

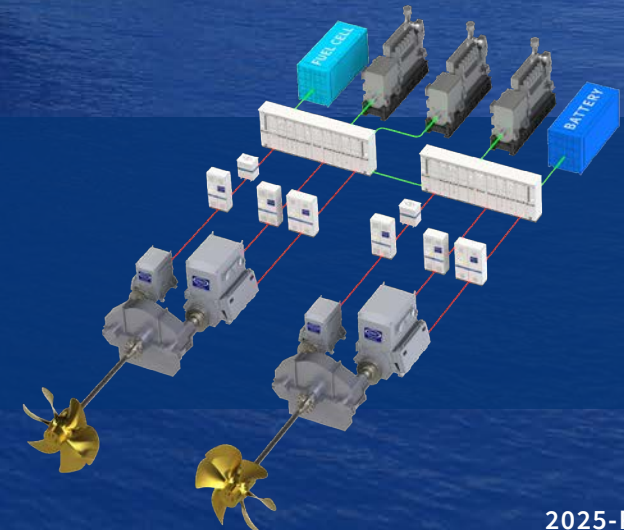


LEAN PROPULSION®



**STEALTH ELECTRIC PROPULSION
FOR ANY NAVAL SHIP**

STADT NAVAL AS





STEALTH LEAN PROPULSION®

The Navies need *reliable vessels* that are efficient to operate, year after year, in all seasons and weather conditions. Naval ships of the future call for electric power, for new weapons and propulsion. One that enables them to operate in a low noise stealth mode. As a vendor of conventional PWM propulsion systems for many years, we asked the question: “Can a new way of thinking also give us a new generation of naval propulsion systems that are Future Proof and meet naval ships requirements” ?

STADT NAVAL AS, a part of the STADT GROUP AS, has taken these challenges seriously when developing the Stealth Lean Propulsion®, based on patented STADT Dynamic Ultra Low Frequency Switching Technology. It is available now for the most powerful applications, more than 50 MW per propeller. A lean propulsion system that is amazingly *reliable*, and also reduces service costs, weight, fuel, emission and waste, while freeing up space.

A sophisticated and silent system with STEALTH performance, extremely long lifetime, and excellent manoeuvrability. Designed to meet MIL-STD-901 and other requirements.

The new drive technology has been awarded by The Royal Institution of Naval Architects for its unique characteristics, and many ships are now sailing with the Lean Drive technology all over the world.



STADT - AWARDED TECHNOLOGY LEADER

STADT GROUP AS was established back in 1985 by Hallvard L. Slettevoll. In 2015 a modern STADT Maritime Center was opened in Gjerdsvika harbour.

For many years STADT has been a leading company in AC drive innovations. Extensive experience in development of motor drives has resulted in the *patented STADT Lean Drive technology*. This has huge advantages compared to traditional PWM - technology, since it is free from electric disturbances. The STADT Lean Drive is also a very efficient power drive system and *brings reliability up to a new standard*.



The first STADT electric propulsion delivery went to the Norwegian coastguard K/V Tromsø in 1996, representing a technological breakthrough.



One of the 150 ship propulsion references

The Lean Drive was patented in 2008 and 2022, and launched to the first ship applications in 2008. The new drive technology has been awarded several times for its unique characteristics, and many ships are now sailing with the Lean Propulsion® technology all over the world. Due to increased interest in the Stealth performance of STADT drives for the Naval industry - a separate business unit was established within the STADT GROUP AS in 2022 - STADT NAVAL AS.

BEST IN NAVAL CLASS ELECTRIC PROPULSION

”The STADT Lean Propulsion® system has features that has not been achieved in previous propulsion solutions. Its most impression feature being is its completely silent, stealth operation, which is already been adopted in a series of naval ships and commercial vessels.

The systems impressive efficiency comes from its very low power loss. At time contributing to lower emissions and a reduced carbon footprint.”

-The RINA awarding committee

INNOVATIVE PROPULSION FOR YOUR NEXT SHIP



Awarded by The Royal Institute
of Naval Architects (RINA) in London



STEALTH LEAN PROPULSION® - PATENTED TECHNOLOGY

SUSTAINABLE, LEAN AND GREEN:

- ^ Highest reliability - proven over years
- ^ Silence by all means, lowest Underwater Radiated Noise (URN)
- ^ Scalability (up to 100 MW), ready for Railguns and Lasers
- ^ Reduced maintenance and high redundancy
- ^ Reduced fuel consumption, by slow steaming

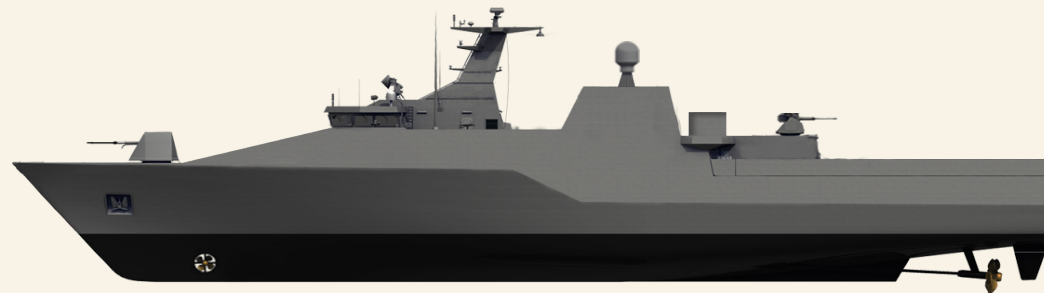


CUSTOMERS EXPERIENCES

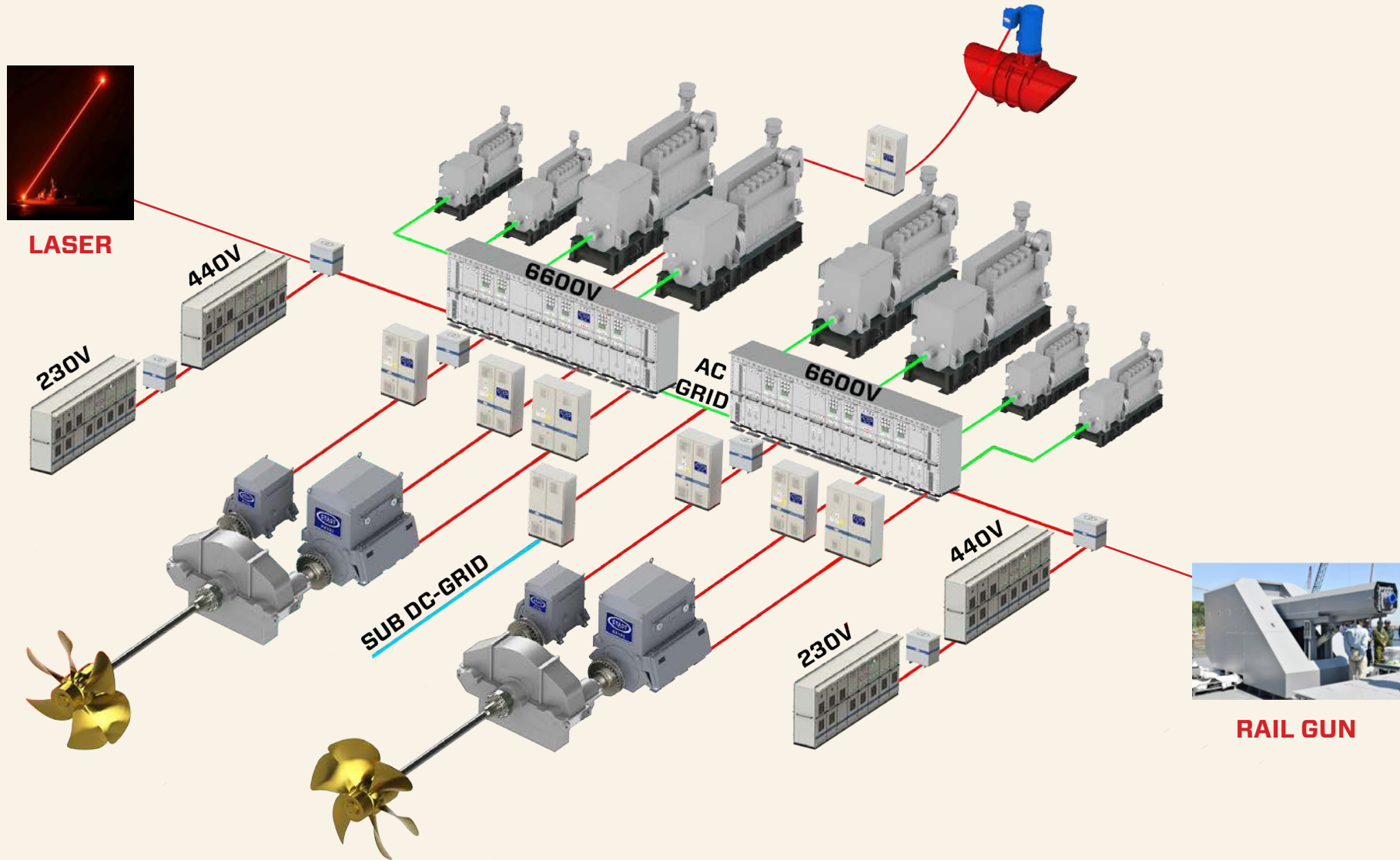
«In the past, we were not able to use frequency inverters at all. All PWM inverters interfered with the sensitive equipment on board, and they have therefor been banned from marine environments».

Karl-Axel Olsson

Manager Electric Systems, Kockums ThyssenKrupp Marine Systems



STADT NAVAL AC+DC GRID



NEW WEAPONS CALL FOR ELECTRIC SOLUTIONS

MoD – ELECTRIC PROPULSION DEVELOPMENT WITH STADT

The Norwegian Ministry of Defence has signed an agreement to take part in a development project that has the purpose to extend the range and features of the STADT Stealth Lean Propulsion®.



Due to increased use of electric and electronic weapon-systems, the Norwegian Navy and navies all over the world show increased interest for electric propulsion to power future navy vessels. Overall goals are to seek minimum carbon footprint, lower power consumption with utilisation of new low emission power sources. It is also a goal to increase operational range and defence capabilities by Stealth operations.

STADT NAVAL will in cooperation with the Norwegian Navy further develop its own technology to meet their impressive goals. The naval extension of the STADT Lean Propulsion® - the STADT Stealth Drive range, is based upon the core technological elements that has been well developed and proven globally in the patented STADT Lean Drive technology.

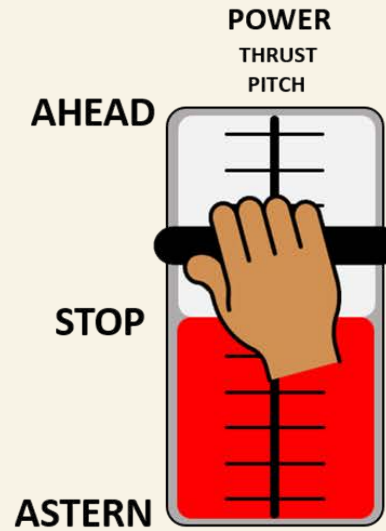
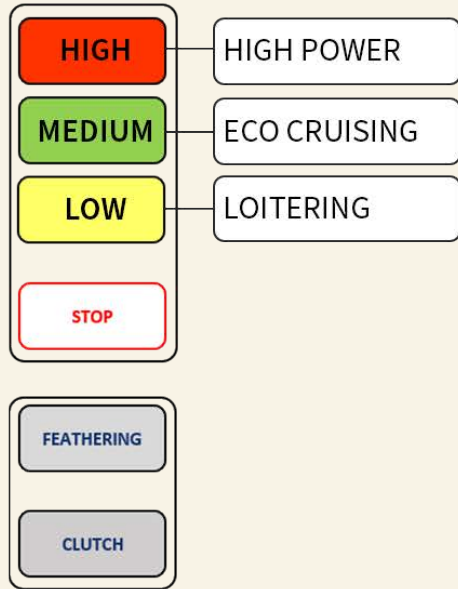
A spokesman from the Norwegian Navy has expressed that they have found that STADT has developed a very innovative technology that has a potential to increase defence capabilities for the navy fleet. Measurements done by the navy shows significant reduction in URN and no emission of EMI.

MoD is also supporting STADT NAVAL in the European Defence Fund (EDF) projects.

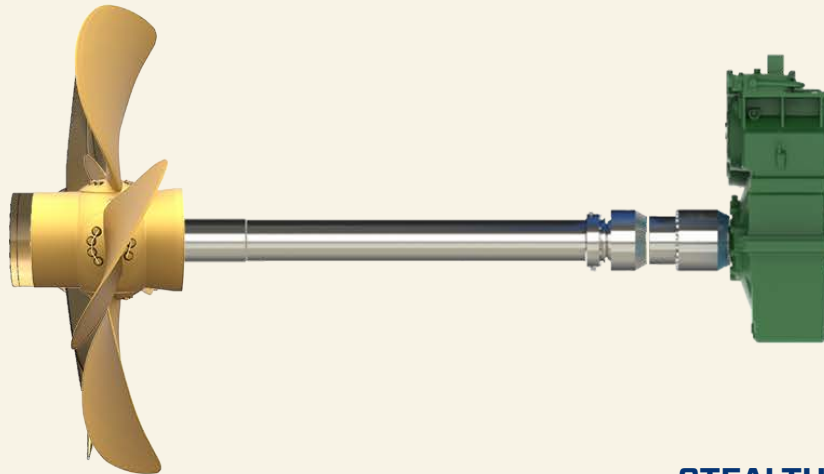


Rolf Kjos (MoD) , Armament Director
Hallvard Slettevoll (STADT) , Director
Morten Tiller (MoD) , Retired Director

DYNAMIC POWER - AT YOUR FINGERTIPS



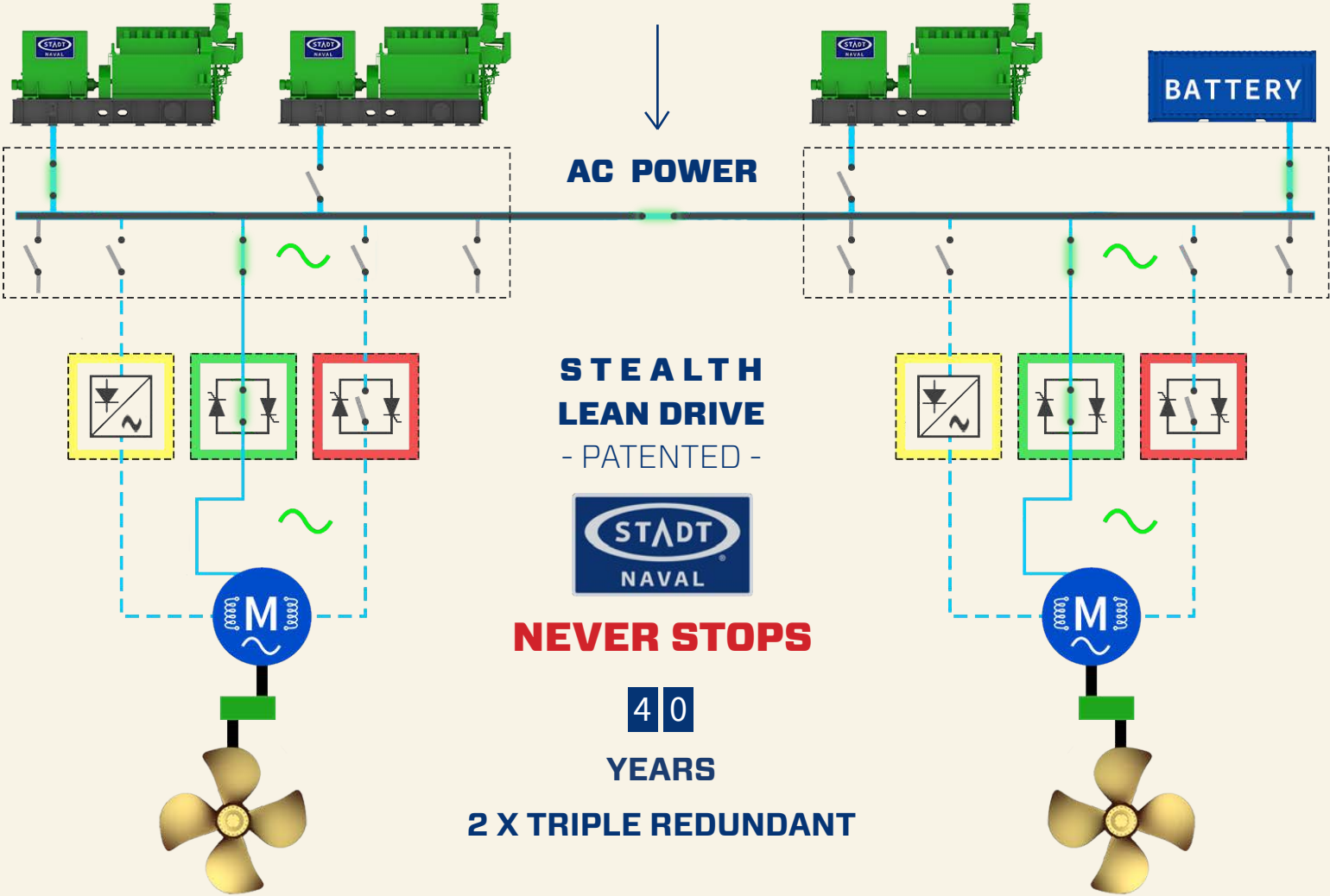
0-150 rpm
0-35000 kW



Geared transmissions saves a lot of weight and space

STEALTH LEAN PROPULSION®

STADT NAVAL STEALTH LEAN PROPULSION®

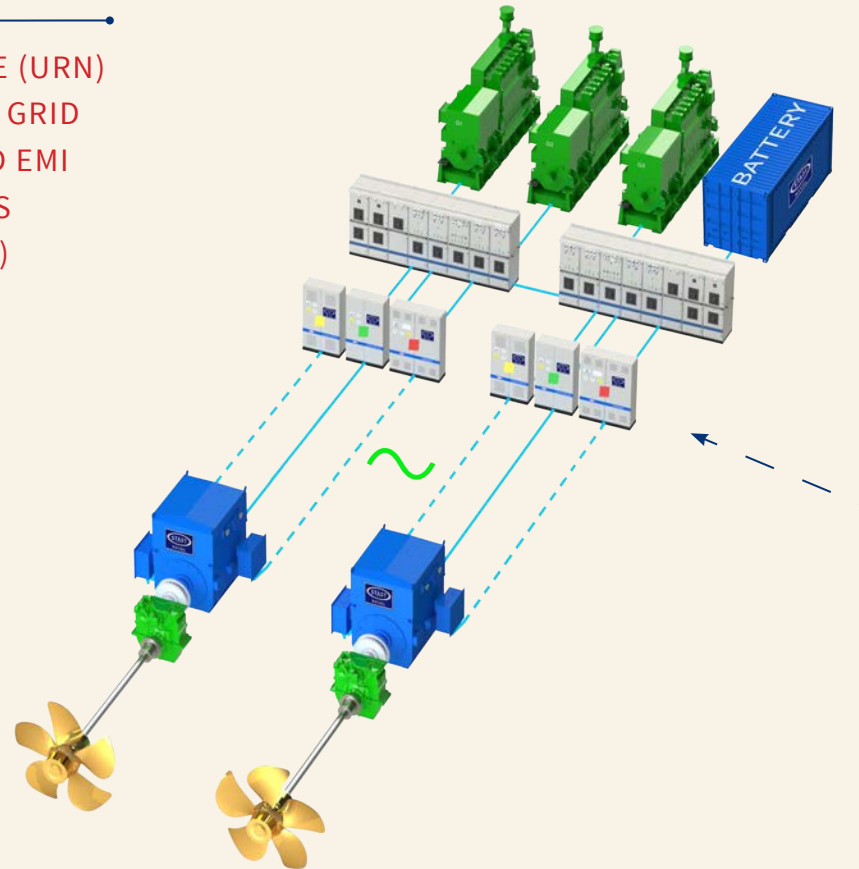


DISCOVER THE POWER OF SIMPLICITY

STADT NAVAL ELIMINATES:

- UNDERWATER RADIATED NOISE (URN)
- POWER DISTURBANCE THD ON GRID
- COMMON MODE VOLTAGES AND EMI
- THE BIG DRIVE TRANSFORMERS
- EXPLOSION RISK (CAPACITORS)
- BREAKING CHOPPER SYSTEMS
- 6 % WASTED ENERGY LOSSES
- WATER COOLING SYSTEMS
- 80.000 COMPONENTS
- SCREENED CABLES
- COMPLEXITY

= **LESS DOWNTIME**



STADT NAVAL GIVES YOU

- + STEALTH PERFORMANCE - BY AC
- + HMS AND COMFORT (SILENCE)
- + REDUNDANCY IN DRIVE SYSTEM
- + POWER TO PROPELLER
- + SAFETY AND RELIABILITY
- + SPACE AND LOWER WEIGHT

= **BETTER PERFORMANCE**

HOW COME ?

PATENTED, DYNAMIC -
ULTRA LOW FREQUENCY
SWITCHING TECHNOLOGY.

WHY DISTURB PERFECTION?

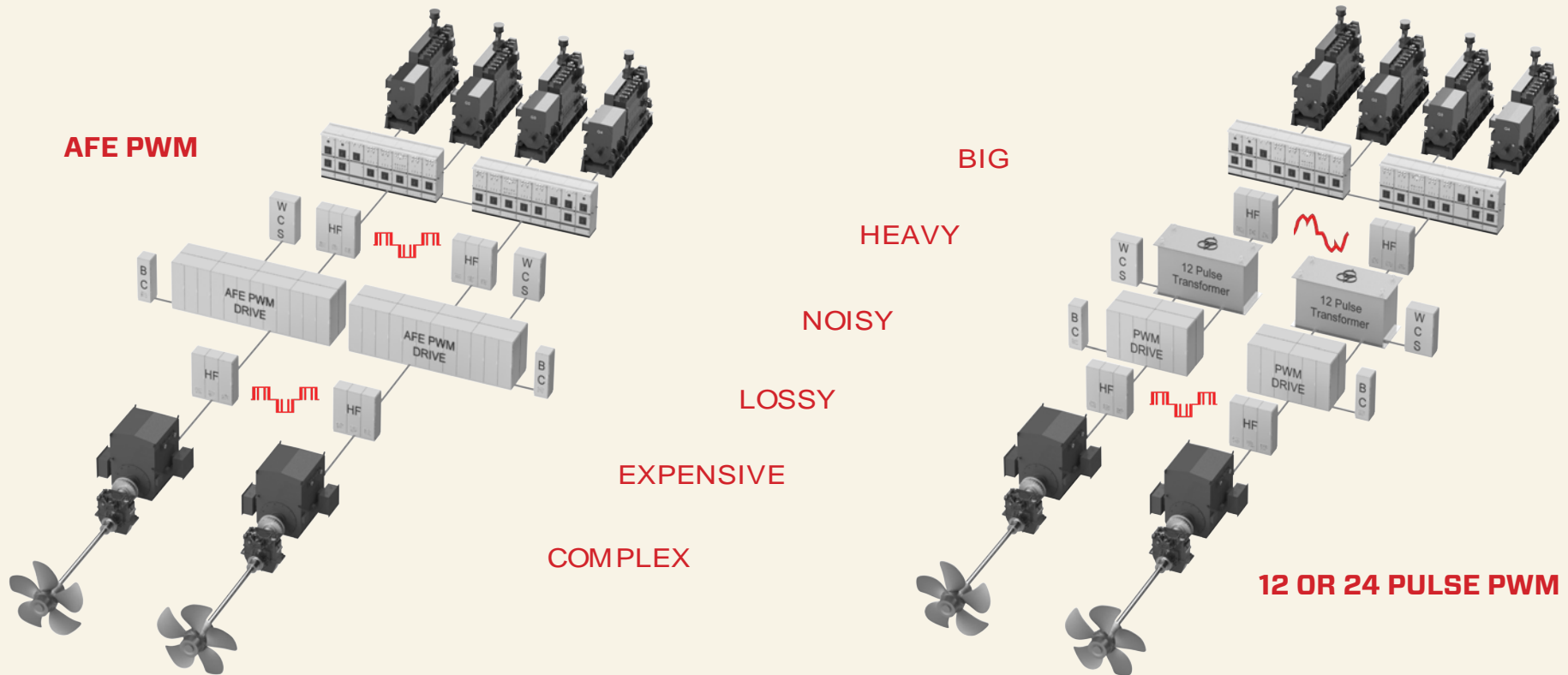
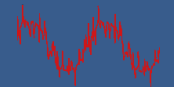
STADT LEAN PROPULSION®

EVALUATION OF TODAY'S DIFFERENT DRIVE SOLUTIONS

Lean Issues To Consider	STADT Stealth Lean Drive	12 Pulse or 24 Pulse	AFE (Active Front End)
Technology in AC drive	Sine Wave	PWM	PWM
No. of electric energy transformations	0	4	4 or 5
Power Train Losses in Drive	0,1 %	6 %	6 - 7 %
Cooling Type	Air is sufficient	Water	Water
Power Transformers Needed	No	Yes	Sometimes • - - ,
Regenerates Power to Grid	Yes	No	Yes ↓
Weight & Size of Drive System	100 %	500 % - 600 %	450 % - 700 %
All Voltage Class (220V-15kV)	Yes	No	No
Underwater Radiated Noise (URN)	Lowest	High	High
Harmonic Distortion (THD)	No	High	High
Common Mode Voltages and EMI	No	High	High
Acoustic Switching Noise and URN	No	Yes	Yes
Screened Power Cables needed	No	Yes	Yes
Redundant Power Units	Standard	Special	Special
Designed Economic Lifetime	40 Years	6 Years	6 Years
Maintenance Requirement	Very Low	Frequent	Frequent
Onboard Crew Skills	Ordinary	Special	Special
MTBF (mean time between failures)	7 Years	1 Year	1 Year
MTTR (mean time to repair)	1 Hour	1 Week	1 Week
Spares Globally Available	Yes	No	No
No. of Power Components in Line	1	80 000	150 000
Capacitors In Main Power Circuit	No	Yes	Yes
Explosion Risk in Drive	No	Yes	Yes
Financial Risk (Service cost, Off-hire)	Very Low	High	High

PWM WILL NEVER BE STEALTH OR NOISE-FREE

Complex PWM Drives (for comparison), competitor's technology

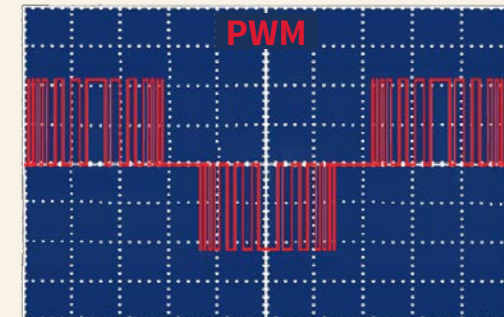


PWM = PULSE WIDTH MODULATION 

PWM VS LEAN DRIVE – THE DIFFERENCE

^ **PWM (Pulse Width Modulated AC)** is an artificial chopped waveform

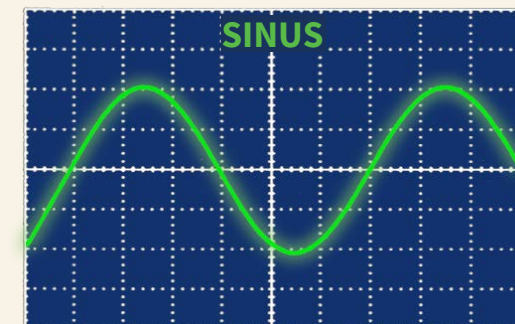
- ^ Created by AC to DC to AC conversion via the transistor inverter
- ^ Power-loss both in drive and transformers
- ^ Represent a variety of disturbance issues and will create :
- ^ Common mode noise, EMI, THD, URN and audible noise
- ^ Stress on El-motor bearings and windings
- ^ Hidden failures, also on other equipment on the same grid – **high failure rate**



→ **PWM is a complex technology – power loss & heat – challenging installation**

^ **STADT LEAN PROPULSION®** is based on Perfect Sinusoidal Waveform

- ^ No disturbance due to **Dynamic Ultra Low Frequency Switching Technology**
- ^ Low audible Underwater Radiated Noise (URN)
- ^ Minimum loss - no heat generation – no need for water-cooling
- ^ Represents the **perfect source for our AC induction motors**
- ^ **Lowest** failure rate

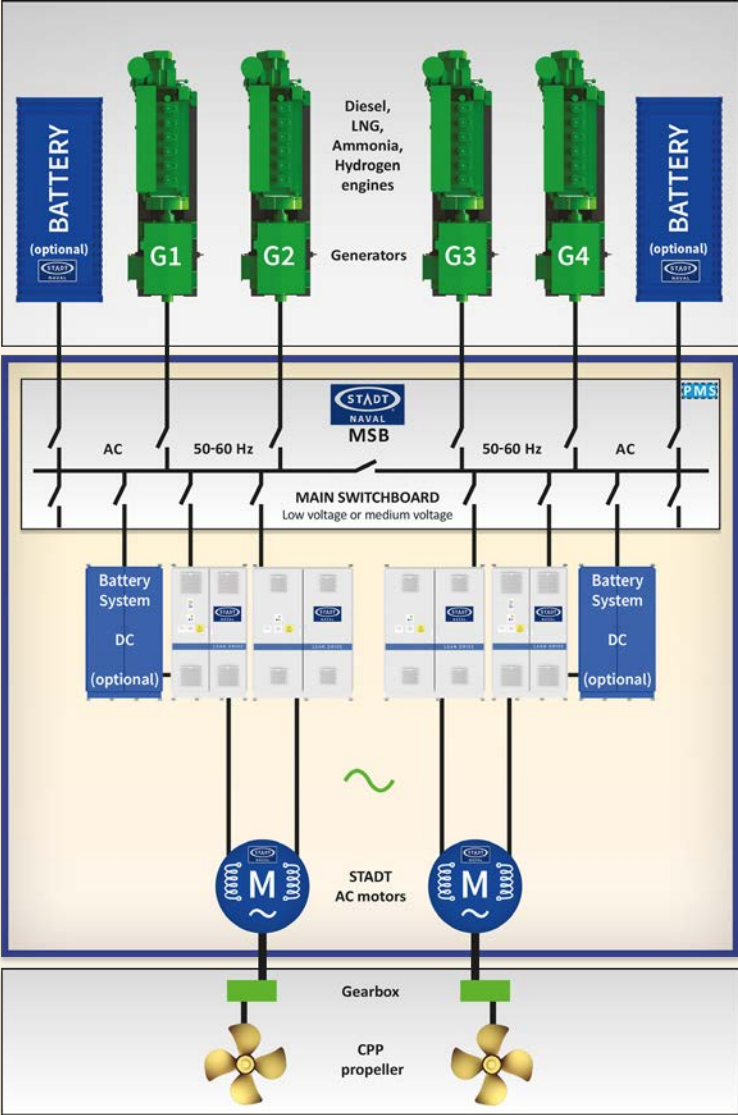


→ **Sinus is simplicity - efficiency - increased reliability - eased installation**

...so why disturb perfection ?

STADT AC VARIGRID™

For Variable Speed Gensets



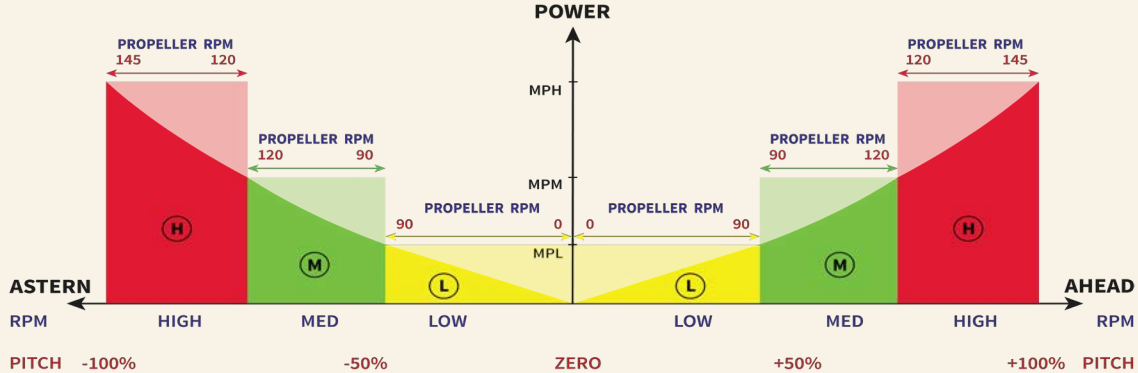
An AC main switchboard will as a result supply variable frequency that can be set in various ranges :

50 to 60 Hz or **45 to 65 Hz** or **30 to 60 Hz**

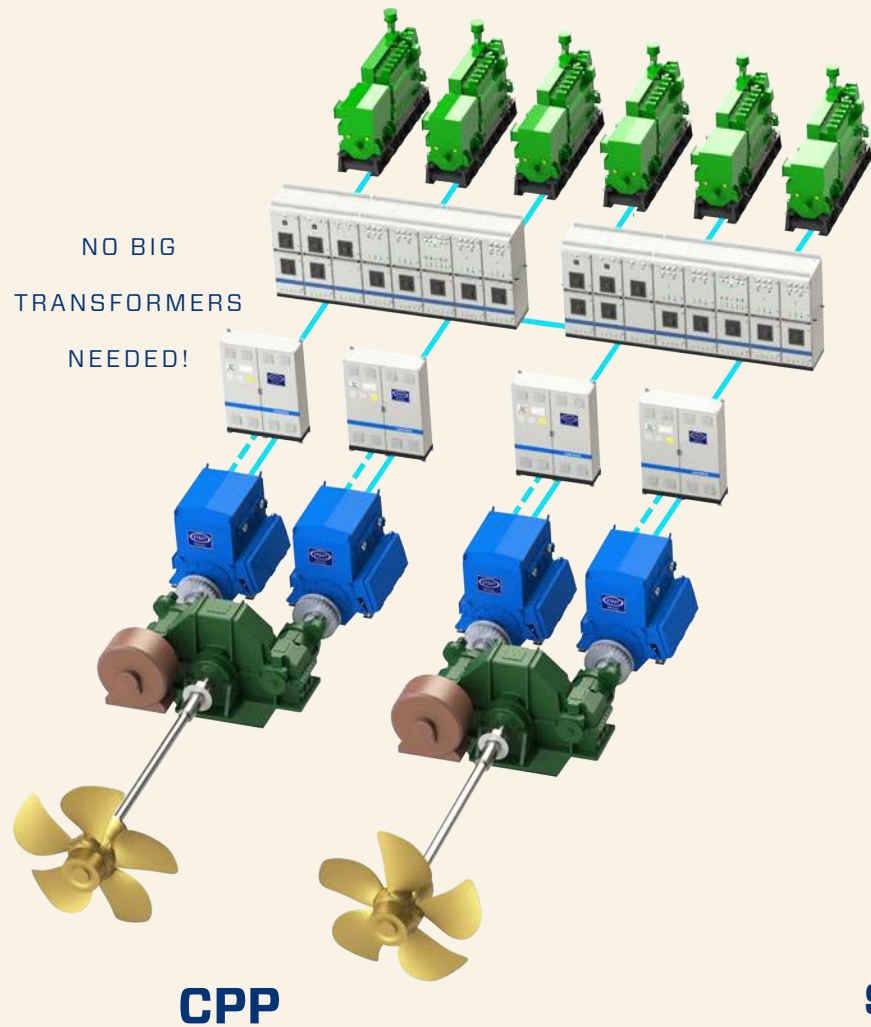
Through a variable frequency on the AC grid and Main Switchboard, STADT with AC VariGrid™ can control the RPM on STADT electric motors and Propeller in all operation modes.

BENEFITS

- ▲ Lower Fuel Consumption
- ▲ Less Emission
- ▲ Lower Noise Level
- ▲ Less Luboil Consumption
- ▲ Less Wear and Tear on Gensets
- ▲ Increased propulsion efficiency



WHEN HIGH POWER IS REQUIRED - FOR NAVAL SHIPS UP TO 100 MW



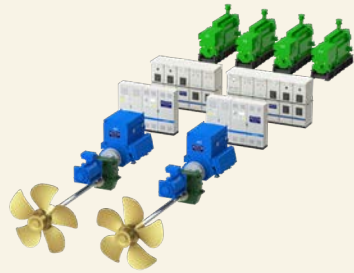
TRANSFORMER-FREE IN LOW / MEDIUM / HIGH VOLTAGE:

- Λ 440 V AC
- Λ 690 V AC
- Λ 3300 V AC
- Λ 4160 V AC
- Λ 6600 V AC
- Λ 11000 V AC
- Λ 13500 V AC



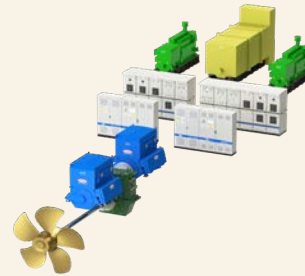
STADT STEALTH LEAN PROPULSION®

STADT LEAN PROPULSION® ARRANGEMENTS - IEP



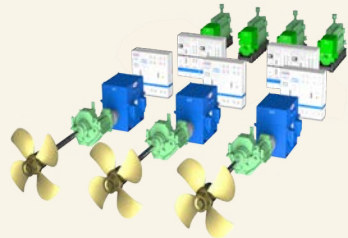
Twin screw PTI, CP

- ^ 4 generators
- ^ 4 electric motors
- ^ 2 main switchboards



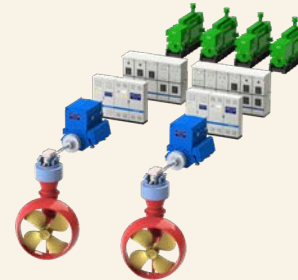
Single screw, CP

- ^ 2 diesel generators
- ^ 1 gas turbine generator
- ^ 2 electric motors
- ^ 2 main switchboards



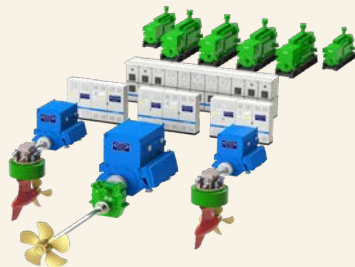
Triple screw, CP

- ^ 4 generators or more
- ^ 3 electric motors
- ^ 2 main switchboards



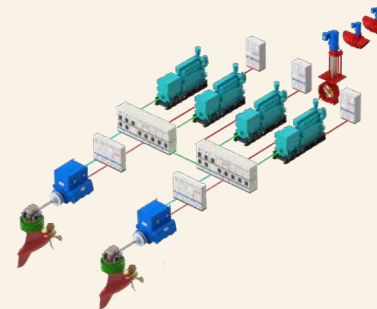
Twin screw (Azimuth or Voith), CP

- ^ 4 generators
- ^ 2 electric motors
- ^ 2 main switchboards



Triple screw (2 Azipulls), CP

- ^ 6 generators
- ^ 3 electric motors
- ^ 1 main switchboard
with Bus-Tie



Twin screw (2 Azipulls), CP

- ^ 4 generators
- ^ 2 electric motors
- ^ 2 main switchboards
- ^ 2 BT, 1 RT DP-2

BATTERY OR FUEL CELL OPTIONS AVAILABLE IN ALL CONFIGURATIONS

THE STADT NAVAL SCOPE

Built according to MIL-STD-901 standard, we offer a full product range as listed below.



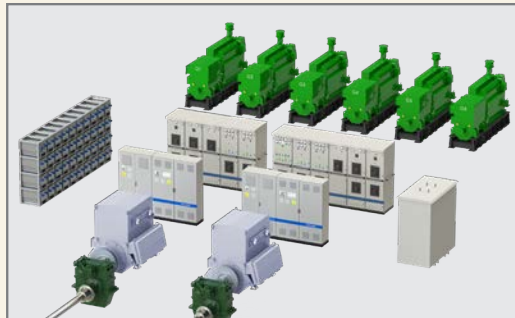
STADT Lean Drives. Scalable in power to more than 50 MW per propeller. Pure AC drive technology patented by STADT.



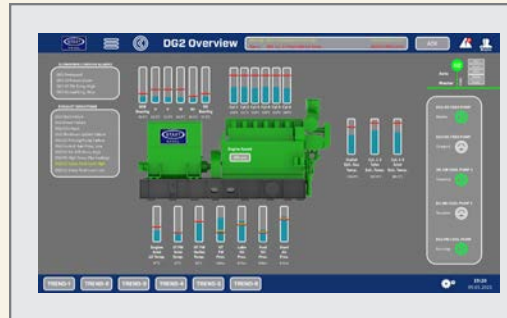
STADT AC motors, asynchronous technology, a broad range.



STADT main AC switchboards, low voltage or medium voltage. Optional DC sub-switchboards.



STADT power generators, battery systems, shore-to-ship power solutions, distribution transformers, etc.



Power Management System(PMS), IAS, remote access from shore, Dynamic Positioning(DP).

SERVICES and EPC:

- ^ Engineering of propulsion solutions
- ^ Manufacturing and installation
- ^ Commissioning
- ^ Audits on request
- ^ Global Services

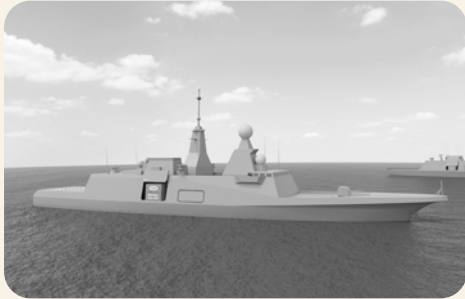
STADT GROUP HISTORY

40 YEARS IN AC DRIVES



MORE THAN 150 SHIPS AND RIGS POWERED BY STADT DRIVES

REFERENCES



European Defence Fund (EDF)

Partner / Beneficiary in EDF

And HEGAPS, a Digital Twin project



SAAB AB - Sweden

Series of Naval ships



ORP Jerzy Różycki - 261

ORP Henryk Zygański - 264

Naval ships, Polish Navy



KV Tromsø

Naval ship



ORP Ratownik

Naval submarine rescue ship,

Polish Navy



Cartagena A62

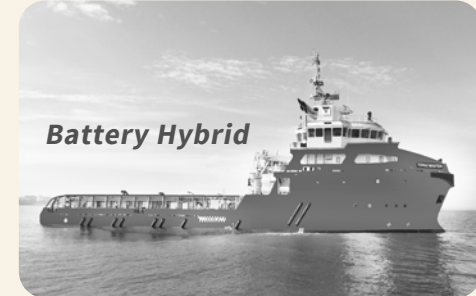
Spanish Armada



REFERENCES



Sanco Star
Sanco Spirit
Geological Research Ships



Rawabi 324
NCA80E for Rawabi Vallianz



White Rabbit
Trimaran yacht 83x20m
Built in aluminum
Echo Yard Australia



Ocean Fortune
Ocean Mermaid
SSV - Vestland Offshore



SK Arctic, SK Atomik, SK Kinetik,
SC Winter, SC Bongkot, SK Dynamik,
Warami, TOPAZ Master, TOPAZ Mariner
AHTSV NCA80E, Nam Cheong

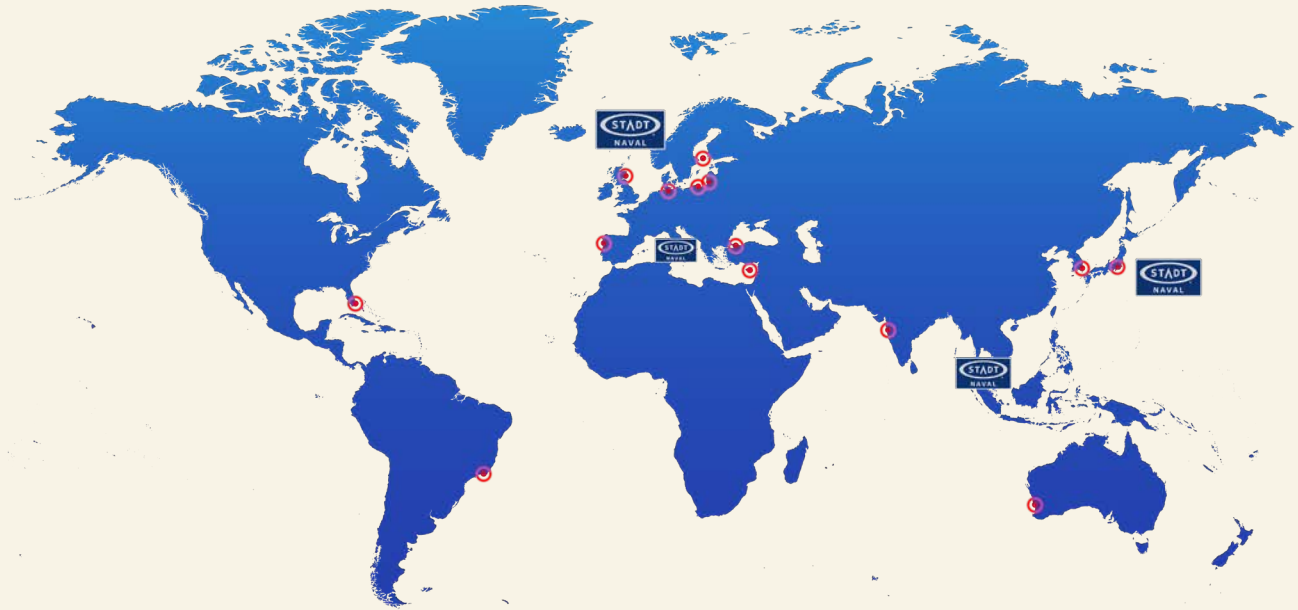


THOR Magni, Modi,
Frigg, Freyja
SSV operated by PGS

STADT GLOBAL NETWORK

STADT SERVICE POINTS:

STADT NORWAY, GJERDSVIKA
STADT ITALY, ROME
STADT SINGAPORE, SINGAPORE
STADT JAPAN, TOKYO
STADT GERMANY, HAMBURG
STADT SPAIN, VIGO
STADT POLAND, GDYNIA
STADT TURKEY, TUZLA
STADT DENMARK, ESBJERG
STADT BALTIC, KLAIPEDA
STADT UK, ABERDEEN
STADT MEDITERRANES, LIMASSOL
STADT NORTH AMERICA, MIAMI
STADT SOUTH AMERICA, RIO DE JANEIRO
STADT KOREA, BUSAN
STADT INDIA, MUMBAI
STADT AUSTRALIA, PERTH
STADT MIDDLE EAST, DUBAI



STADT OFFICES:

STADT NORWAY, GJERDSVIKA
STADT ITALY, ROME
STADT SINGAPORE, SINGAPORE
STADT JAPAN, TOKYO

STADT IS A MEMBER OF

NORWEGIAN DEFENCE
AND SECURITY INDUSTRIES
ASSOCIATION



GALLERY



LEAN PROPULSION®

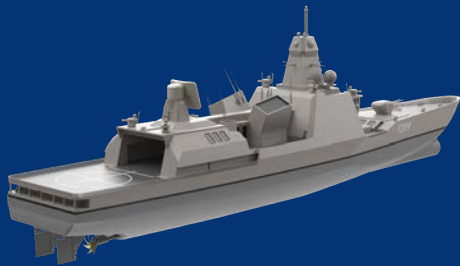


LEAN BRINGS YOU

- + RELIABILITY
- + VERY LONG LIFETIME
- + SUSTAINABILITY

- + STEALTH & HSE
- + MORE CARGO CAPACITY
- + LONGER ENDURANCE

- + LESS EMISSION AND FUEL
- + COST EFFICIENCY
- + LOWEST URN



LEAN PROPULSION®



STADT NAVAL AS IS PART OF THE STADT GROUP AS



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Made in Norway

