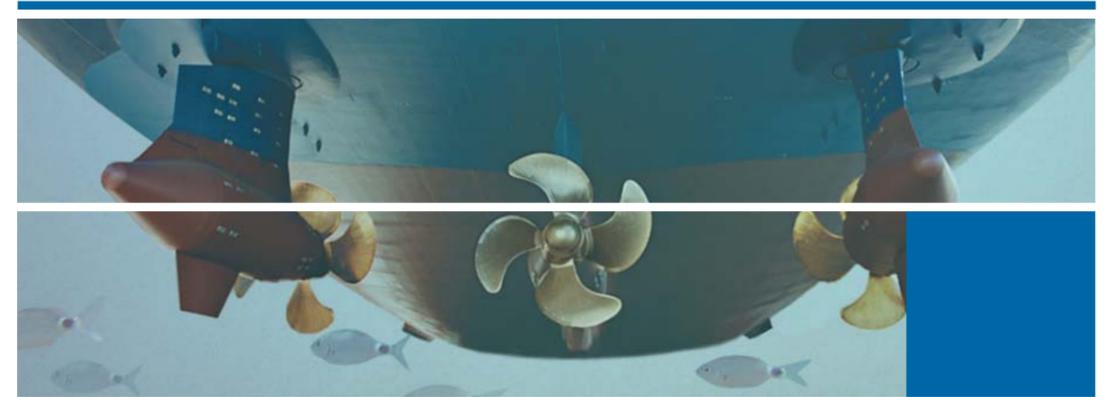


## Azipod® & CRP Azipod® Propulsion

When conventional just isn't enough...

Azipod® is the forerunner in advanced podded propulsion technology and is creating new opportunities in modern ship design, building and operations.



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Sundheim-Madsen 10-2006

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# Unique Benefits

in ship design, building and operations



● Single Azipod®



● Twin Azipod®



● Fixipod®



● CRP Azipod®

In Ship Design

**New opportunities in ship design**

Azipod® offers great flexibility in overall vessel design, creating the opportunity to transport more payload at higher speed with less power. This has inspired naval architects to develop new ship designs and concepts that transform unique Azipod® advantages into safer, more environmental and profitable ships.

In Ship Building

**Saves building time and costs**

For the yard, Azipod® means simpler hull form and structure, and far easier machinery installation. Fewer sub-suppliers, less parts and large savings in weight and space are all elements that have significant effects on construction time and costs. The pod itself can be installed at virtually any time during construction.

In Ship Operations

**Peak operational performance**

Following efficient design and construction, the true pleasure of Azipod® propulsion is experienced at sea. High maneuverability, quick response, fast cruising speeds and smooth, quiet operations are all hallmarks of Azipod® propulsion. Combined with high operational efficiency and low emissions, Azipod® has a positive impact on operational costs, safety and the environment.

**Redundant, space-saving machinery**

The combination of Azipod® and the electric power plant concept frees up valuable onboard space and creates unique opportunities for redundant propulsion configurations. By replacing long shaft lines with electrical cabling, the modular machinery can be located for maximum payload - and all equipment from gensets to the Azipod® units can be configured and duplicated to achieve the required redundancy and reliability.

**Outstanding maneuvering capabilities**

Ships with Azipod® propulsion have far better maneuverability than ships with shaft line propellers, rudders and tunnel thrusters. The ability to direct the powerful main propellers and produce full thrust in all directions, regardless of ship speed, substantially enhances maneuverability. Features such as extremely short crash-stop distance, tight turning circle and excellent course-keeping capability make Azipod® attractive for a wide range of vessels.

**Low fuel consumption - low emissions**

The environmental and economical benefits of electric propulsion and the power plant concept are today widely accepted. Running the diesel engines close to optimum load in all operational modes gives better engine performance and lower fuel consumption. With the added hydrodynamic benefits of Azipod®, fuel savings and emissions will typically improve by an additional 15% compared to electric shaft line propulsion, due mainly to reduced hull resistance and excellent wakefield for the pulling Azipod® propeller.



# Propelling

modern ship design & construction



2 x 6.5 MW Azipods® for Fesco Sakhalin icebreaking offshore vessels



Azipod® is quickly maneuvering into new vessel segments

Single Azipod®



Twin Azipod®



CRP Azipod®



## Adaptable to a wide range of vessel types

Azipod® is an inherently flexible system that can be applied in several different configurations and adapted to a broad spectrum of vessel types. The base model Azipod® is a highly optimized open water design delivered in standard sizes up to 28 MW. In addition, there is a model range designed specifically for icegoing vessels.

In recent years, the industry has witnessed several benchmark vessels made possible by Azipod® propulsion. Interest and usage of Azipod® is steadily increasing, and ship designers and research laboratories are continuously working on new innovative vessel concepts based on Azipod®.

Azipod® applications include:

- **Single Azipod®** solutions are used for vessels such as tankers and cargo ships, and with a double-wound motor, a high degree of redundancy is achieved.

- **Twin Azipod®** provides greater maneuverability and full redundancy from power generation to propeller. Twin Azipod® is the most widely used propulsion for cruise ships.

- **Fixipod®** is a non-rotating pod that, combined with twin Azipod®, is a very attractive solution for large vessels with high power and redundancy requirements.

- **CRP Azipod®** is a unique contra-rotating propulsion system designed specifically for high-speed, high-power vessels such as Ultra Large Container ships, LNG carriers and RoPax ferries.

## Improved fuel economy through better hydrodynamics

Ships with Azipod® propulsion feature significantly better hydrodynamic efficiency compared to ships with traditional shaft line propulsion, resulting in high fuel savings and low emissions.

The main reasons for improved hydrodynamic efficiency are:

- Reduced hull resistance by eliminating long shaft lines and brackets and simplifying and optimizing hull design
- The pulling Azipod® propeller works in an optimum environment where the inflow to the propeller is homogeneous due to the absence of any shaft support appendages in front of the propeller.
- The inherent flexibility of the Azipod® units means they can be freely and precisely located on the vessel hull to achieve maximum hydrodynamic efficiency.

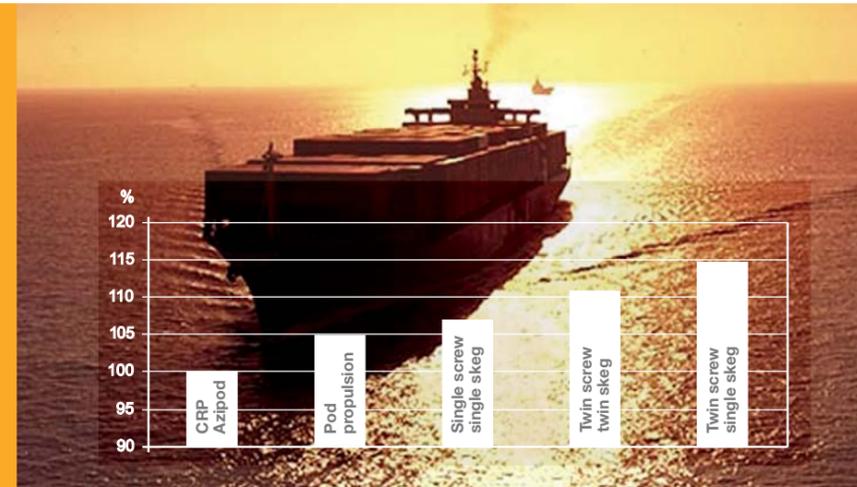
Extensive operational experience and testing - both full scale and model tests - over the last decade shows that the propulsion efficiency of a twin Azipod® solution is 8 to 18% better than traditional shaft line propulsion. To realize the full potential of Azipod®, the ship must be fully optimized for podded propulsion from an early design phase. New hybrid Azipod® solutions such as CRP Azipod® have demonstrated even higher savings for certain high-power vessel types.



# High-efficiency

## contra-rotating propulsion system

CRP Azipod®



Better hydrodynamics  
- lower propulsion  
power requirements



Akashia and Hamanasu are the largest and fastest ferries in Japan and the first vessels to take advantage of the new CRP Azipod® propulsion system.

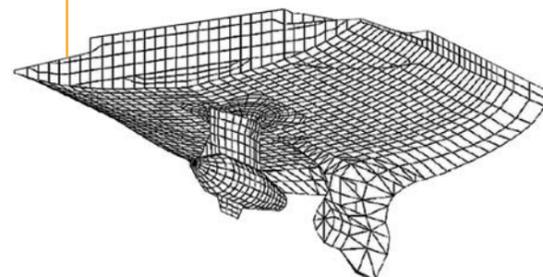
### New fast-ferries with CRP Azipod®

ShinNihonkai Ferry (SNF), the leading ferry operator in Japan, took delivery of two innovative RoPax newbuilds in 2004 from Mitsubishi Heavy Industries. These new ferries were the world's first vessels to be installed with CRP Azipod® propulsion.

In their first two years of operation, the ferries have documented a remarkable 20% savings in bunker fuel consumption as compared to previous ferries on the same route, while providing higher speed and 15% more transportation capacity - which has expanded transportation opportunities for the owners.

### Machinery arrangement

To each RoPax ferry, ABB delivered a 17.6 MW Azipod® unit, propulsion control system and a 27 MW, 6.6 kV power generation and distribution system. The Azipod® unit works in tandem with a reduction gear-driven CPP propeller. Power distribution is 25.2 MW on the CPP propeller and 17.6 MW on the Azipod®, for a total of 42.8 MW. In order to achieve the same vessel speed, the total installed power using a conventional twin-shaft would be around 10% higher.



FEM model of CRP Azipod® support structure

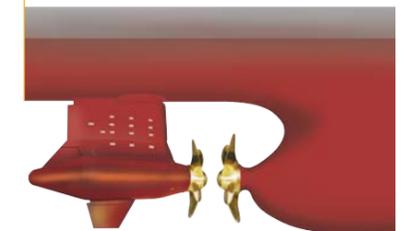
### Today's most efficient propulsion solution

Steadily increasing market demands for larger and faster ships have led to the development of CRP Azipod®, an innovative contra-rotating propulsion system that enhances efficiency up to 15% compared to other propulsion technologies.

Contra-rotating propulsion means that there are two propellers on the same line rotating in opposite directions. With CRP Azipod®, a steerable Azipod® unit is installed in place of a normal rudder, aligned downstream of the main propeller. The Azipod® propeller takes advantage of the rotative energy left in the slipstream of the forward propeller, providing significant efficiency gains. CRP Azipod® combines with most types of main propulsion.

The CRP Azipod® system encompasses several unique advantages resulting in the best hydrodynamic efficiency in the industry:

- *Thrust load is divided* over two contra-rotating propellers
- *Rotational losses are recovered*
- *Single-skeg hull form* offers better wakefield and lower resistance
- *Cavitation characteristics are improved* due to lower loading on the blades
- *Lower cavitation forces* due to smaller optimum propeller diameter and larger clearance to the hull
- *Better maneuvering characteristics*, especially in ports and channels

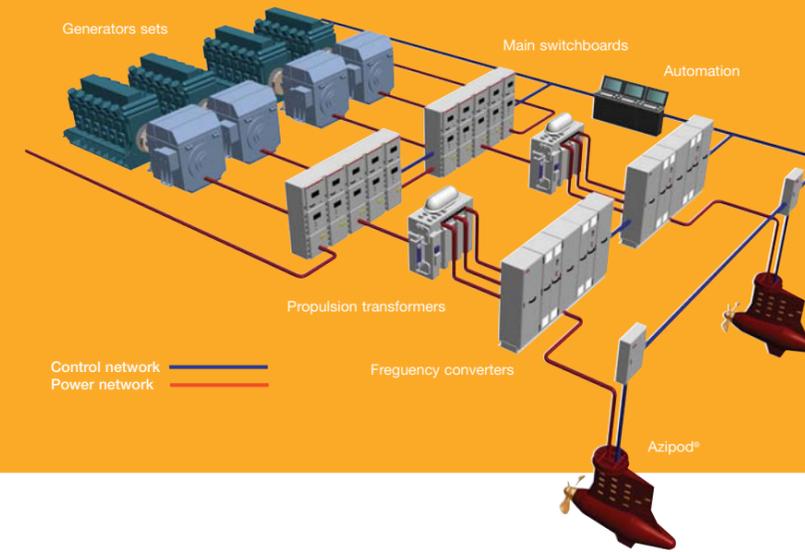
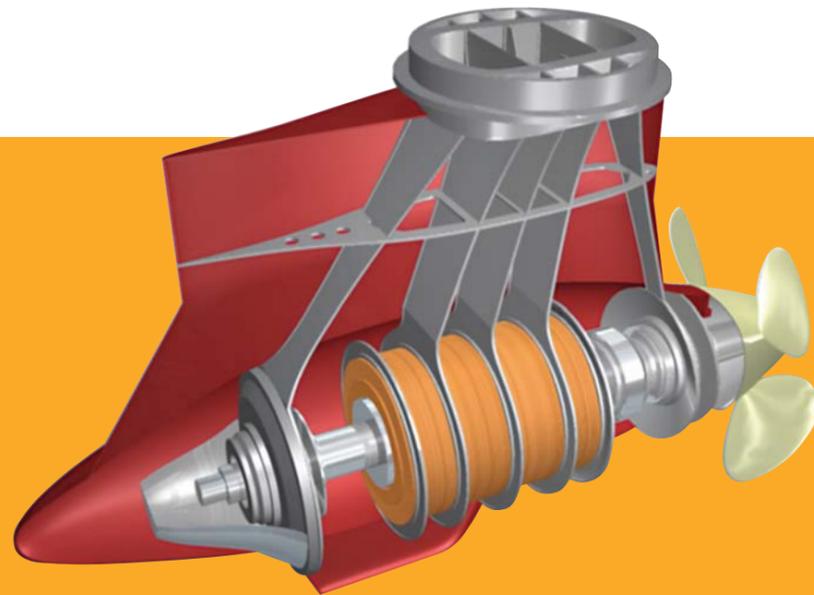


Safety and redundancy through two independent propulsion systems in an efficient single-skeg design

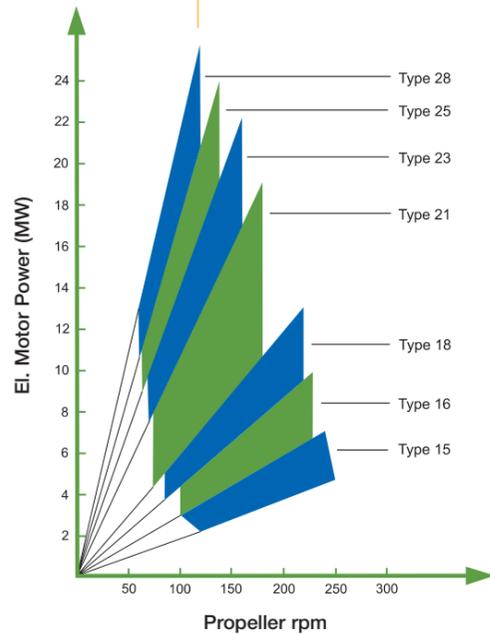
# Power & Thrust

in all directions

Azipod®



*Azipod® combines leading-edge power, propulsion and control technology*



Azipod® is delivered in 7 standard sizes for the 5 to 28 MW power range.

### Azipod® overview and build-up

Azipod® is a unique azimuthing podded propulsion system providing both vessel propulsion and steering in a single unit. Developed in the late 1980's for demanding icegoing service, Azipod® has been continuously refined over the years - mechanically, electrically and hydrodynamically - and is today a highly developed and standardized product, optimized down to the smallest detail.

The Azipod® unit incorporates a variable speed electric motor, and a fixed pitch propeller is mounted directly on the motor shaft. The propeller is individually optimized according to the varying hydrodynamics of each project. The electric motor is controlled by a frequency converter, providing full nominal torque, smooth and stepless in either direction over the entire speed range including standstill. Since there is no gearing or losses in the mechanical power transmission and the propeller is exposed to an excellent wakefield, normally as a pulling device, the efficiency of Azipod® is higher than other propulsors and mechanical thrusters.

Azipod® is mounted with a steering unit and powered through a slip-ring unit, giving 360° of rotation. The pod can also be mounted as a fixed propulsion device (Fixipod®) without a steering unit.

### Typical ABB scope of supply

ABB is the only supplier to manufacture and deliver a total podded propulsion solution including the complete power plant. A typical ABB scope of supply includes one or more Azipod® units, frequency converters, propulsion transformers, main switchboards, generators and propulsion control & monitoring system.

### Propulsion and power plant configurations

The power generation and distribution plant consists of several medium- or high-speed diesel/gas engines that drive the electric generators connected to the main electric switchboard. All loads including propulsion, thrusters, auxiliaries and ship systems are normally fed from this grid and the total load is shared between the running generators, which are automatically selected to match the total required power.

The variable-speed AC propulsion drive system consists of the Azipod® propulsion motor, a frequency converter and, in most cases, a propulsion transformer. The propulsion motor is controlled by varying input frequency and voltage from the frequency converter.

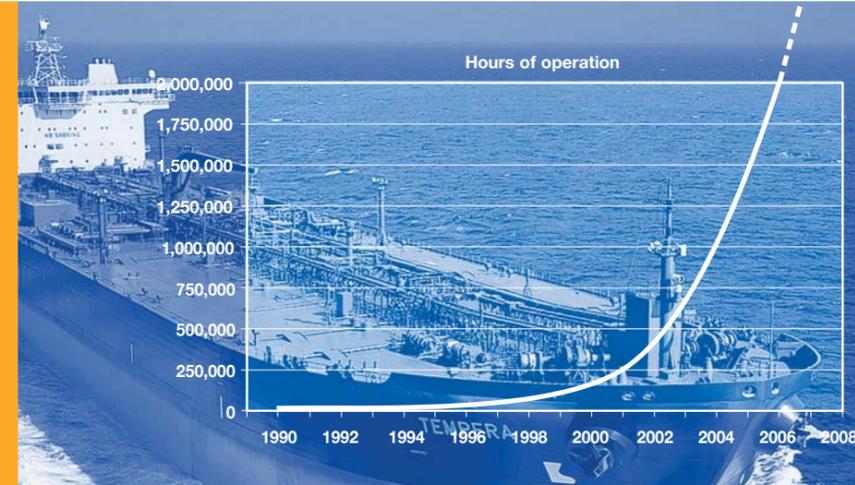
The overall system is highly configurable to meet the unique requirements and class standards of each project. The drawing above shows an example of a typical twin Azipod® system configuration.



Azipod® is manufactured according to the strictest international quality and environmental standards.

# Azipod® Customers

choose Azipod® again and again



Currently, Azipod® hours of operation increase by one million per year



## Working together with our customer

ABB works closely with our customers from a very early design phase to develop and optimize the total vessel concept, contributing specialized competence and extensive experience to the project. Areas of special focus include the ship aft body and critical hydrodynamic aspects, as well as general machinery arrangement including the complete electric power plant and Azipod® propulsion solution.



ABB can take full responsibility for the total equipment supply, system engineering, project management and installation and commissioning support. During the transition from design to construction and throughout the construction phase, ABB provides a broad range of supervisory services and all necessary drawings and instructional material to ensure a smooth delivery, installation and commissioning of the total Azipod® system.



## Operational services & support

After-sales services are an integral part of the total Azipod® delivery, greatly influencing the operational costs of the ship. Our specialized Marine Services address the needs of each customer - assuring high performance and reliability throughout the life of the vessel. ABB Marine Services include preventive maintenance, planned repair & drydocking, on-call services, system commissioning, spare parts, modernization and training.

One-lift mounting of Azipod® unit

## Azipod® is a registered trademark of ABB

Azipod® is the registered trademark for ABB's azimuthing podded propulsion system in the 5 to 28 MW power range. Created in the late 1980's through ABB innovation, Azipod® was the first commercially available podded propulsion system on the market. Today, the name Azipod® is often used as a general term for podded propulsion systems - but there is only one Azipod® and only one podded propulsion system with a long and successful track record. With over 15 years of field experience, Azipod® is a well established product with more than 2 000 000 accumulated hours of operation and a recorded uptime of over 99.8%.

## Customer satisfaction

For ABB, customer satisfaction and customer loyalty are the true measures of quality, and Azipod® customers build with Azipod® again and again. Cruise ships and icegoing vessels are examples of vessel segments where Azipod® has emerged as the propulsion system of choice. Today, an ever increasing number of vessel types are being designed and built with Azipod®, and the successful introduction of CRP Azipod® promises to have great impact on the future of high-power, high-speed vessels.



All Azipod® systems are delivered with a remote propulsion control and monitoring solution.