

Sustainable electric propulsion

A new technology for speed and power control of larger machinery operated via AC motor-drives has been launched to the shipping market.

TEXT: STADT POWER TECHNOLOGY

The patented STADT STASCHO Sinus drive technology was first delivered to the seismic research vessel "Sanco Star" of Norway, operated by RXT. In this case the drives were used for the full-electric main propulsion for the ship, driving 2 propellers each 2500 kW. The first 18 months of operation offshore Brazil for Petrobras, has clearly demonstrated the qualities of the new system. STADT is now busy with new projects, and has now also put in to service the sister ship "Sanco Spirit" and the two first full-electric Purse Seiners ever built in Norway, the "Harto" and the "Stokke Senior".

The company STADT AS in Norway has developed the new product, STADT STASCHO, over the past 7 years. STADT

has very long experience in development of Megawatt AC motor-drives for ship and industry, as well as complete system integration for diesel-electric vessels.

The STADT STASCHO range now goes up to 50 MW in voltages up to 15 kV, optionally also in higher voltage classes and even higher powers.

The technology used in STADT STASCHO is based upon IGBT transistors and thyristors. The system is also working as an integrated part of the CP propulsion system, where speed and pitch is controlled in an optimal way. The STADT system is totally integrated with the ships propulsion plant as well as the power generation system and its PMS. It has its own configurable power controller, touch

screen and interface to other systems on the ship. The system is normally air cooled due to its very low losses. This makes it easy to locate the drives in the control room of the ship.

The most interesting features of the new patented drives are:

EXTREMELY LOW ELECTRIC LOSSES, less than 0,03% at full load resulting in total electric system losses of only 5 to 6% . The system losses will be found in the electric generator, in the STASCHO and in the electric propulsion motor. Knowing that equivalent AC Drive systems based on i.e. 12 pulse configuration has system losses in the range 13-16% - this new technology will have huge impact on the energy consumption and emissions from the ships.

SINUSOIDAL TECHNOLOGY RATHER THAN PWM. One of the reasons for the unique characteristics of the new STADT STASCHO drive technology is that it is based on bidirectional Sinusoidal voltage and current, both toward the driving electric AC motor, and backward to the electric switchboard. The basis of this new technology comes from the company NFO Drives AB in Sweden, which has developed a patented inverter that controls standard AC-motors with a pure sinusoidal voltage and current. The Sinus-technology gives many advantages compared to the widely used Pulse Width Modulation - PWM technology, used by the vast majority of drives manufacturers in the world. The most important advantages, is that Sinus does not generate any disturbances at all, enabling the user to use unscreened power



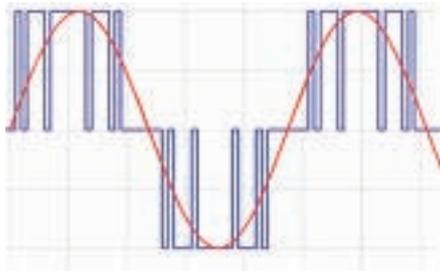
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"Sanco Spirit"



cables and standard AC motors without getting problems typically found in PWM driven applications, like machinery bearing damages and EMC related problems. PWM is a synthesized way of creating a variable frequency, for speed control of AC motors. The high frequency pulse train in this synthesized voltage is the root to many types of complex problems revealed by many users that has experienced the traditional frequency inverters through the last years. - AC motors was designed for Sinus, and works best with Sinus.

For military projects, the Sinus technology gives unique benefits. As an example, Kockums - Thyssen Krupp Marine Systems have chosen this technology for their applications onboard the Visby class, a stealth type of vessel with low noise signa-



» PWM in blue, SINUS in red

ture. "We have not previously been able to use frequency inverters at all," states Karl-Axel Olsson at Kockum. "All inverters interfered with the sensitive equipment on board and were therefore banned within the Navy."

- The NFO Sinus controlled drives solved this problem.

Sinusoidal control of AC motors can be compared to the DC motor drives when it comes to silent operation.

The STADT Sinus-technology with no electromagnetic disturbances and no acoustic noise is definitely a preferred solution for a research vessel like "Sanco Star", since their job is to record sensitive seismic signals into their huge onboard computer system. Also military and oceanographic research vessels that earlier was forced to use DC motors, can now choose the more reliable AC motors in combination with STADT STASCHO.

FUEL- AND EMISSION-REDUCTION UP TO 45 %. Although fuel costs are to live with at the time being, we all know that these costs will increase again. Therefore it is important to plan for the future, and keep the running costs for the ships as low as possible. Fuel savings up to 45 % are achievable by using the STADT STASCHO in ship propulsion system. This is possible due to optimal mode operation of genera-

tor sets, and the low-loss electric AC-motor control for the propellers. Pollution from NOX etc is reduced equally.

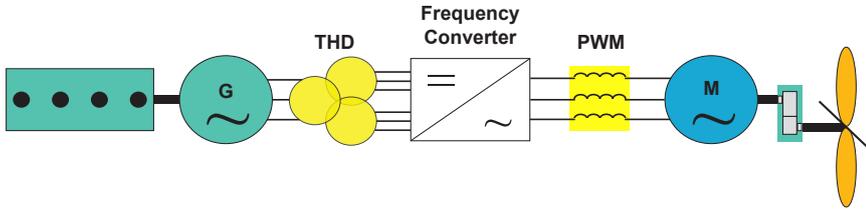
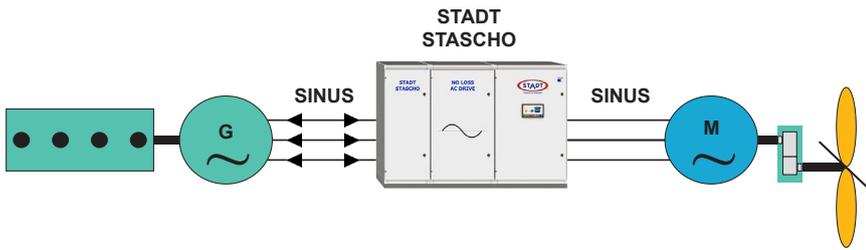
EXTREMELY LOW HARMONIC DISTORTION - THD, typically 2-3 % in main switchboard. - A major achievement, realised without using the big transformers or filters that other systems is totally depending on.

The class requirements regarding THD becomes more and more strict from year to year.

Earlier it was common practice to design diesel-electric systems where the THD could reach distortion levels above 20 % in voltage inside the main switchboards. Now the class says 5 %.



» Propeller shaft-line at "Sanco Star"



» Electric propulsion alternatives – loss considerations. The new way is shown above, the old way (PWM) below.

RELIABLE TECHNOLOGY WITH LONG LIFETIME - A SUSTAINABLE SOLUTION. Through the development of the STASCHO, STADT has put great effort in designing a converter system that can serve without major maintenance for more than 25 years. This has been possible by eliminating some of the components with limited life time typically found in other PWM drives. The technology is based on very reliable components, as is now very well proven at sea operations for long time. The system is approved by DNV and NMD (The Norwegian Maritime Directorate).

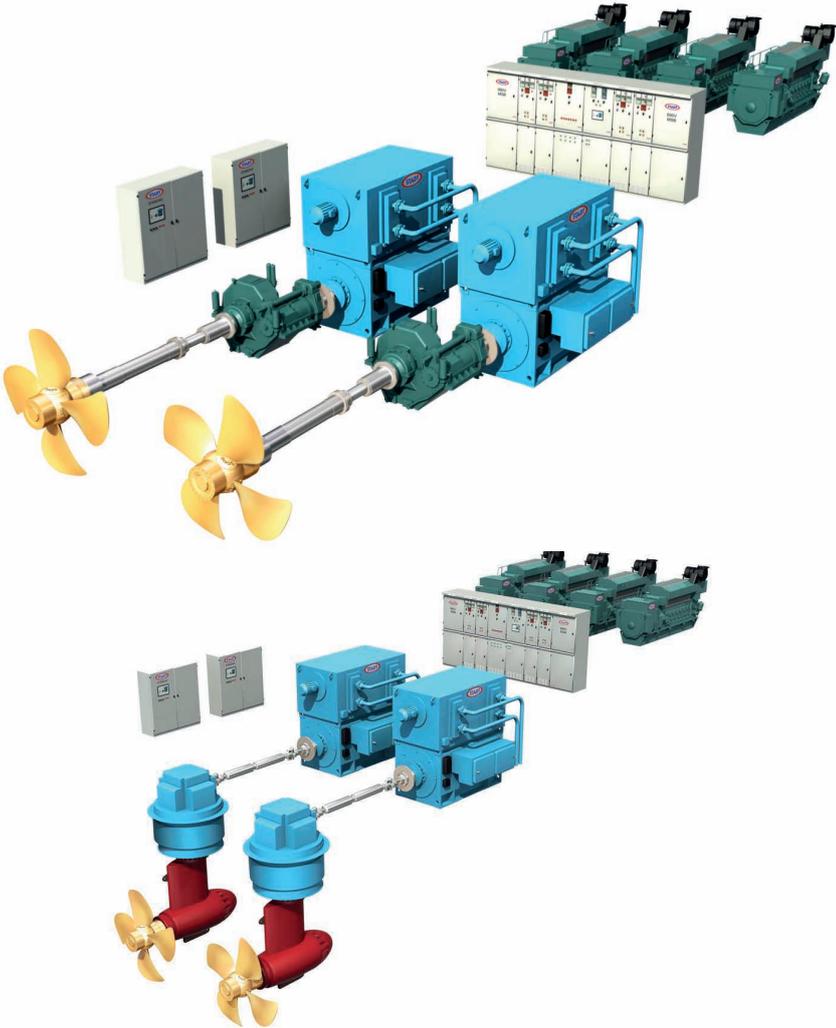
PRODUCT FEATURES	SINUS	PWM
An energy saving product But Electric System losses is very different	YES 6 %	YES 15 %
Standard AC motor can be used	YES	NO
Standard cabling to AC motor, unscreened PWM needs high voltage special cabling as well	YES	NO
Warranty against bearing currents in machinery PWM needs high focus on this issue	YES	NO
Guarantee against EMC problems SINUS means zero electromagnetic noise transmitted	YES	NO
No extra acoustic noise from motors PWM generates a disturbing noise in AC motors	YES	NO
Simple installation and wiring Aircooled STASCHO with Sine waves saves costs. PWM is normally watercooled	YES	NO
Can be used in all types of sensitive environments	YES	NO
Very low harmonic pollution to main grid PWM requires big 12/18/24-puls trafoes or AFE to deal with this problem	YES	NO
Economical lifetime more than 25 years PWM inverters has components with economical lifetime of ~ 10 years	YES	NO
Compact size and low weight Mainly due to the fact that STASCHO has no trafo or filters	YES	NO
Easy maintenance world wide PWM is a far more complex solution	YES	NO

A COMPACT SOLUTION. The fact that the big power transformers is obsoleted in the STASCHO drive system, results in a much more compact solution compared to competitors drives in 12, 18 or 24 pulse configurations. The transformers can be very big, even bigger than the electric motor they are supposed to feed. And their weight is substantial as well.

Even though the STADT STASCHO can demonstrate major advantages towards existing drive solutions, the fact is that even pricewise it is attractive.

The new STADT STASCHO is expected to be warmly welcomed in naval application, both for military and commercial vessels with gas – or diesel-electric propulsion systems. The low losses will save fuel in all working conditions for the ship, especially at high power. The difference from 15 % losses to 6 % is significant, and will result in a new way of evaluating the way that propulsion systems for ships will be designed in the future.

In Norway, it is reported that 95 % of offshore vessels built last year, was diesel-electric. - New types of ships will most likely turn in to electric propulsion to save oil and pollution, says Hallvard Slettevoll, president of STADT as. ●



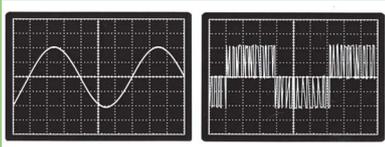
» STADT STASCHO as an integrated solution.



TECHNOLOGICAL COMPARISON BETWEEN SINUS AND PWM DRIVES

PWM: PULSE WIDTH MODULATION, is a synthesized way to generate artificial AC voltage. It contains a lot of high frequency pulses and is an electromagnetic noise transmitter. PWM is today used by most (>98 %) AC drives manufacturers in the world.

SINUS: Patented proven technology by NFO DRIVES and STADT.



DNV ULSTEINVIK
The local DNV office in Ulsteinvik participated in the certification process during the manufacturing of the STADT STASCHO Electric propulsion converters at the STADT factory in Gjerdsvika. DNV also offered assistance during the design process to ensure compliance to DNV rules.

The installation of the system took place at the Norwegian shipyard Vaagland, where DNV followed the installation and commissioning of the system, as well as the FMEA certification of the DP AUTR system. THD measurements was verified according to the class requirements.

