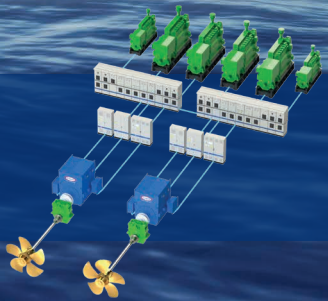
STADT®

STEALTH LEAN PROPULSION



SIMPLY THE BEST SOLUTION
FOR ANY NAVAL SHIP

STADT STEALTH LEAN PROPULSION®

The Navy needs reliable vessels that are efficient to operate, year after year, in all seasons and weather conditions. Most importantly, the ship must have a reliable propulsion system with propellers and power systems that never fail. One that enables them to operate safely and low noise anywhere on the planet. 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 prepared for tomorrow’s naval ships requirements” ?

STADT has taken these challenges seriously, when developing the STADT Stealth Naval Lean Propulsion®, based on a completely different architecture – a truly revolutionary design, also 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 requirements.

The new drive technology has been awarded several times for its unique characteristics, and many ships are now sailing with the Lean Drive technology all over the world.

Hallvard Slettevoll
Director , CEO

STEALTH AND SAFE PROPULSION

No electromagnetic interference, EMI, due to sine wave operation
No acoustic switching noises
No harmonic voltage distortion, THD, on the ship
No transformers for the propulsion are needed
No electric losses in the drives at normal operation
High redundancy in all levels of the drive systems
Major reduction of space and weight for the drives
Minimal need for cooling of drives and its systems
No need for screened power cables and cable segregation
Rugged and very well proven technologies
MTBF and lifetime improved dramatically compared to competitors
Simplified technology , 80 % reduction in number of components

COMPLETE SILENCE

STADT STEALTH LEAN PROPULSION® - PATENTED TECHNOLOGY

SUSTAINABLE, LEAN AND GREEN:

- Silence by all means
- Reduced fuel consumption, by slow steaming
- Reduced NOx, SOx, BC and CO2 emission
- Reduced maintenance and high redundancy
- Scalability (up to 100 MW)

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

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 Naval 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 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.

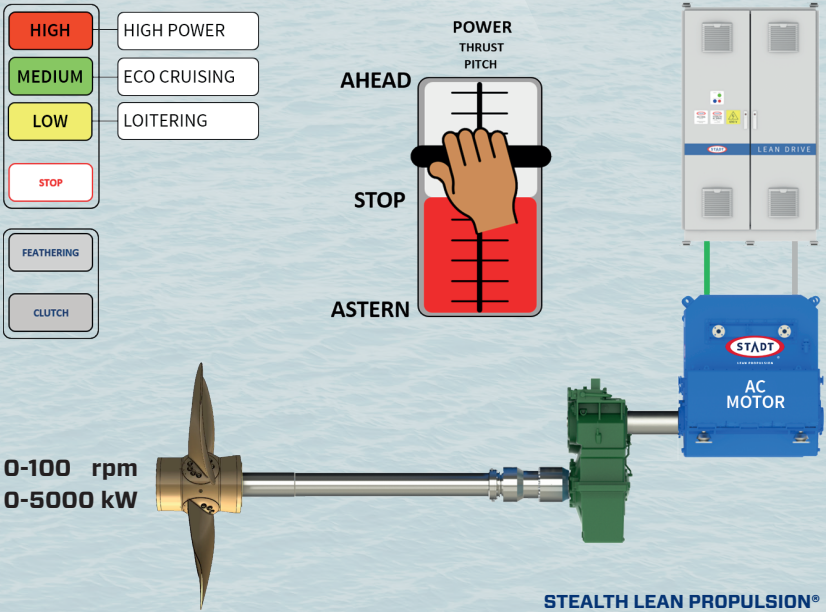
A spokesman from the Norwegian Navy has expressed that they have found that STADT has developed a very innovative technology that has a potential to increase defence capabilities for the future Navy fleet.

WHY WE USE CPP - CONTROLLABLE PITCH PROPELLER

THE PATENTED STADT STEALTH LEAN DRIVE COMBINES PITCH AND RPM-CONTROL

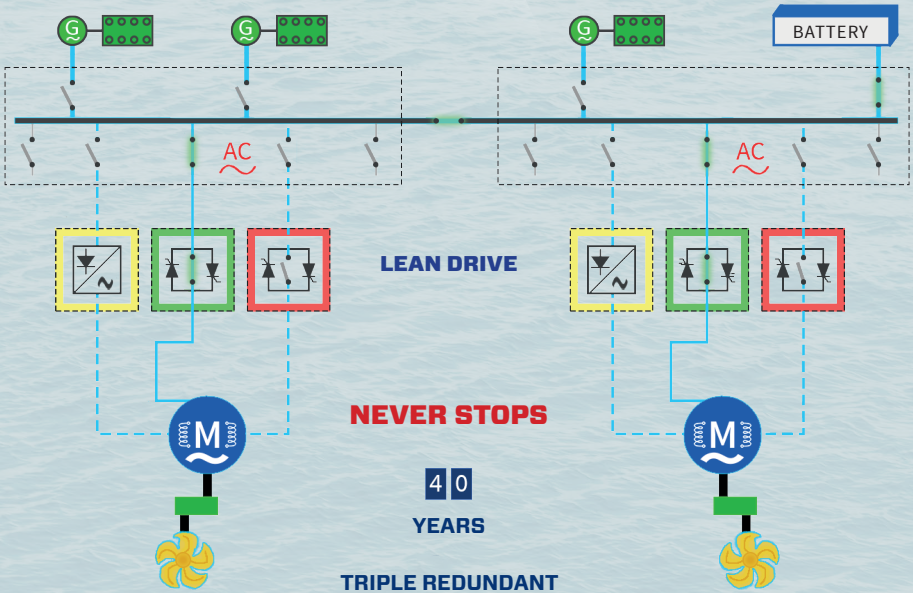
- Significantly improved overall efficiency at varying load and/or varying speed conditions
- Better manoeuvrability (responce acceleration, crash stop)
- Better performance at reversing and in DP, full power control at your fingertips
- Better operational conditions for gear, shaft, and bearings, especially at low speed
- Forgiving for design errors
- Each blade may be changed independently if damaged, at sea
- Future-proof with regard to changes of use of the vessel, slow steaming, extensions, etc.
- Possibility for full feathering position, which is saving fuel when only running one propeller

POWER, - AT YOUR FINGERTIPS



STEALTH LEAN PROPULSION®

STADT STEALTH LEAN PROPULSION®



NEVER STOPS

40

YEARS

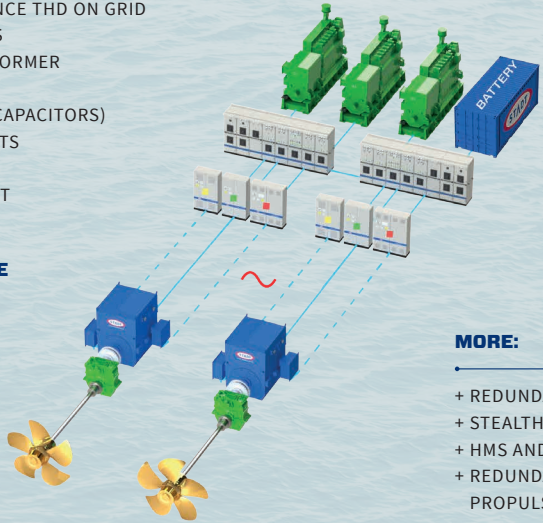
TRIPLE REDUNDANT

DISCOVER THE POWER OF SIMPLICITY

ELIMINATED:

- POWER DISTURBANCE THD ON GRID
- HARMONIC FILTERS
- 12 P - 24 P TRANSFORMER
- NOISE (PWM→EMI)
- EXPLOSION RISK (CAPACITORS)
- 80.000 COMPONENTS
- COOLING SYSTEMS
- 5-6 % WASTED HEAT
- COMPLEXITY

= LESS DOWNTIME



MORE:

+ REDUNDANCY IN DRIVE
+ STEALTH
+ HMS AND COMFORT (SILENCE)
+ REDUNDANCY, ALSO IN AC PROPULSION MOTORS
+ POWER TO PROPELLER

= BETTER PERFORMANCE

STADT STEALTH LEAN PROPULSION®

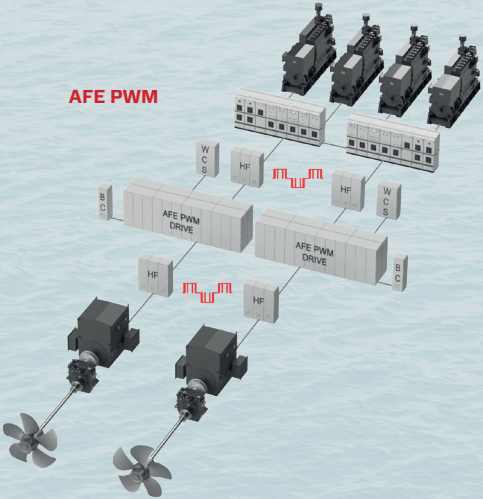
EVALUATION OF TODAYS DIFFERENT DRIVE SOLUTIONS

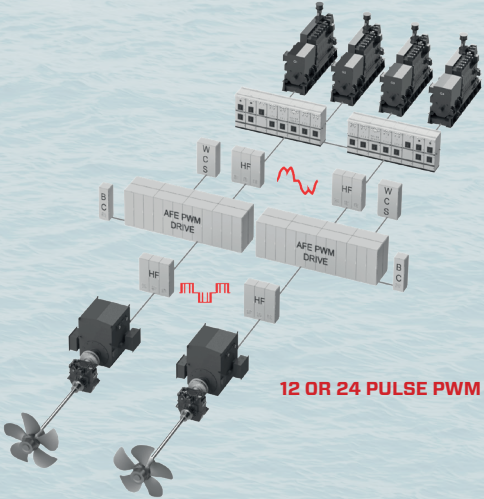
Lean Issues To Consider	STADT Lean Drive	12 Pulse or 24 Pulse	AFE (Active Front End)
Technology in AC drive	Sine Wave	PWM	PWM
No. of electric energy transformations	0	4	4 or 5
Power Train Losses	No, (negligible)	6 %	6 - 7 %
Cooling Type	Air is sufficient	Water	Water
Power Transformers Needed	No	Yes	Sometimes
Redundant Power Units	Standard	Special	Special
Harmonic Distortion (THD)	No	High	High
Electromagnetic Interference	No	High	High
Acoustic Switching Noise	No	Yes	Yes
Screened Power Cables needed	No	Yes	Yes
Depending on Harmonic Filters	No	Yes	Yes
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
Weight of Drive System	100 %	1100 % - 1400 %	600 % - 1600 %
Size of Drive System	100 %	500 % - 600 %	450 % - 700 %
All Voltage Class (220V-15kV)	Yes	No	No
Power Scalable	Yes	No	No
Regenerates Power to Grid	Yes	No	Yes
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
Propeller Pitch Configuration	CP	CP or FP	CP or FP
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

AFE PWM





12 OR 24 PULSE PWM

PWM = PULSE WIDTH MODULATION

STADT STEALTH LEAN PROPULSION® REFERENCES

SAAB AB - Sweden

Naval ship

NATO contracts

Naval ships

KV Tromsø

Naval ship

Sanco Star

Sanco Spirit

SRV operated by PGS

THOR Magni, Modi, Frigg, Freyja

SSV operated by PGS

Econuri

Incheon Port Authority Guide Ship

Samsung Heavy Industries

150 MW INSTALLED POWER

SK Arctik, SK Atomik, SK Kinetik,
SK Technik, SC Winter, SC Bongkot,
SK Dynamik, Warami
AHTSV NCA80E, Nam Cheong

TOPAZ Master
TOPAZ Mariner
NCA80E for Topaz Marine

White Rabbit
Trimaran yacht 83x20m
Echo Yard Australia

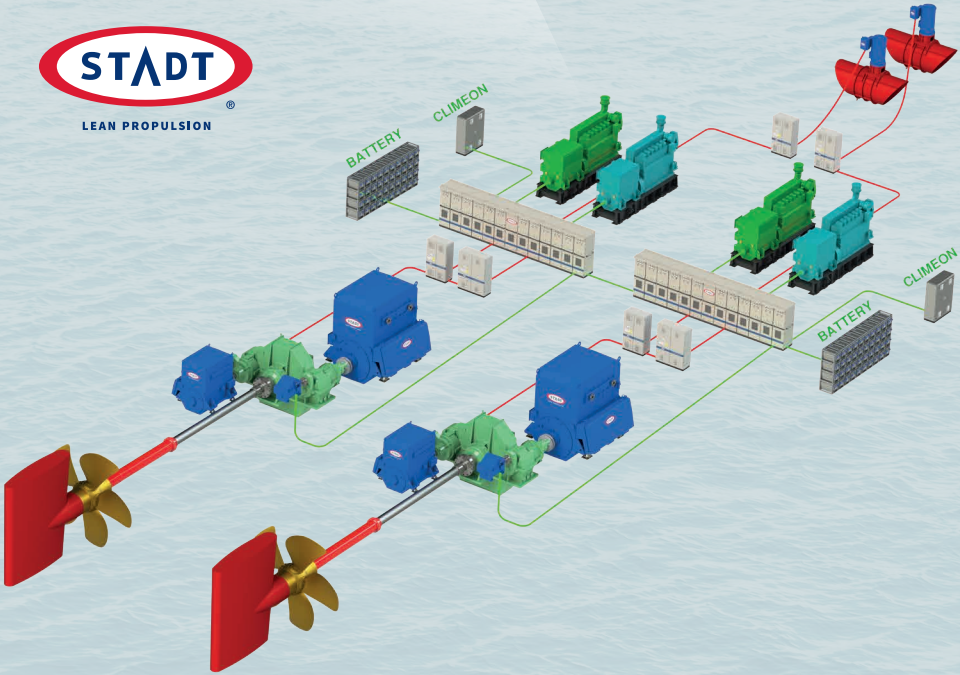
Ocean Fortune
Ocean Mermaid
SSV - Vestland Offshore

Seihav
WELL-BOAT
Lerøy Seafood

Meløyfjord, Voldnes,
Stokke Senior, Harto
Purse Seiners

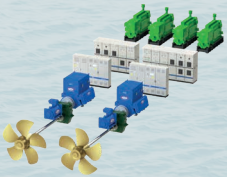
STADT HYBRID

STADT
LEAN PROPULSION



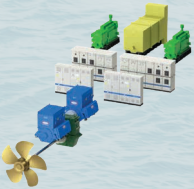
STADT LEAN PROPULSION® ARRANGEMENTS - IEP

SOME BASIC ARRANGEMENTS FOR FULL ELECTRIC PROPULSION, BASED ON DIESEL OR BIO FUELS BATTERY OR FUEL CELL OPTIONS AVAILABLE IN ALL CONFIGURATIONS



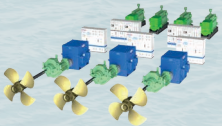
Twin screw PTI, CP

- 4 generators
- 4 electric motors
- 2 main switchboards



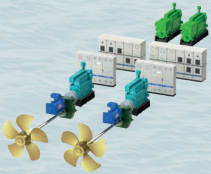
Single screw, CP

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



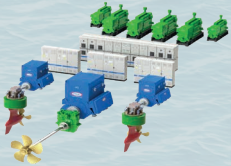
Triple screw, CP

- 4 generators
- 3 electric motors
- 2 main switchboards



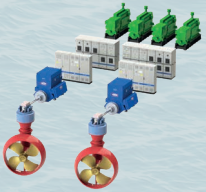
Twin screw, CP - Hybrid

- 2 generators
- 2 main engines
- 2 electric motors
- 2 main switchboards



Triple screw (2 Azipulls), CP

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

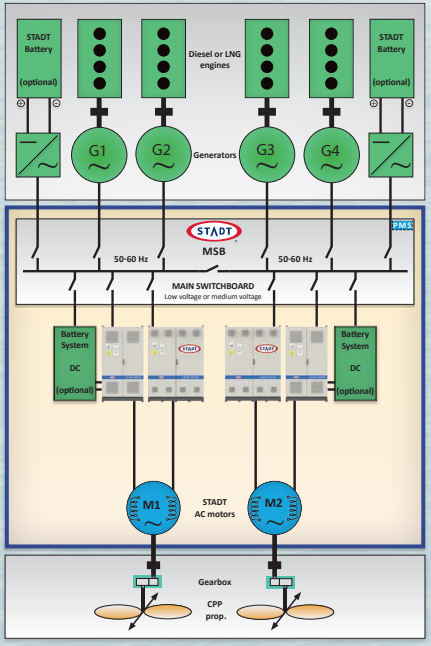


Twin screw (Azimuth or Voith), CP

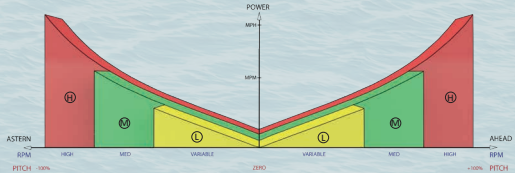
- 4 generators
- 2 electric motors
- 2 main switchboards

CODLAG is also an option

STADT - YOUR SYSTEM INTEGRATOR



LET US DESIGN YOUR NEW SUSTAINABLE PROPULSION SOLUTION

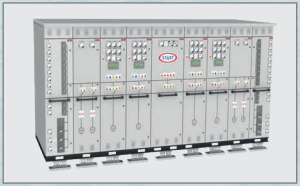


THE STADT SCOPE

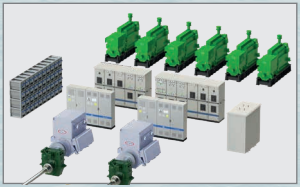
Built according to MIL-STD-901 standard, we offer a full product range as listed below.

STADT Lean Drives. Scalable in power to more than 50 MW per propeller.

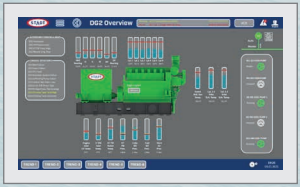
STADT AC motors, a broad range.



STADT main switchboards, MCC, low voltage and medium voltage.



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
- Global Services

STADT - AWARDED TECHNOLOGY LEADER

The STADT Group was founded by Hallvard L. Slettevoll in 1985. We are located in the new and modern STADT Maritime Center in Gjerdsvika harbour.

For many years STADT has been a leading company in AC drive innovations. Long experience from 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, bringing 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.

The Lean Drive was patented in 2008, and launched to the first ship applications the same year. 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.

STADT HISTORY

1980 PHILIPS PWM Technology

1985 Founded STADT

1986 SINTEF Transistor Technology

1988 SOLCON Thyristor Technology

1995 VACON CPU Drive Technology

1996 Major Customer

1998 AKER Industry Partner And Investor

1999 SND INVEST Investor (Government)

2001 ABB Buyout – PWM Drive Technology

2008 Patented Lean Drive Technology STADT LEAN PROPULSION

2011 SAMSUNG Partner and Customer

2012 Our Biggest Order 16 Vessels

2013 KONGSBERG Industry Partner

2014/2015 Technology Awards

2017 Contract Navy Market

2019 Contract NATO

2021 MoD STEALTH Project

2015  Opening of STADT Maritime Center

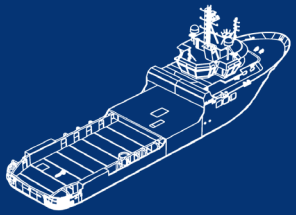
35 YEARS IN AC DRIVE DEVELOPEMENT

LEAN BRINGS YOU

+ SAFETY & RELIABILITY
+ VERY LONG LIFETIME

+ STEALTH & HSE
+ MORE CARGO CAPACITY
+ LONGER ENDURANCE

+ LESS EMISSION AND FUEL
+ COST EFFICIENCY



FSi

We are member of
NORWEGIAN DEFENCE AND SECURITY INDUSTRIES ASSOCIATION

STADT
LEAN PROPULSION

STADT AS
Moljevegen 50 | N-6083 Gjerdsvika | Norway
Tel.: +47 700 25 800 | www.stadt.no