider Propeller can adjust thrust extremely quickly and accurately according to X,Y coordinates. This feature makes it parti-

Below: Thrust generation of a VSP, two examples: clearly evident the lift (blue vector) generated by each blade (decomposed in the X and Y components) and their resultant vector with the overall thrust (green vector).

In order to obtain a better understanding of the VSP's thrust generation, it is recommended to download the simulation programs iVSP (system mechanics and hydrodynamics) and iVSP2.1 (high-quality maneuver simulation of VSP vessels) from the Voith website or the Android and iOS stores.



cularly valuable for MCMVs. Furthermore this propulsion system provides the fastest and most accurate thrust, steering and stabilization forces: simultaneously in the longitudinal and transverse directions of the ship.

Unlike an azimuth thruster, VSP can generate longitudinal and transverse thrust independently of each other. Since only the amplitude and the phase position of the blades oscillations have to be changed, the thrust can be adjusted extremely quickly.

Concerning the dynamic positioning (DP), the X,Y logic represents a very big advantage, because the force requirements of the DP system can be met very quickly, separated into longitudinal and transverse thrust (as showed in the two drawings at the bottom of the previous page).

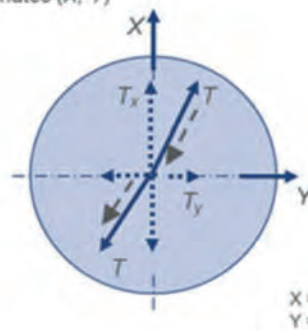
Another remarkable advantage is the integration of the VSP into the hull, as only the blades protrude from it. There is no further hydrodynamic resistance due to struts, pods and keel appendages as is the case of traditional propellers. Integration into a modern DP2 Vessel (ship able to maintain the position even in case of failure of one active component) with Voith Roll Stabilization (VRS) is quite simple (as shown in the picture here at the right). To further optimize and reduce suction effects, Voith developed a project known as "head box". In addition to reducing the loss for interaction, it is possible to integrate the VSP into almost any existing ship hull by means of the head box without major structural changes.

Electric Voith Schneider Propeller (VSP) – technical description

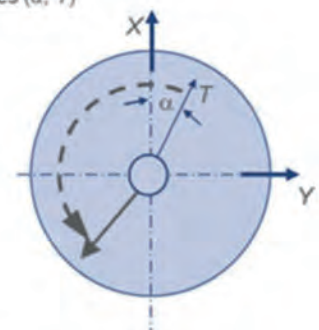
The aim was to develop a very quiet, robust and efficient electric motor for modern ships – especially minehunters – starting from the specific characteristics and to adapt it to the special features of the VSP. It was taken into account that the Voith Schneider Propeller operates at very low rotation speed, requires a high torque and is often used in the partial load range on minehunters. Therefore, the highly efficient technology of the permanently excited synchronous motor (PMSM), also known as torque motor, was the obvious choice. The technology of this modern electric motor is characterized by very high efficiency over the entire load range. For this purpose, the PMSM was integrated directly into the housing of the Voith Schneider Propeller, and a special version was developed for this purpose. The result of the development is shown in the two drawings at the bottom of this page. Moreover the PMSM torque motor utilizes the same bearing of the hydromechanic VSP component and replaces the following elements of the

On the side: Electric Voith Schneider Propeller (eVSP): CAD model a) in full view and b) in sectional view.

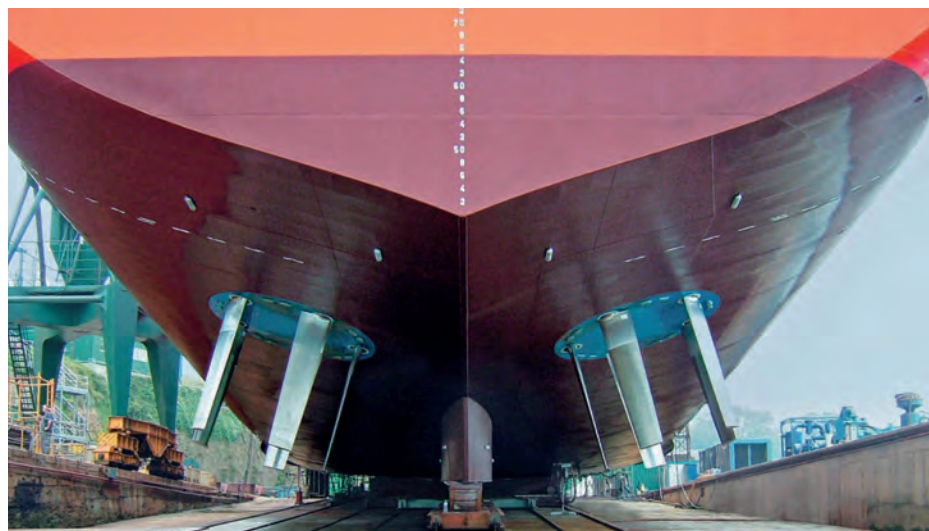
VSP Thrust Control:
According to rectangular coordinates (X, Y)



Z-drive Thrust Control:
According to polar coordinates (α , T)



Above: Thrust control principles of VSP and Z-drive thrusters.



Above: Modern DP2 Vessel with Voith Roll Stabilization (VRS) system.

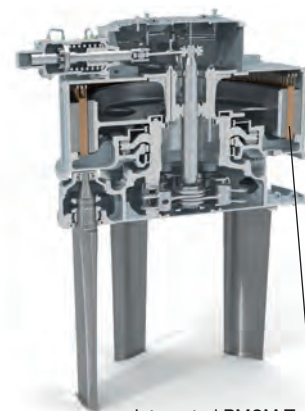


Above: Voith Schneider Propeller integrated into a SOV (Special Operation Vessel) hull by optimized headboxes (Test model at the SVA Potsdam and CFD - Computational Fluid Dynamics - processing done by Voith).

a)



b)



Integrated PMSM Torque motor



Comparison between eVSP and traditional VSP concepts (in this specific case powered by an electric motor; as is well known, the traditional VSP can be powered by any type of motor, electric or internal combustion engine).

PMSM torque motor of eVSP substitutes:

1. The bevel gear
2. The primary gear
3. The asynchronous motor
4. The shaft line
5. Control/cooling of the asynchronous motor and the primary gearbox
6. Ship foundations for the asynchronous motor and the primary gearbox

traditional propeller: bevel gear, primary gearbox, asynchronous motor, shaft lines, cooling/controls for the primary gearbox and the asynchronous motor, foundations in the ship for the primary gearbox and the asynchronous motor. A comparison between the two concepts, eVSP vs. classical VSP, is shown in the picture on top of this page. Thanks to the agile PMSM torque motor new variable speed dynamic positioning controls for minehunters can be realized. Furthermore its high efficiency and

the elimination of gearbox and shaft line losses are at the basis for the efficiency increase in the range of 4% to 12%.

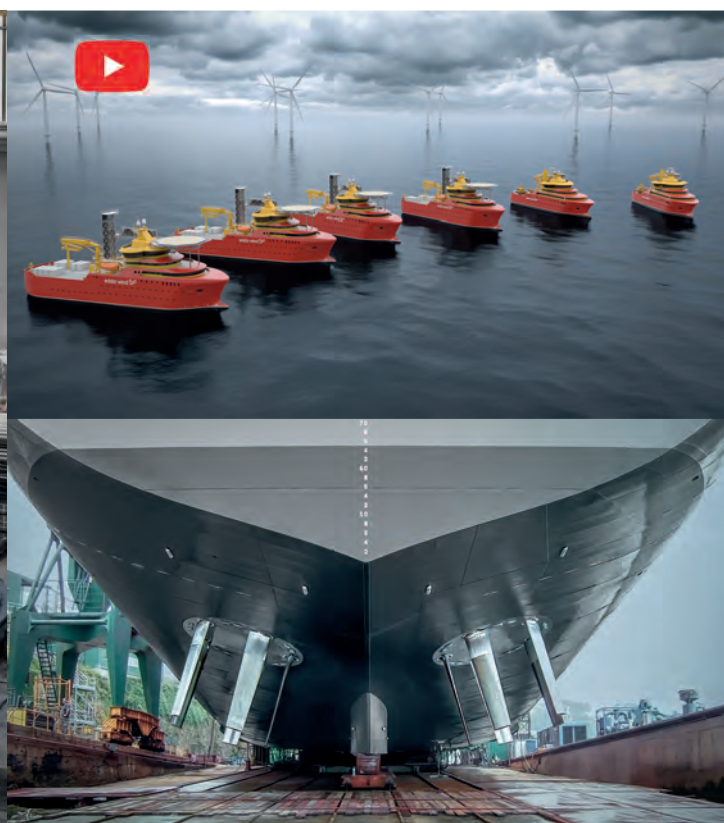
Advantages of the eVSP for MCMVs

The electric Voith Schneider Propeller allows a variety of benefits for minehunting operations compared to alternative drive systems. The possibility to manage propulsion, steering and

roll stabilization by means of only one single system for easy handling is certainly a point in its favor. Moreover eVSP combines in one single system main and auxiliary propulsion (without however giving up the redundancy): therefore propeller size for silent mode is much bigger compared to auxiliary drives consisting of multiple small azimuth thrusters. Furthermore the low propeller load and the low rotation speed increase the quietness and the lack of shaft, shaft struts, propeller hubs, rudder or auxiliary drives, allows the absence of interferences due to these appendages. Hydrodynamically, there is rotational symmetry and therefore noise isn't generated in any specific direction. During maneuvering there are no significant changes in noise development because the Voith Schneider Propeller rotates continuously and does not respond sensitively to changes in the direction of working. Sonar too is not disturbed by the astern thrust. This propeller is moreover easily adaptable to different operating conditions such as free running, silent routine and towing and ensure highest maneuverability under all operating conditions. Being more responsive than any other propulsion system, it allows the best performances for which concerns dynamic positioning. High efficiency represents an advantage for free running speed; the size and the low rotation speed give to the system a high sturdiness and a long service life.

The high towing force is an important advantage for minesweeping operations compared to vessels with traditional open screw propellers. VSP allows an excellent seakeeping behavior

The eVSP 26 at the Heidenheim plant after factory acceptance test for a fleet of Service Offshore Vessels (SOV). Today many offshore vessels are in service with significant performances and operational capabilities enhancements thanks to eVSPs installed onboard.



thanks to the damping effect on ship's motions and the ability to reduce slamming pressure in the aft ship. Also the uniqueness of VSP to avoid problems with propeller ventilation represents an advantage compared to any different propulsion system.

VSP is characterized by four very important aspects for minehunters. We must first remark its robustness to shock loads, having been designed for high torques because of its low speed. This makes it very resistant to a shock wave from the explosion of a sea mine. Another important advantage is given by the Voith Roll Stabilization System (VRS), installed onboard numerous ships since 2007, has proven itself extremely efficient, allowing a significant increase of the minehunters operational capabilities. Since the VSP beam can be ideally controlled, the SONAR operation of a MCMV with VSP propulsion system is particularly little disturbed and therefore the chance of success of a minehunting operation is very high. Finally the fast and unique thrust generation of the VSP makes it particularly well suited to dynamically hold a vessel in position (Dynamic Positioning - DP).

The comparison to a ship with Z-Drive, conducted by the independent Dutch testing institute MARIN, shows this impressively. To this end, it's worth to underline that only a calculation which considers the dynamic DP reflects the reality. Often, only the static DP is considered, which however doesn't take into account the propellers dynamics and the environmental conditions in fast ever-changing. Without including these important parameters, it's easy to gather wrong results. In order to obtain a right result it's necessary to include in the calculation the dynamics over time too.

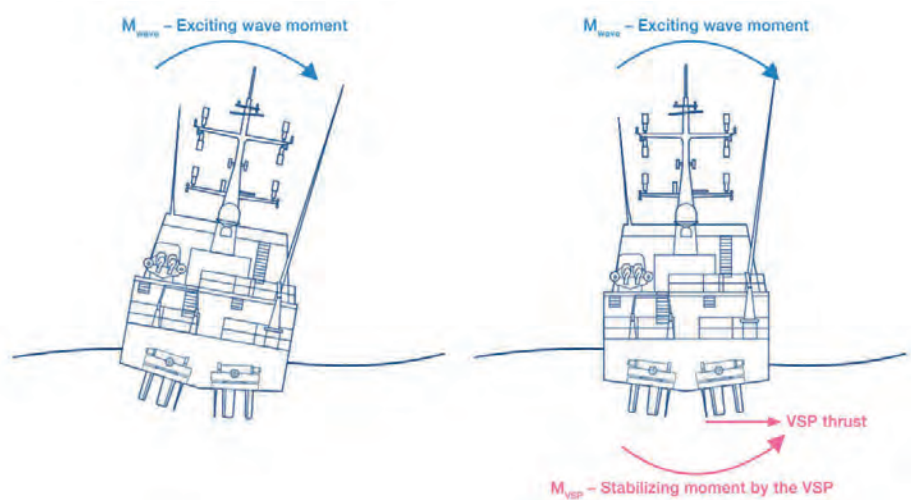
Conclusions

After decades of operational successes onboard over 70 MCMV vessels in 15 navies around the world, Voith developed the electric Voith Schneider Propeller (eVSP) in order to further improve its technology. Since the high efficient permanent magnet electric motor is integrated directly into the propeller, the disadvantages of mechanical components, such as gear losses, are eliminated; this allows huge benefits in terms of noise reduction. Today this fully electric propulsion system is ready to replace the traditional VSP for military use. The new generation of Voith Schneider Propellers enables minehunters to operate at 18 knots and more. Besides, thanks to the new blades optimized by CFD (Computational Fluid Dynamics) and the new 6 blades rotor, the new eVSP family provides a very smooth sailing.

In addition to the well-known advantages of the Voith Schneider Propellers in minehunting operations, the new eVSPs allows to obtain significant improvements in terms of underwater acoustics, efficiency and installation in the hull.



An Intermarine minehunter with Voith Schneider Propeller during shock test.



Influence of astern jet stream of propellers on the sonar

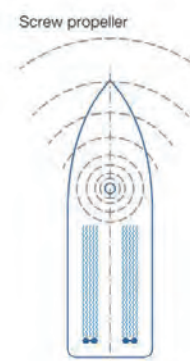
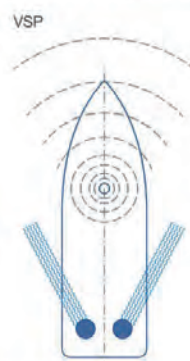


Illustration of particularly important aspects of an MCMV driven by eVSPs (shock resistance, roll stabilization, undisturbed sonar operation and excellent dynamic positioning).

