



SeaJet™ Pod

7.5 MW and 15 MW PODs

gepowerconversion.com

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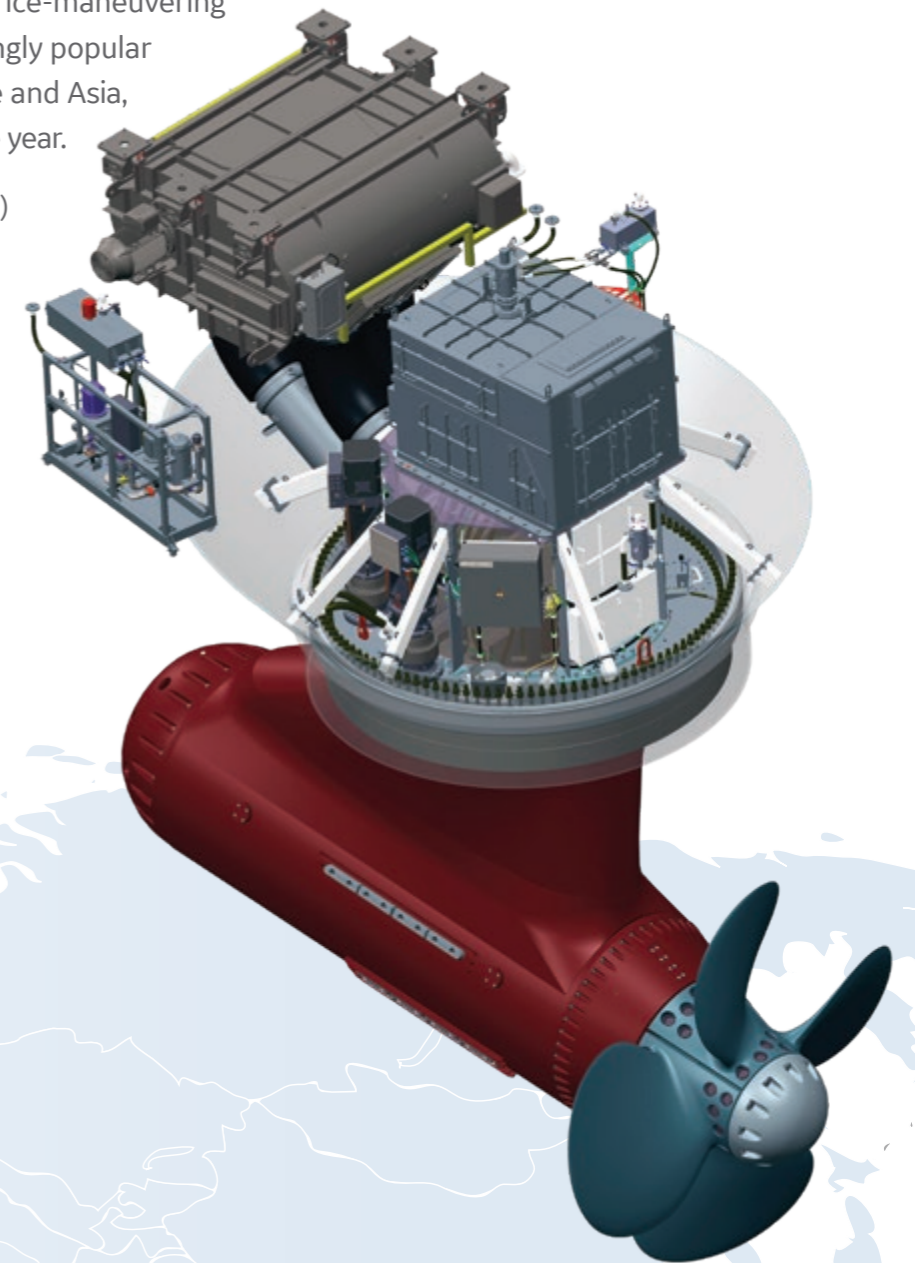
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SeaJet™ Pod Ice-class pods offer maneuverability, reliability and efficiency

Vessels must have ice-breaking and ice-maneuvering capabilities to traverse the increasingly popular northern sea route between Europe and Asia, which is bound by ice for most of the year.

GE's SeaJet™ Pod (7.5MW and 15MW) is an ice class electric pod propulsion unit engineered to provide 360 maneuverability and other significant advantages over traditional propeller technology.



Benefits

Improved Operation

- Optimal maneuverability with sealed, self-contained electric pods that are steerable at different angles
- Better ice-breaking capabilities with higher overall hydrodynamic efficiency
- More reliable and compact—compared to traditional propeller machines such as azimuth thrusters—with no need for gears or for the propulsion unit to be housed within the vessel
- Anti-pollution seal system

Less Maintenance

- More robust and reliable than synchronous machines due to advanced induction motor technology drawn from GE's marine business
- No risk of oil leakages into the sea
- Optimal technician access inside the pod with reduced internal webs and stringers
- Advanced bearing technology

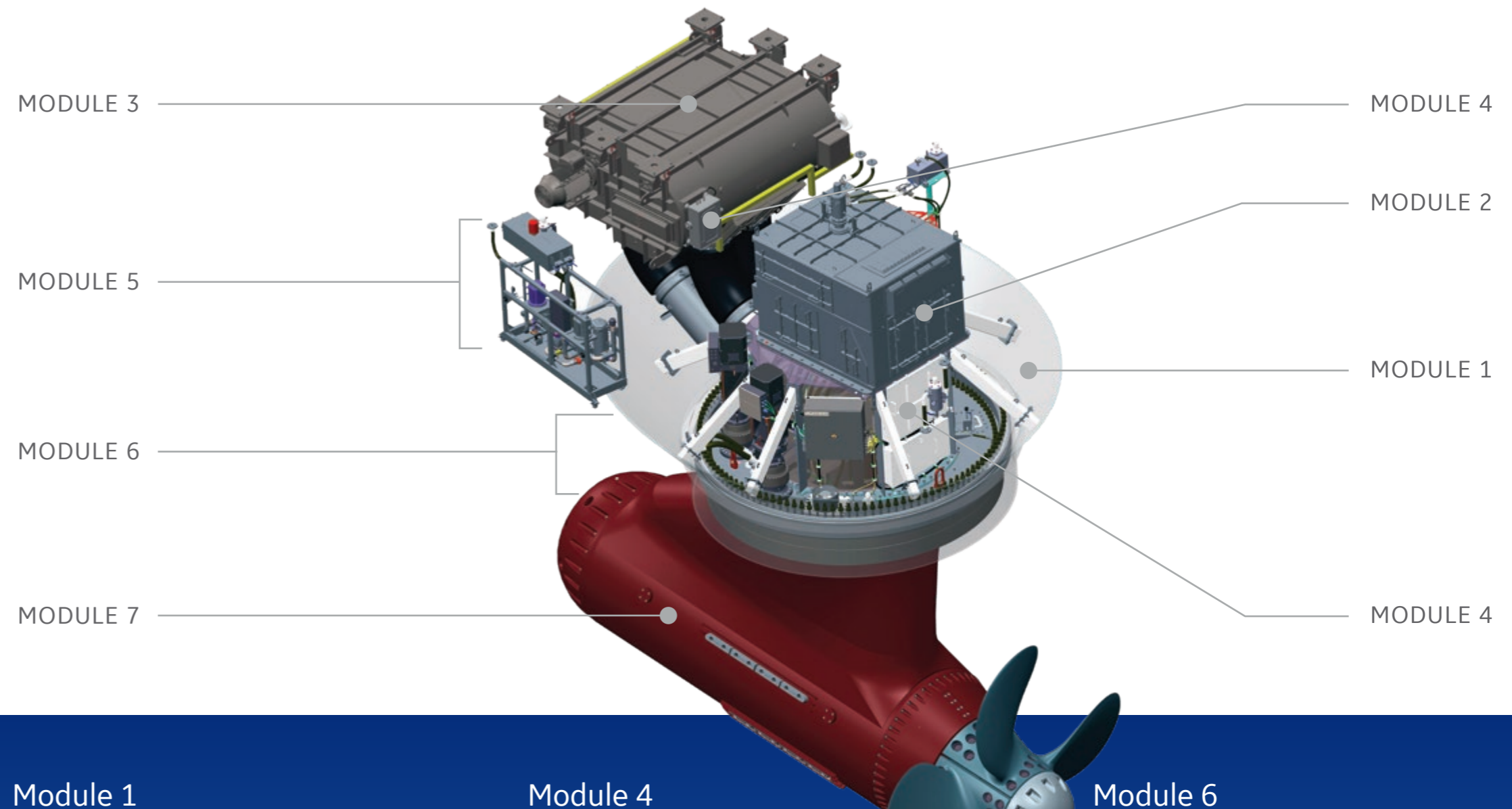
Enhanced Safety

- Safer handling of brake/locking and turning without need for manual access into the pod
- Sea-proven power and auxiliary slip rings
- Improved adoption to hull with modularized configuration
- Compliant to IEC standards

Greater Efficiency

- Improved vessel efficiency by up to 5% helps operators save up to \$1MM depending on the vessel type and operational profiles
- Reduced energy consumption due to electrical steering system
- Smaller induction motor with bilateral cooling system
- Low-resistance squirrel cage

Overview of the SeaJet™ Pod



Module 1

The Hull Interface: Has a steering module that is supported by a conical or seating block configuration

Module 2

Rotary Interface: Distributes the electric energy, signals, and fluids to the pod propulsion module on 360° rotation

Module 3

Cooling Unit: Exchanges heat from propulsion motor active parts with fresh water circuit from the vessel. Regulates temperature of the air to the pod motor

Module 4

Air Pressurization Unit and Air Safety Unit: Regulates air pressure inside the propulsion module, steering module, and cooling unit. The air safety unit avoids air over-pressure or pressure drop

Module 5

Lubrication System: Lubricates and cools the dynamic shaft SWS with glycol lubrication. The oil lubrication system lubricates the steering system and DE-NDE bearings of the propulsion pod

Module 6

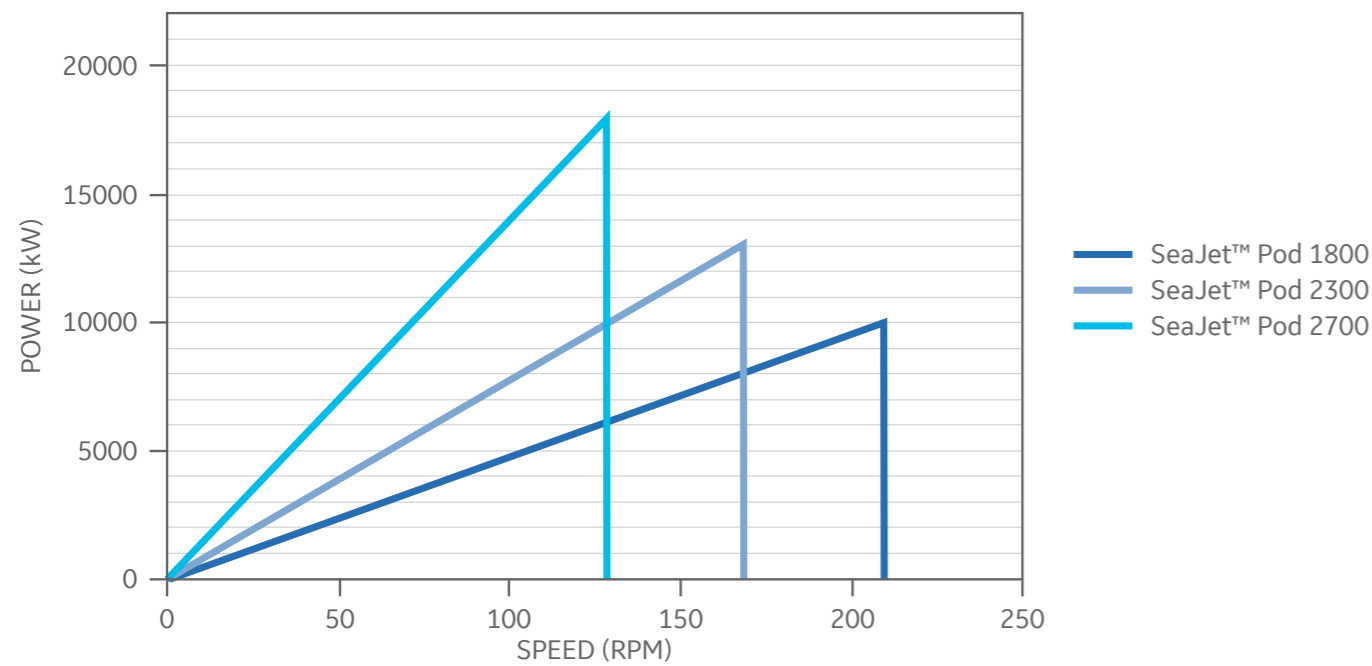
Steering Module: Drives the propulsion module with 360-degree rotation. Made of a slewing roller bearing and electric steering actuators, it also allows technician access inside the pod during maintenance.

Module 7

Propulsion Module: Propels the vessel, driven by a high torque density induction motor supplied by a PWM converter

Technical Specifications

	SeaJet™ Pod 1800	SeaJet™ Pod 2300	SeaJet™ Pod 2700
Power Range (MW)	5 to 8	9 to 11	12 to 17
Rated Shaft Speed (rpm)	156	120	108
Propeller Diameter (m)	4.300	5.60	6.00
Weight (T)	140	230	270



Technical Data: SeaJet™ Pod 1800

Ice Class	Icebreaker 7 RMRS
Rated Voltage	3,150 VAC
Number of Blades	4
Propeller Type	Fixed Pitch and Built Hub Configuration
Steering System	Electric Motor + Torque Limiter + Gearbox + Pinion & Ring Gear

Technical Data: SeaJet™ Pod 2300

Number of Blades	4
Propeller Type	Fixed Pitch and Built Hub Configuration
Steering System	Electric Motor + Torque Limiter + Gearbox + Pinion & Ring Gear

Technical Data: SeaJet™ Pod 2700

Ice Class	ARC 7 RMRS
Rated Voltage	3,150 V
Number of Blades	4
Propeller Type	Fixed Pitch and Built Hub Configuration
Steering System	Electric Motor + Torque Limiter + Gearbox + Pinion & Ring Gear

Technical Advantages

- **Propulsion Motor:** An asynchronous motor with advanced performance provides a reliable system with less maintenance and more autonomy.
- **Lubrication and Bearing Cooling:** Simplified lubrication system.
- **Pressurization:** The system allows for reduced consumption of the auxiliaries, increased cooling efficiency for the propulsion motor, and reduced differential pressure on shaft line and steering dynamic lip seals.
- **Electric Steering:** Four electric motors with the flexibility to change “functionality” helps to reduce energy consumption.

- **Sea Water Seals:** Sea water seals are fresh water lubricated and cooled, without the use of oil.
- **Brake System:** The shaft line can be braked and locked at low speed for secure intervention. The brake system installed in the pod housing cool channel prevents the risk of dust and fire.
- **Test Bench:** Pushing the boundaries of our equipment to the highest reliability standards, the test bench system for the SeaJet™ Pod allows technology validation in real time by simulating extreme environmental conditions or the worst-case scenario.

Main Features

Propulsion Motor

The propulsion motor is a high torque, single winding, induction machine with simple, fully proven technology.

Bi-lateral air ventilation provides homogeneous cooling of active parts and limits cooling fan energy consumption. In addition, the propulsion motor can rotate both clockwise and counter-clockwise.

Cooling System

The cooling system is bidirectional, which allows for efficiency and homogeneous cooling. It includes:

- Pressurized air
- Redundant heat exchanger and fans

Steering Module

Bolted to the propulsion module, the steering module provides technician access to the pod and allows for pod rotation with smart torque control driven by electric motors. The steering module distributes the cold/ warm air between the propulsion module and the cooling unit and is engineered to limit pressure drop in the air cooling circuit.

Sea Water Seals and Shaft Seal

The propulsion system is lubricated by a fresh water /glycol mix, reducing grease or oil that can spill into the water.

Sea water seals protect the drive end bearing housing from the sea water.

A void space is pressurized to limit lip wear. In addition, the sea water seals can be changed from inside the pod using a maintenance inflatable.

Shaft Brake

The shaft brake's external location helps save space and reduce duct pollution and fire risks in the pod. The shaft brake can be controlled remotely (by request) and can lock the shaft line at speeds up to seven (7) knots.

Propulsion Motor

Improving reliability and availability are paramount to GE's propulsion motor configuration. For that reason, we applied our motto—"Simplicity equals reliability"—in the development of the SeaJet™ Pod, especially the most critical aspects of the propulsion motor—its rotating parts.

Technical Details:

The induction motor's use of a magnetic field to transfer energy between the stator and rotor offers a distinct advantage over other electrical machines that require a direct electrical connection between the rotor and supply system. The simplicity of the induction motor and the converter configuration makes the system simpler and easier to maintain and offers a high level of availability.

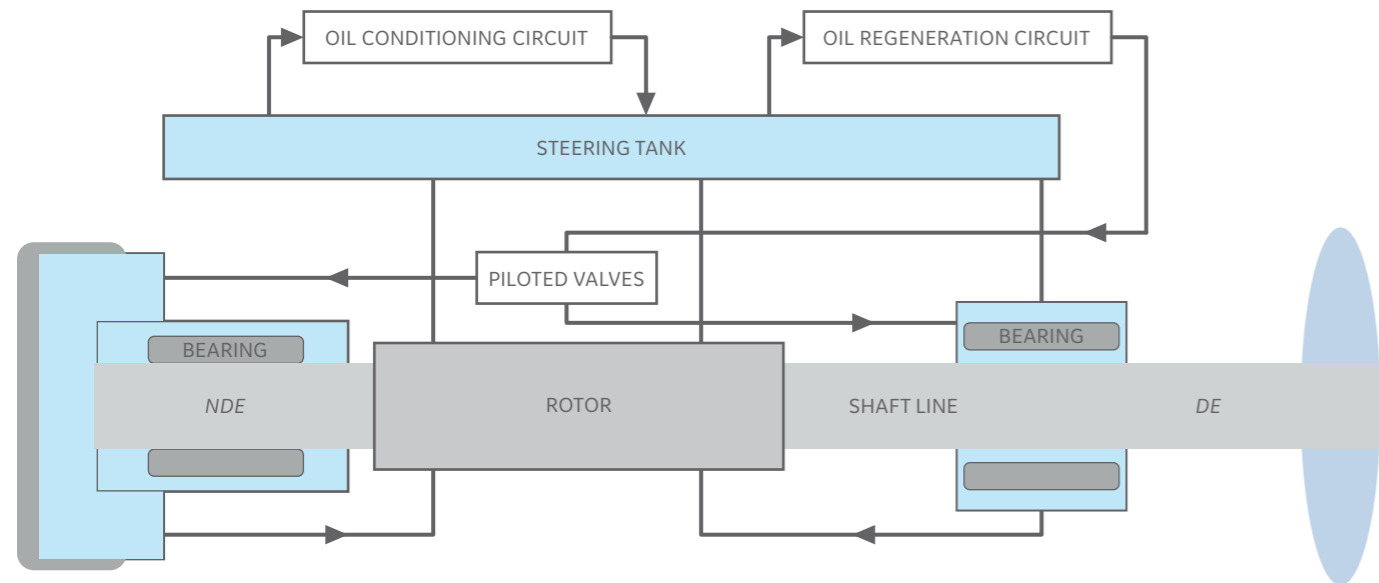
The SeaJet™ Pod's speed torque is related to its slip—the difference in the speed of the rotor relative to the resulting magnetic flux. Unlike synchronous machines, no oscillatory phenomena is observed in induction motors because the rotor flux is not related to the rotor and is constantly synchronous with the resulting magnetic flux. Once the rotor speed is reached for the load torque, the speed stabilizes without oscillation. The slip at zero speed also allows drive optimization to provide higher torque for Ice operations.



BENEFITS:

- Simple rugged construction
 - Cylindrical squirrel cage has no active insulated parts
 - Rotor configuration is improved with a low-resistance cage for low slip to reduce operational losses
 - Large air gap consistent with Ice shock and low noise signature requirements
- Reduced maintenance costs
- Reduced acoustic noise and vibrations due to slot skewing

Cooling System



The SeaJet™ Pod offers self-contained lubrication technology for the shaft and slewing bearing system. The bearings are fully submerged in the oil bath and engineered to operate without external oil lubrication system.

Technical Details:

The lubrication system includes a slewing bearing oil tank, header tanks in the pod room for oil filling, and a conditioning circuit and oil regenerative circuit.

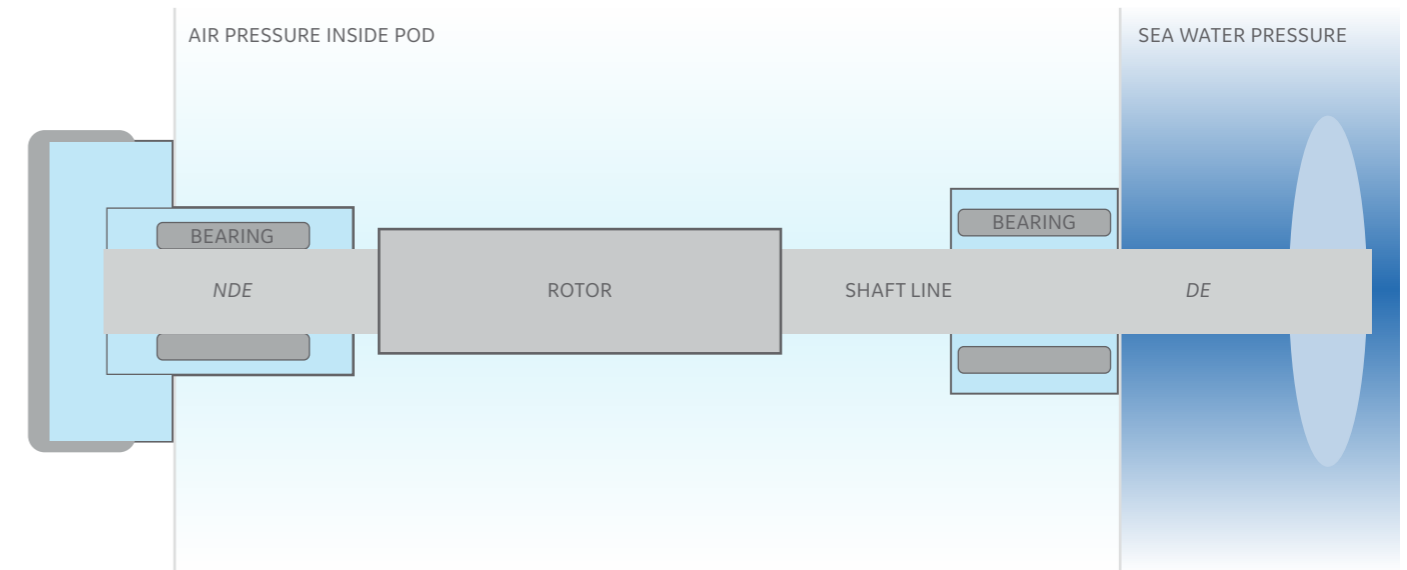
The same oil is used for both the shaft bearing and slewing bearing, and it is conditioned continuously using a closed loop oil filter system. To keep the bearing shaft line oil bath at the same air pressure inside the pod, the slewing bearing tank is pressurized at 0.2 bar by a header tank located in the pod room.

The regeneration circuit runs sequentially to change the oil in the DE or NDE circuit, depending bearing housing circuit. The bearing temperature is monitored with temperature probes in the oil bath close to the bearing active part.

BENEFITS:

- Space saving and robust
 - With the oil tank in the slewing bearing tank instead of the pod room, a smaller footprint is needed
 - Autonomous cooling of the bearing provides a more robust solution
- Simplified construction for longer life
 - The pod can be operated without forced lubrication
 - The piping and fluid distribution box have been simplified
 - Oil lubrication of the slewing bearings help to deliver a longer life span
 - Reduced pressure on the bearing seals enhances life span

Pressurization System



The SeaJet™ Pod's patented pressurization system helps to deliver high levels of pod room pressurization to reduce the auxiliary consumption needs of the compact cooling system.

Technical Details:

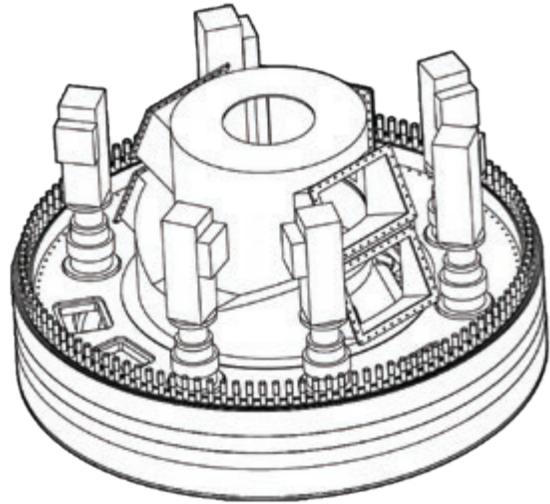
Through internal pod pressurization, the propulsion motor's cooling is enhanced, allowing the motor to help meet a high torque density solution.

Pod pressurization means no condensation forms when the unit is not in service. The set air pressure inside the pod prevents sea water from entering the propulsion module, and the set pressure in the lubrication circuit prevents oil leakage from the bearing to the propulsion module. Moreover, this internal pressurization also simplifies the seals system, increasing the life span of the seals.

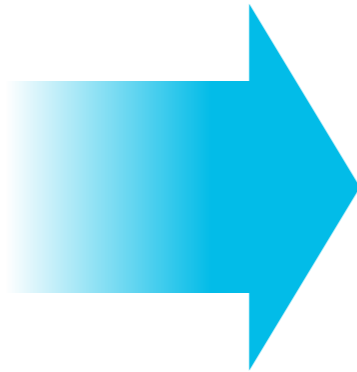
BENEFITS:

- Reduced auxiliary consumption needs
- Increased cooling efficiency
- Reduced differential pressure on the shaft line and steering dynamic lip seals
- Improved drainage suction
- No need for a dehumidifier and drier

Steering Module



STEERING MODULE



STEERING ACTUATOR

GE has long played an important role in the marine space by driving greater efficiency and reliability through innovation. A prime example is the SeaJet™ Pod's electrical steering actuator technology that reduces energy consumption and enhances operational flexibility, delivering steering performance engineered for both open water and ice applications in accordance to IMO and SOLAS standards.

Technical Details:

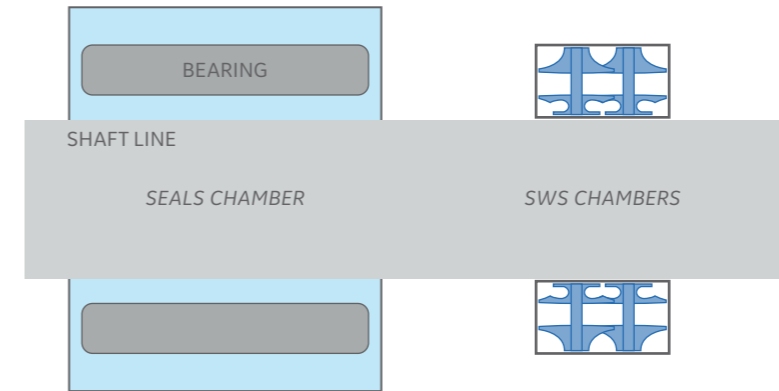
The steering module provides pod rotation with smart torque control using steering actuators driven by asynchronous electric motors with a planetary type reduction gear transferring the torque from each electric steering motor to the gear pinion. A torque limiter provided between each reduction gear and steering motor helps ensure smooth and efficient operation during heavy loads on the steering system, especially during ice operations.

The mechanical locking system locks the steering at the zero degree position to prevent unwanted motion of the pod during maintenance activities.

BENEFITS:

- Reduced maintenance requirements
- Lower energy consumption
- Functional flexibility
- Simplified configuration for enhanced reliability

Sea Water and Shaft Seal System



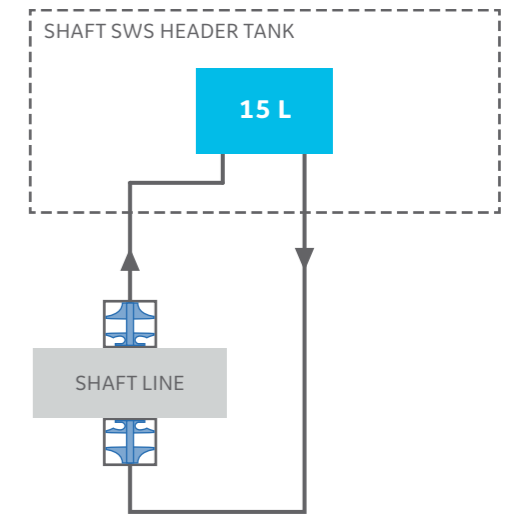
Engineered to meet all environmental standards, the SEAJET POD's seal system protects the drive-end bearing housing from sea water and prevents oil discharge from the pod into the sea.

Technical Details:

GE's sea water seal technology uses seals made of polyurethanes that accept a mixture of fresh water and glycol as lubricant rather than oil. Due to their high tear resistance as well as high tensile properties, the seals' specifications accept strong eccentricity of the shaft line—an exceptionally useful feature for pods that will operate in heavy ice conditions. In addition, internal pod pressurization limits the number of lips and leakage.

BENEFITS:

- More environmentally sustainable
 - Fresh water/glycol lubricant reducing oil discharge
 - Reduced number of lips and header tanks translates to less leakage
- Reduced maintenance requirements
 - Seals can be replaced from within the pod using an inflatable maintenance seal system



KEY FEATURES:

- Resistance to maximum shaft line deflection without the liner touching the seals carrier
- Engineered for operating distances up to 90,000 km, depending on difference pressure, lubrication fluid, and ambient conditions
- Seals are exchangeable inside the pod

Shaft Brake System

The SeaJet™ Pod's shaft brake system employs patented linear actuator technology and is integrated to the pod hub for secure access to the pod during maintenance.

Technical Details:

This system is made from flexible shafts containing a linear actuator, lever, and friction brake pads. The friction pads are activated manually or via electrical motor by linear actuators located inside the pod. To save space in the pod, the brake and locking drum are integrated to the propeller hull and located in the space between the sea water seal and propeller boss. The system allows for secure braking and locking during maintenance operations by:

- Stopping the shaft line in wind milling with a water relative speed of four (4) knots
- Holding the shaft line while the vessel is sailing up to seven (7) knots with the other pod
- Holding the shaft line during blade exchange.

BENEFITS:

- Enhanced maintenance security
 - Allows shaft line to be braked and locked at low speed
 - Provides better pod access
- Safer operation
 - Avoids risk of dust pollution and fire by the brake pads
- Reduced space requirements
 - Engineered to save space inside the pod
 - Incorporates a shorter shaft line
- Shaft brake located in seawater
- Mechanical system

Test Bench

Because robust product testing is foundational in aiming to ensure high quality and reliable critical equipment, GE's test bench and test system allow for real-time technology validation of the SeaJet™ Pod. The device can be tested under simulated load, torque, and dynamic response conditions. By simulating extreme environment conditions or worst-case scenarios, our testing pushes equipment boundaries to help achieve the highest standard of reliability.

Experience and Innovation:

Our pod unit installation on the test platform corresponds to the configuration on the vessel, allowing testing to be conducted with a high level of accuracy and precision. The test bench can generate axial and transverse forces on the pod unit and allows torque tests to be performed on a locked rotor.

BENEFITS:

- Enhanced reliability
 - Validation of pod system's thermal and mechanical behavior under conditions as close as possible to those experienced at sea
 - Calibration of the pod to efforts encountered in operation
 - De-risking of the pod system
- Faster installation and commissioning

KEY FEATURES:

- Pod testing up to 20 MW
- Motor performance testing
- Bearing and sea water seal performance testing
- Pod system testing with auxiliaries





Services

With a comprehensive global network of service engineers and technicians, GE is uniquely positioned to provide the knowledge, experience and skills for your full range of industrial service requirements to protect assets, maintain critical processes, and help lower risk and increase productivity.

GE delivers original equipment spare parts around the world and repairs, refurbishes, and upgrades customer systems with our latest technology. GE offers risk protection through contractual services based on system experience and sophisticated application calculations.

About GE Power Conversion

GE's Power Conversion business, a business unit of GE Power, applies the science and systems of power conversion to help drive the electric transformation of the world's energy infrastructure. It does so by making and delivering advanced motor, drive and control technologies that evolve today's industrial processes for a cleaner, more productive future. Serving specialized sectors such as energy, marine, renewables and industry, through customized solutions and advanced technologies, GE Power Conversion partners with customers to maximize efficiency.

For more information, please email:

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