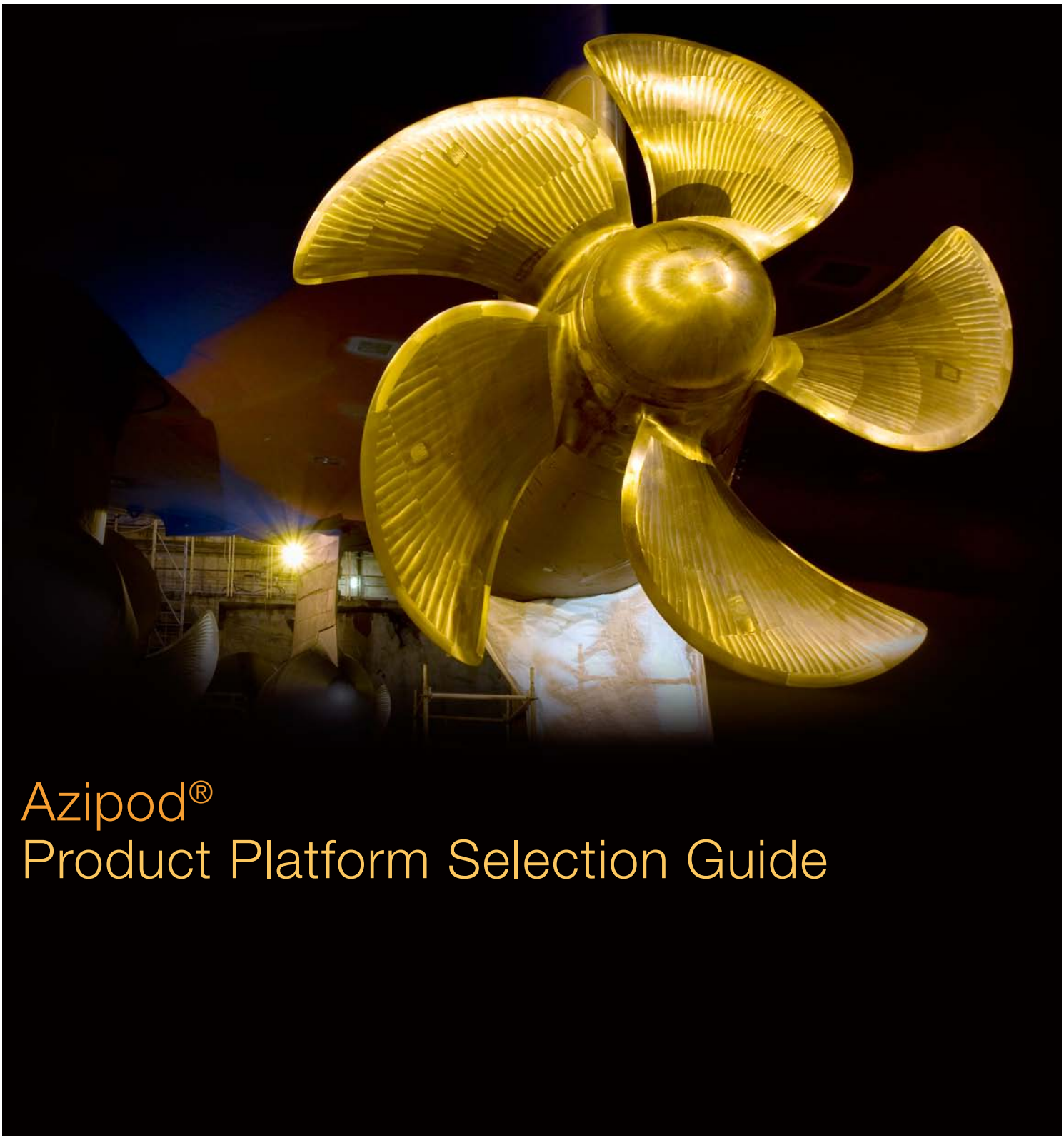

Azipod®
Product Platform Selection Guide

Power and productivity
for a better world™

Preface

This selection guide provides system data and information for preliminary project evaluation of an Azipod podded propulsion and steering system outfit. More detailed information is available in our platform-specific “Product Introduction” publications. Furthermore, our project and sales departments are available to advise on more specific questions concerning our products and regarding the installation of the system components.

Our product is constantly reviewed and refined according to the technology development and the needs of our customers. Therefore, we reserve the right to make changes to any data and information herein without notice.

All information provided in this publication is meant to be informative only. All project-specific issues shall be agreed separately and therefore any information given in this publication shall not be used as part of agreement or contract.

Helsinki, August 2010

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Abbreviations not clarified within the document

kVA = kilovolt Amperes
MW = Megawatts of power
RPM = Revolutions Per Minute

1 General

The first Azipod® installation onboard was commissioned in 1990. By August 2010, the Azipod consept has been selected for more than 100 vessels and the milestone of 5.7 million cumulated operating machinery hours has been reached.

1.1 Azipod propulsion and steering

Azipod is a podded electric main propulsion and steering system driving a fixed-pitch propeller at variable speed both in ahead and astern rotation.

Azipod propulsion is designed for the preferential use of the (directly driven) pulling propeller when driving in the ahead direction. Azipod is azimuthing (steering around its vertical axis) infinitely by 360°. It is available for power ratings of up to 21 MW, depending on product platform and the design variables of the project.

The full ship system consists of the required number of Azipod steering propulsors, and an “ACS” series marine propulsion power drive for each Azipod. Additionally a remote control system and the power plant (generators, switchboards) are usually included in the scope of the delivery.

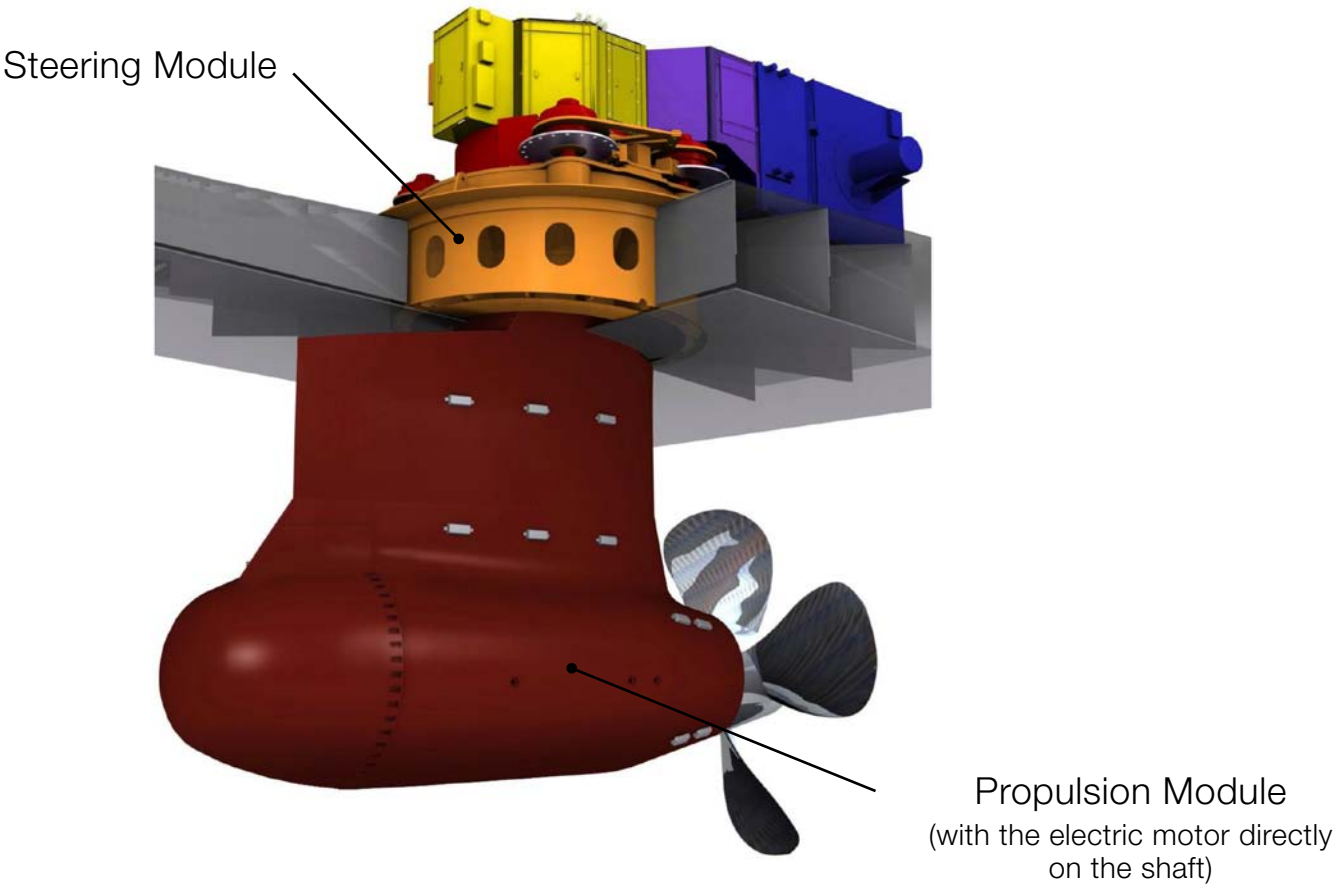


Figure 1-1 Basic arrangement of the Azipod (VI series platform shown)

1.2 Electric propulsion and power plant

In order to drive the Azipod propulsion system, the ship needs an electric power plant (not specifically discussed in this document). Alternator sets supply power to the 50 or 60 Hz installation of electric switchboards for distribution to all consumers onboard, including the Azipod propulsion.

Generally, ABB aims to deliver the power plant as well as the Azipod system. Our mechanical interface to the engine maker is basically standard, although dependent on the delivery of engines or e.g. gas turbines from the contractors.

During the whole project, the basic tool for power plant design is the so-called single-line diagram. The actual onboard configuration can be efficiently discussed already in the early stages of work by using this clear visual representation.

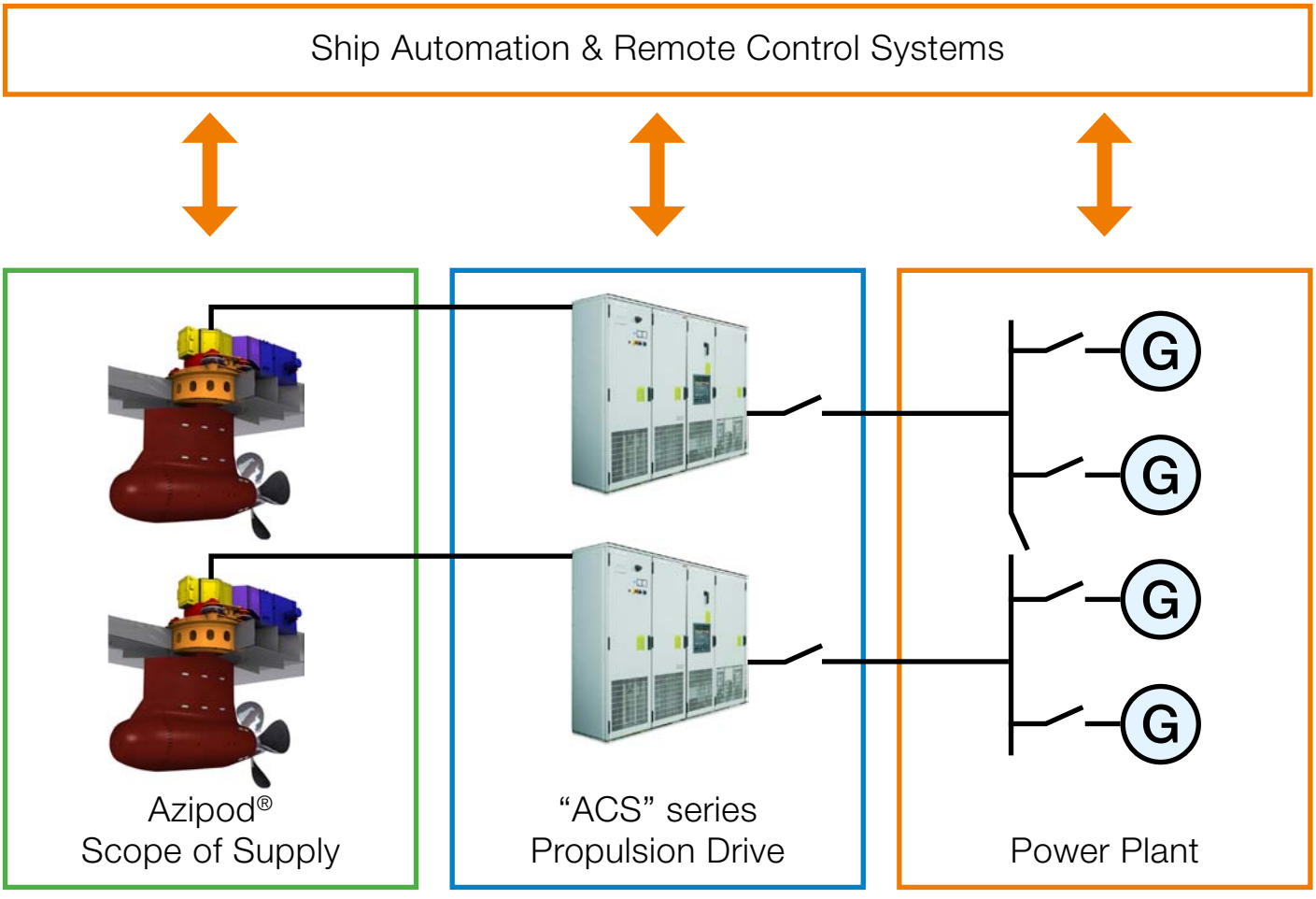


Figure 1-2 Simplified single-line diagram of the power plant with a propulsion system

2 Selecting Azipod®

The following paragraphs describe the initial considerations that are recommended to ensure that Azipod will fit adequately with the ship's main propulsion and steering profile:

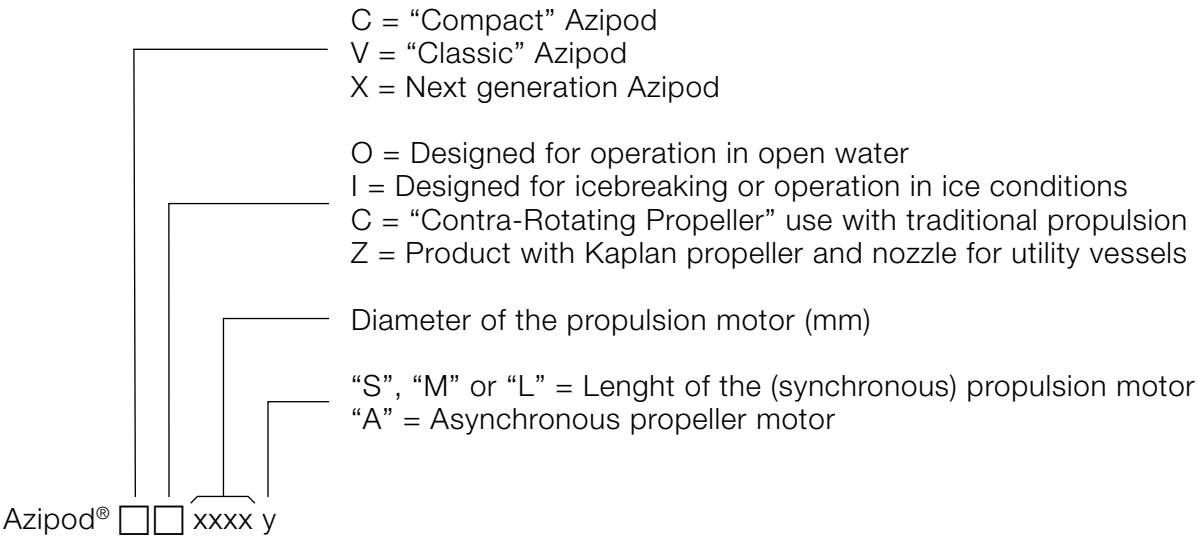
2.1 Basic standpoints

To evaluate the suitability of Azipod for the ship or rig project, the following basic questions are usually evaluated as a first step by the ship owner or the shipyard:

1. Will the ship be built with one or more Azipod outfits?
2. Are there particular requirements for the configuration of the electrical power plant onboard?
3. What is the most convenient location for Azipod in the lines of the ship?
4. What are the operational attributes:
    a. Ship trial speed?
    b. Any particular requirements for bollard pull thrust, or ice operation?
    c. Needs for operation with Dynamic Positioning (DP)?
    d. Maneuvering profile for the ship, particularly if an after bridge is planned?

2.2 Azipod type codes

In the ship concept design stage, the following main designation is used. A more specific type code will be allocated for the product during the advanced design stage.



Example: Azipod® VI1600A

...being an ice-operating Azipod with a shaft power in the lower end of the range (e.g. 5 MW) and built with an asynchronous propeller motor.

2.3 Typical contemporary power range per Azipod type

Azipod C series: from 1 to 4.5 MW
Azipod V series: from 3 to 13 MW *
Azipod X series: from 10 to 21 MW

* The classic Azipod V series is presently mainly projected as the VI variant, for operation in ice conditions.

2.4 Available product variations

The available variations are shown in the following figure:

Green: Standard concept application with the “Product Introduction” manuals.
Yellow: Check the availability with ABB Marine sales department.

	O Open water	**I** Ice operation	**C *** Contra-rotating	**Z** Nozzle thruster
C “Compact”	**CO**	**CI**	**CC**	**CZ**
V “Classic”	**VO**	**VI**	**VC**	
X “Next Generation”	**XO**	**XI**	**XC**	

Figure 2-1 Azipod by the product type (first letter) and application (second letter)

* See page 12

2.5 Examples of ship applications

Azipod C series

CO variant: Yachts, cruise ships, ferries, tankers, offshore supply construction ships, research ships
CZ variant: Drilling ships and rigs, other high bollard pull thrust applications

Azipod V series

VO variant: Cruise ships, ferries
VI variant: Icebreakers, ice breaking cargo ships / supply ships / tankers / LNG carriers

Azipod X series

XO variant: Cruise ships, ferries, tankers, LNG carriers, naval ships
XC variant: Fast ferries, LNG carriers, container ships

3 Azipod® product platforms

The three available Azipod product platforms are briefly described below.

3.1 Azipod C series

This product platform was developed with the experiences gained from the classic family of larger Azipod products.

The Azipod CO variant (optimized for open water operation) is available in three different frame sizes for propeller power ratings of up to 4.5 MW.

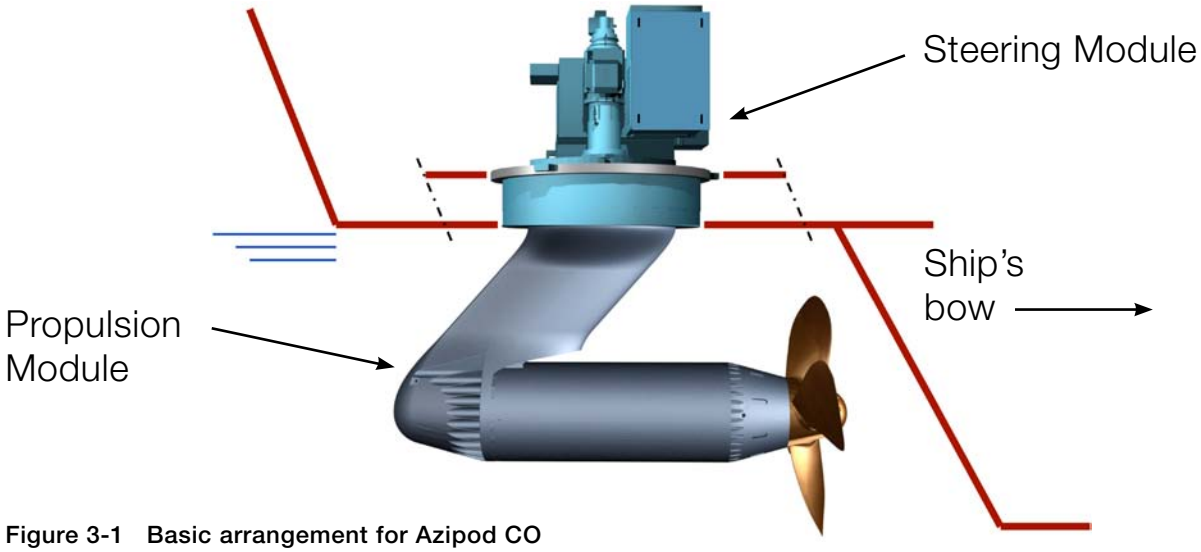


Figure 3-1 Basic arrangement for Azipod CO

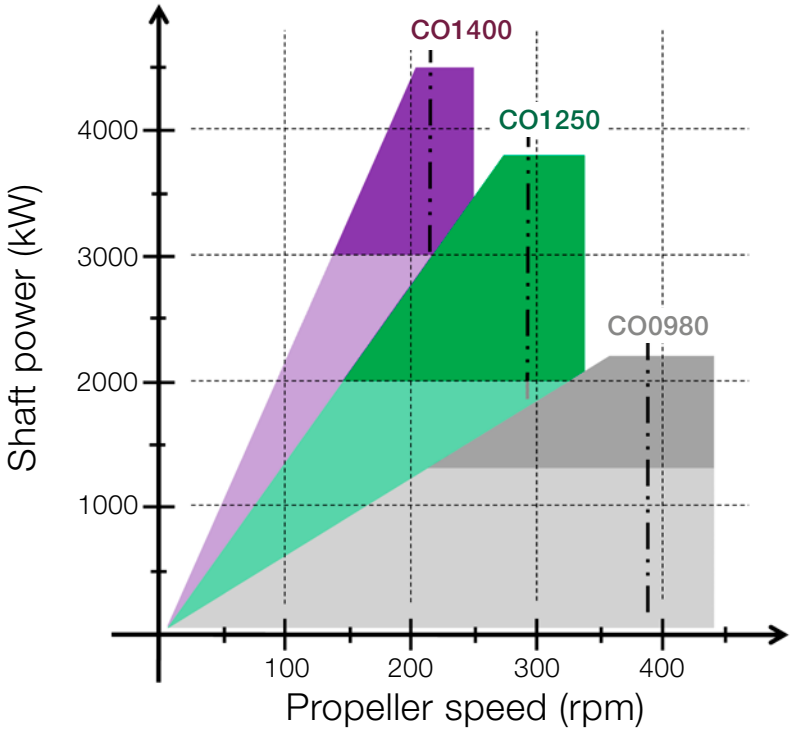


Figure 3-2 Azipod CO power output vs. propeller RPM

The Azipod CZ variant is designed for propulsion and steering of mainly oil rigs or high thrust and slow speed utility ships.

The available Azipod CZ main variants are listed in the table below. Due to the particular applications of this product, the nominal ratings are given also for the static thrust as well as for the shaft power.

Contrary to the other Azipod product platforms, Azipod CZ runs the propeller in a nozzle and is designed for the preferential use of the pushing propeller when driving in the ahead direction.

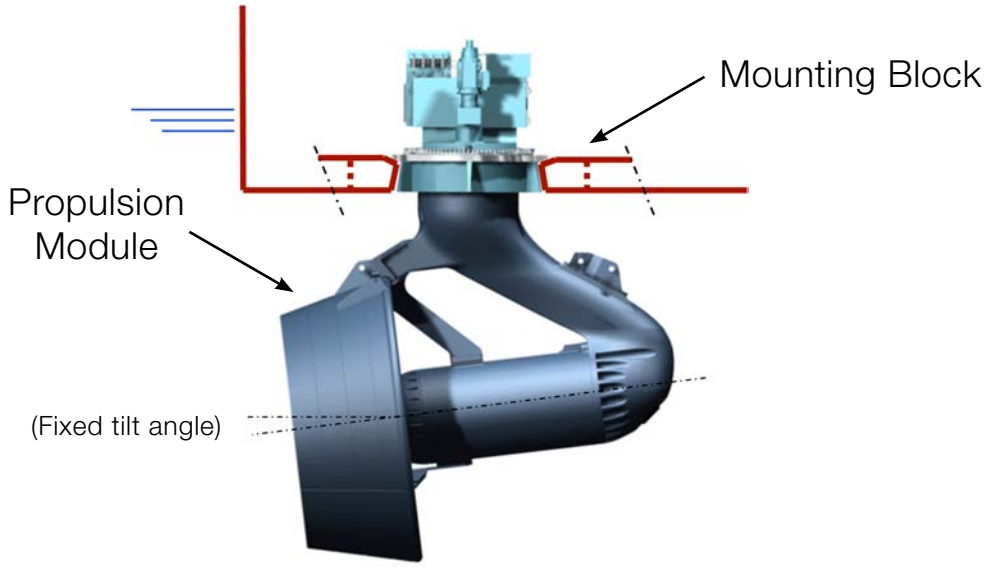


Figure 3-3 Basic arrangement for Azipod CZ

Azipod type code	Rated power	Rated static thrust
CZ1400S	3,3 MW	63 tonnes
CZ1400L	3,8 – 4,5 MW	73 – 84 tonnes

Figure 3-4 Overview of power and thrust ratings for Azipod CZ

3.2 Azipod V series

Azipod V series is the classic product platform. Two main variants are built: Azipod VO (optimized for open water operation) and Azipod VI (for operation in ice and for icebreaker use).

The power ratings for Azipod VO are specified according to the five different basic frame sizes. The ratings are nominally the same as the ones designed for Azipod X series (see further).

The power ratings for Azipod VI are tailored project-specifically for the particular ice operation profile and ice class of the ship. The so-called astern-propelled icebraking capability is a unique advantage that is available with Azipod VI.

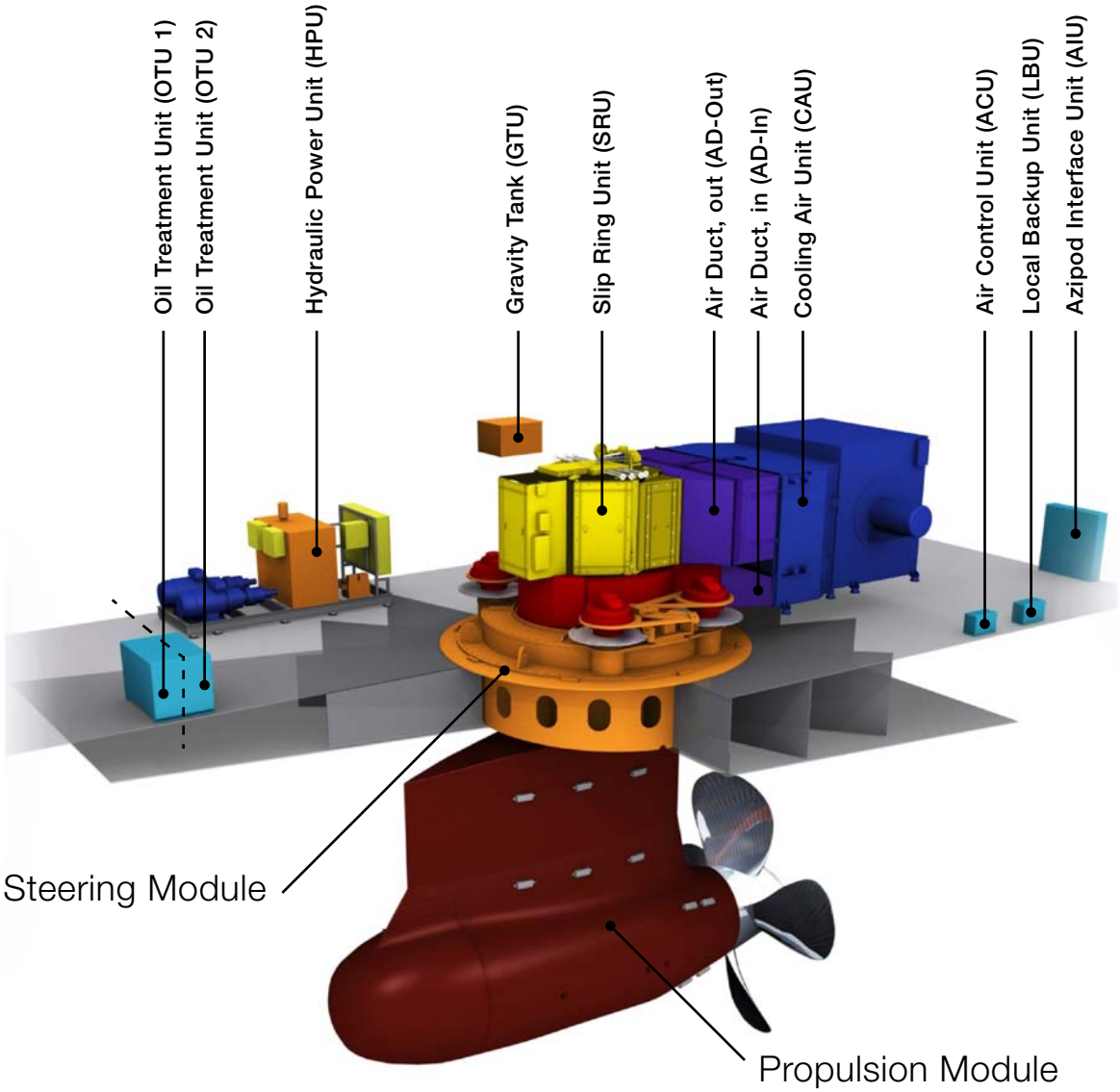


Figure 3-5 Basic arrangement for Azipod V series

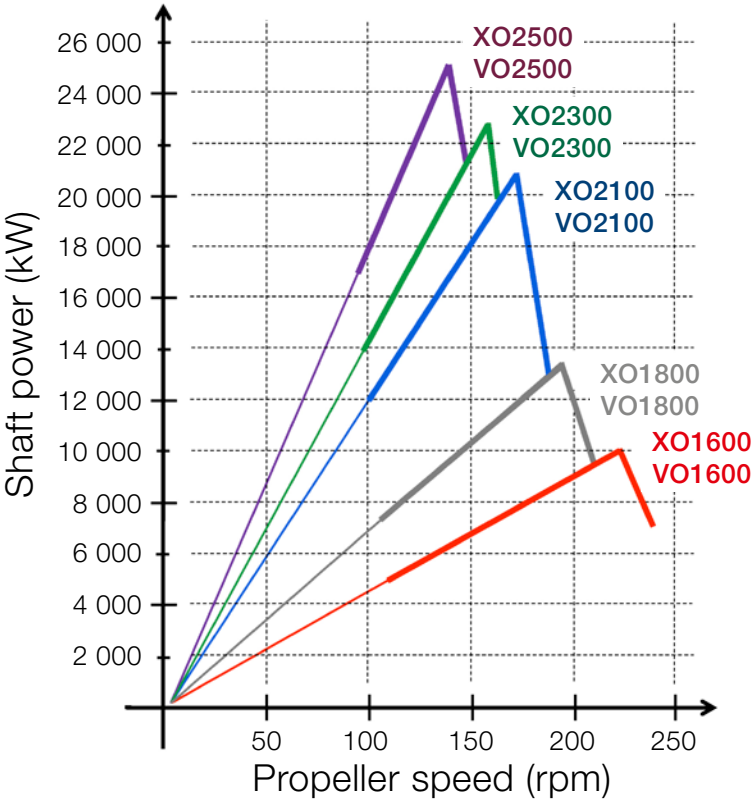


Figure 3-6 Open water Azipod VO and XO power output vs. propeller RPM

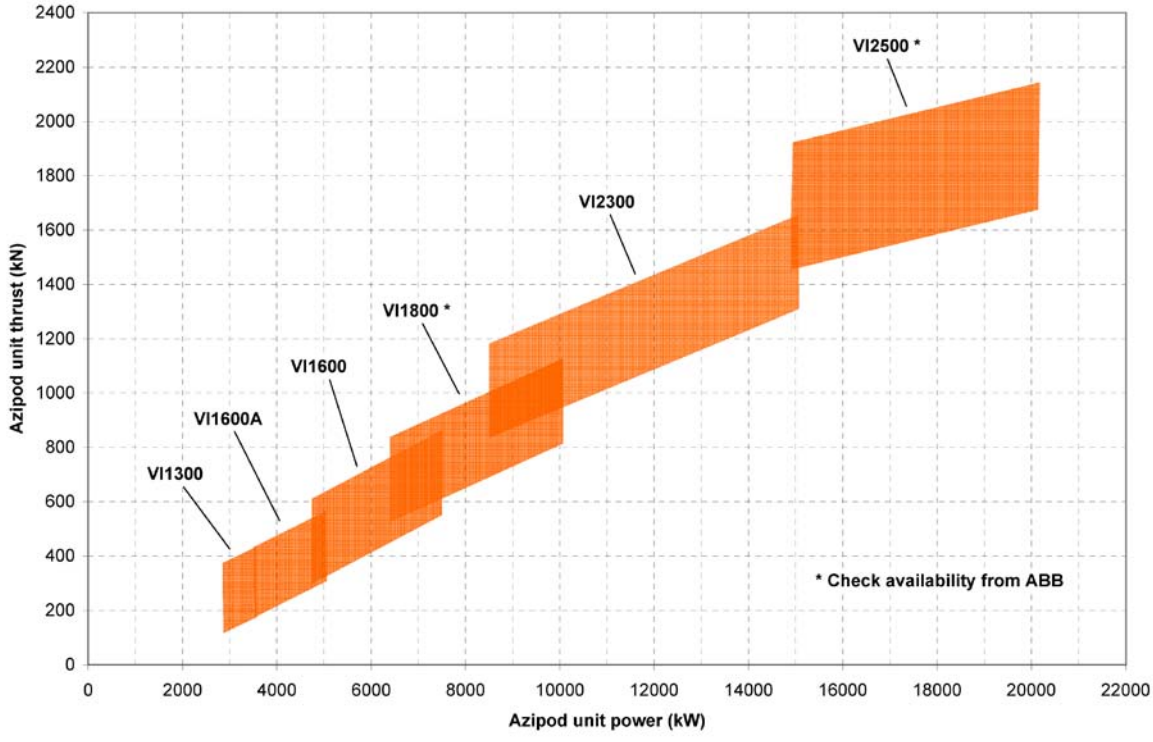


Figure 3-7 Azipod VI power vs. bollard pull thrust diagram for the different frame sizes

3.3 Azipod X series

Azipod X series has been developed as an evolution of the classic Azipod product. It is available at the time of printing in the frame size 2100. Two main variants are built: Azipod XO (optimized for open water operation) and Azipod XC (for use with a traditional shaft line in a contra-rotating arrangement).

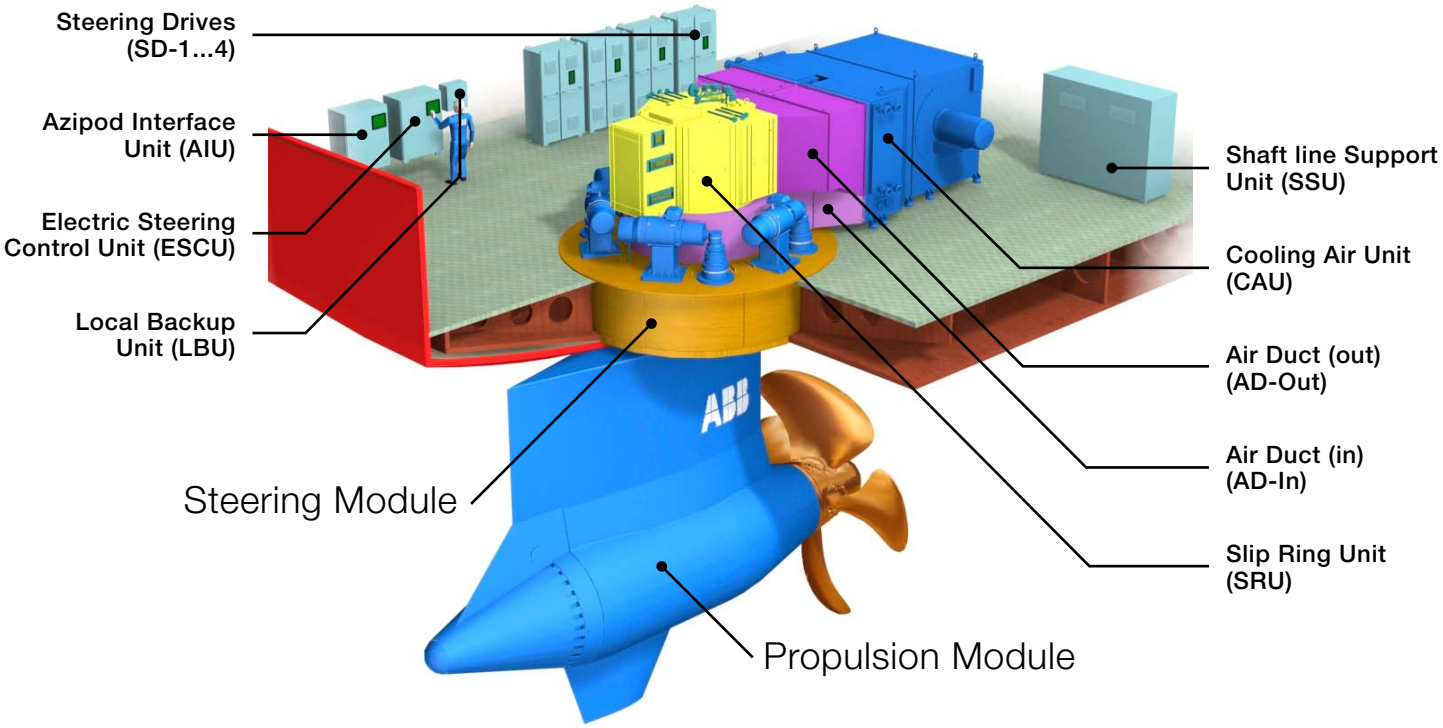


Figure 3-8 Basic arrangement for Azipod X series

The Azipod XC contra-rotating concept is a solution for high propulsion efficiency on fast ships. High power performance is obtained even on a single shaft line configuration without compromising the strong maneuvering ability typical of an Azipod installation. Typically the shaftline propeller takes 50…70% of the total power and Azipod takes the remaining 30…50%.

Figure 3-9 The contra-rotating Azipod solution is made together with a traditional shaft line

4 Onboard remote control system

The Azipod scope of supply is enhanced with the ABB “IMI” (= Intelligent Maneuvering Interface) manual remote control and operator guidance indication system. This provides an up-to-date manual control outfit for the bridge and for the engine control room and can be elegantly installed into the various externally supplied bridge console deliveries seen on the commercial shipbuilding market today. The manual control items are intended for consoles that are located indoors.

The remote control system provides on-line operator guidance and feedback for optimal Azipod use. The purpose of this functionality is to promote economical and smooth ship operation.

This bus-based system is designed redundant and is engineered in-house at ABB Marine. A hardwired back-up sub-system is included. Many different modular control configurations can be provided, also including optional command and control post change functions for an external bow thruster system.

The usual industrial standard interfaces are provided for external Autopilot, external Joystick / DP and external voyage data recorder.

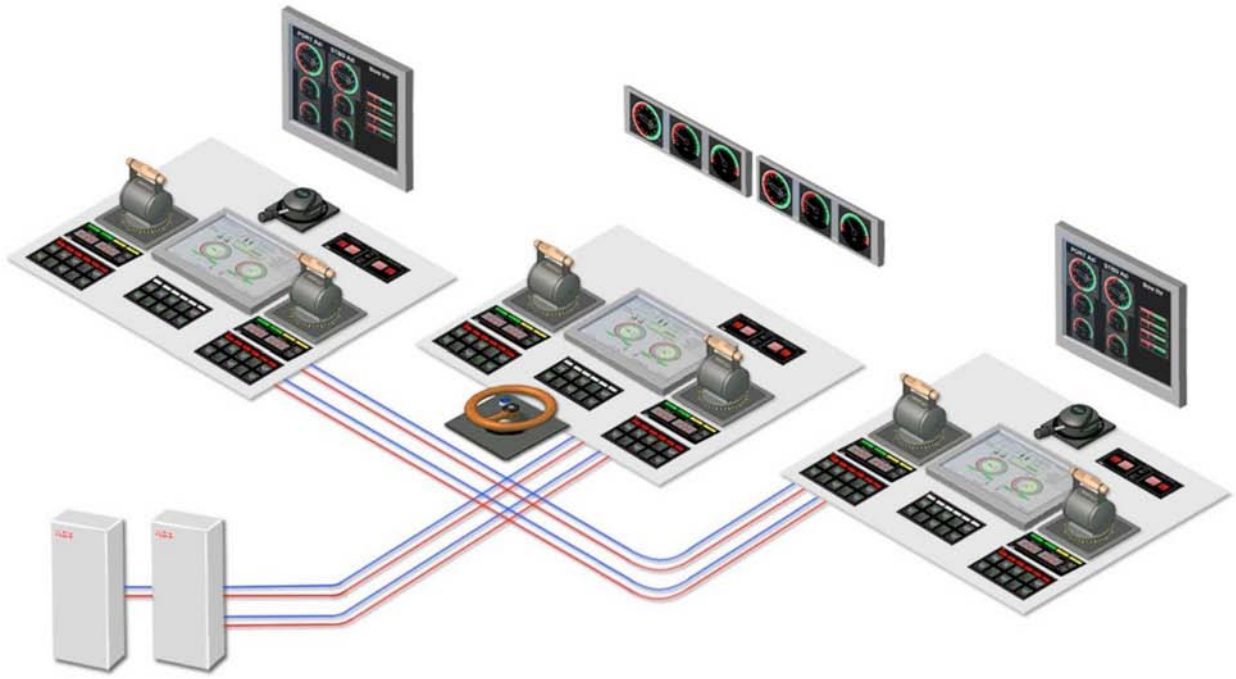


Figure 4-1 Typical remote control outfit

5 Ship design

The following paragraphs describe the usual shipyard design process with Azipod. Contact ABB for consulting when necessary.

5.1 Design flow

A. After defining the basic ship layout, the Azipod Propulsion Module is chosen based generally on the thrust or propeller torque requirements.

B. The Steering Module is selected in function of the steering torque, usually defined by the propeller power, strut height, and the speed of the ship. The ship's power plant dimensioning is checked to match the performance of the two modules.

C. The auxiliary units are chosen to fit the Propulsion and Steering Modules. As above, any special redundancy requirements need to be agreed on within the limits of specified options.

D. Azipod room design work (with the appropriate fire area definition) is carried out.

E. System interfaces are detailed with the allocation of ship automation points.

F. The remote control system layout is configured.

5.2 Hydrodynamics

The shipbuilder begins the hydrodynamic design of the ship with the following steps:

A. Sketching the after lines of the podded ship, locating the Azipod.

B. Estimating the propeller diameter and tip clearance (head box configuration planned where needed).

C. Defining the speed vs. thrust curve for the ship on given draught conditions.

D. Selecting the required power and rpm value for the propeller(s).

E. ABB is able to give a quotation at this point.

6 Information sheet for system quotation

Our intention is to work together with our customers to optimize ship design related to the total building concept. All additional information related to the ship's operating profile and other special requirements will also be helpful.

Shipyard:	
Owner:	
Type of ship:	
Main dimensions of the ship:	Lpp= B= T= GT/DWT =
Block coefficient or displacement:	
Estimate of the resistance (naked hull):	
Speed of the ship:	
Classification society:	
Special notations (Ice class, DP, etc.):	
Number of Propulsion Modules per ship:	
Estimated Propulsion Module power:	
Estimated propeller diameter and rpm:	
Bollard pull requirement:	
Main generator sets: (type, rpm, number and power of units)	
Main switchboard voltage and frequency:	
Auxiliary switchboard voltage:	
Bow thruster power:	
Ship's electrical auxiliary and hotel load:	
Number of ships to be built:	
Delivery time for the equipment:	
Delivery time of the ship:	
Attachments: (GA drawing, etc...)	

Contact us

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