SIMPLY THE BEST SOLUTION
FOR ANY SHIP
Ship owners need 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 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 environmental challenges”?

STADT has taken these challenges seriously, when developing the STADT 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.

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
BE PREPARED FOR THE CARBON-NEUTRAL FUTURE

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 LEAN PROPULSION® - PATENTED TECHNOLOGY

Superior technology with Stealth performance. Ensures that the propeller never stops.

SUSTAINABLE, LEAN AND GREEN:

- Reduced fuel consumption, by slow steaming
- Only 6% losses in systems (AC Motors and alternators included.)
- Reduced NOx, SOx, BC and CO2 emission
- Reduced maintenance and high redundancy
- Slow steaming optimized and lower EEDI

LEAN DRIVE FOR ANY SIZE OF SHIPS
PGS operates a fleet of seismic research vessels, and is one of the biggest companies in this marked.

The vessels operate all over the world, very often in very remote locations where service facilities are not available.

Reliability and efficiency is very important for both our own vessels as well as the support and escort vessels we use.

STADT Lean Propulsion® was chosen by one of our suppliers of support vessels in cooperation with PGS, and we are happy to see it has lived up to all our expectations. Very few, if any undesired failures over 5 years in operation, tells us that this is the right choice for these vessels.

Einar Nielsen
VP Special Projects, PGS
# EVALUATION OF TODAY'S DIFFERENT DRIVE SOLUTIONS

<table>
<thead>
<tr>
<th>Lean Issues To Consider</th>
<th>STADT Lean Drive</th>
<th>12 Pulse or 24 Pulse</th>
<th>AFE (Active Front End)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology in AC drive</td>
<td>Sine Wave</td>
<td>PWM</td>
<td>PWM</td>
</tr>
<tr>
<td>No. of electric energy transformations</td>
<td>0</td>
<td>4</td>
<td>4 or 5</td>
</tr>
<tr>
<td>Power Train Losses</td>
<td>No, (negligible)</td>
<td>6 %</td>
<td>6 - 7 %</td>
</tr>
<tr>
<td>Cooling Type</td>
<td>Air is sufficient</td>
<td>Water</td>
<td>Water</td>
</tr>
<tr>
<td>Power Transformers Needed</td>
<td>No</td>
<td>Yes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Redundant Power Units</td>
<td>Standard</td>
<td>Special</td>
<td>Special</td>
</tr>
<tr>
<td>Harmonic Distortion (THD)</td>
<td>No</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Electromagnetic Interference</td>
<td>No</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Acoustic Switching Noise</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Screened Power Cables needed</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Depending on Harmonic Filters</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Designed Economic Lifetime</td>
<td>30 Years</td>
<td>6 Years</td>
<td>6 Years</td>
</tr>
<tr>
<td>Maintenance Requirement</td>
<td>Very Low</td>
<td>Frequent</td>
<td>Frequent</td>
</tr>
<tr>
<td>Onboard Crew Skills</td>
<td>Ordinary</td>
<td>Special</td>
<td>Special</td>
</tr>
<tr>
<td>MTBF (mean time between failures)</td>
<td>7 Years</td>
<td>1 Year</td>
<td>1 Year</td>
</tr>
<tr>
<td>MTTR (mean time to repair)</td>
<td>1 Hour</td>
<td>1 Week</td>
<td>1 Week</td>
</tr>
<tr>
<td>Spares Globally Available</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Weight of Drive System</td>
<td>100 %</td>
<td>1100 % - 1400 %</td>
<td>600 % - 1600 %</td>
</tr>
<tr>
<td>Size of Drive System</td>
<td>100 %</td>
<td>500 % - 600 %</td>
<td>450 % - 700 %</td>
</tr>
<tr>
<td>All Voltage Class (220V-15kV)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Power Scalable</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Regenerates Power to Grid</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>No. of Power Components in Line</td>
<td>1</td>
<td>80 000</td>
<td>150 000</td>
</tr>
<tr>
<td>Capacitors In Main Power Circuit</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Explosion Risk in Drive</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Propeller Pitch Configuration</td>
<td>CP</td>
<td>CP or FP</td>
<td>CP or FP</td>
</tr>
<tr>
<td>Financial Risk (Service cost, Off-hire)</td>
<td>Very Low</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
TECHNOLOGY DIFFERENCES

STADT LEAN PROPULSION® TECHNOLOGY

STADT LEAN DRIVE

COMPETITOR PWM DRIVE TECHNOLOGY

STEALTH

SINE WAVE IS NOISE FREE, NO EMI

PWM CREATES A LOT OF EMI AND ACOUSTIC SWITCHING NOISE
THE DIFFERENCE:

LEAN DRIVE -PATENTED-

COMPLEX PWM DRIVE

See our animated film at www.STADT.no
DISCOVER THE POWER OF SIMPLICITY

ELIMINATED:
- POWER DISTURBANCE THD ON GRID
- HARMONIC FILTERS
- 12 P - 24 P TRANSFORMER
- NOISE (PWM>EMC)
- EXPLOSION RISK (CAPACITORS)
- 80,000 COMPONENTS
- COOLING SYSTEMS
- 5-6 % WASTED HEAT
- COMPLEXITY

= LESS OFF-HIRE

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

= BETTER PERFORMANCE

STADT LEAN PROPULSION®
COMPLEX PWM DRIVES (for comparison)

Can never be STEALTH or Noise-Free

AFE PWM

12 OR 24 PULSE PWM
STADT LEAN PROPULSION® REFERENCES

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

TOPAZ Master
TOPAZ Mariner
NCA80E for Topaz Marine

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

Ocean Fortune
Ocean Mermaid
SSV - Vestland Offshore

Sanco Spirit, Sanco Star
SRV operated by PGS

Normand Pioneer
Multifunctional Offshore Vessel
Solstad Shipping
**Normand Progress**
Multifunctional Offshore Vessel
Solstad Shipping

**Geobay**
ROV Vessel
Geo Shipping

**Midnatsol**
Trollfjord
Hurtigruten

**Seihav**
WELL-BOAT
Lerøy Seafood

**Bergen Troll**
Tank Vessel
TFDS

SAAB AB - Sweden
and NATO contract

ILLUSTRATION ONLY
WHY WE USE CPP - CONTROLLABLE PITCH PROPELLER

THE PATENTED STADT LEAN DRIVE COMBINES PITCH AND RPM-CONTROL

• Significantly improved overall efficiency at varying load and/or varying speed conditions
• Better manoeuvrability (acceleration, breaking, crash stop)
• Better performance at reversing and in DP
• 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
Carbon-Robust Solutions:

- Wind
- Solar
- Battery
- LNG
- BioGas
- BioFuel
- MDO
- HVO
- Hydrogen
- Ammonia
- Methanol and E-fuels
Twin screw PTI, CP
- 4 generators
- 4 electric motors
- 2 main switchboards

Single screw Twin, CP
- 4 generators
- 2 electric motors
- 2 main switchboards

Triple screw, CP
- 4 generators
- 3 electric motors
- 2 main switchboards

Double ended, 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 (Azimuth), CP
- 4 generators
- 2 electric motors
- 2 main switchboards

BATTERY OR FUEL CELL OPTIONS AVAILABLE IN ALL CONFIGURATIONS
STADT - YOUR SYSTEM INTEGRATOR

LET US DESIGN YOUR NEW SUSTAINABLE PROPULSION SOLUTION
THE STADT SCOPE

Delivered to meet any typical ship classification standard.

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
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.
LE

\textbf{AN BRINGS YOU}

+ SAFETY & RELIABILITY
+ VERY LONG LIFETIME

+ STEALTH & HSE
+ MORE CARGO CAPACITY

+ LESS EMISSION AND FUEL
+ COST EFFICIENCY

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