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Extending the limits of underwater mountable DP thrusters: new unique advantages of gearless Azipod DZ

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Introduction

The long-term operation experience in drilling rigs since 2004 with ABB's gearless Azipod CZ thrusters was discussed in detail on Dynamic Positioning Conference (DPC) papers in 2011 [1] and 2014 [2]. This successful experience with extended maintenance interval was the base for the development of a new gearless thruster series, Azipod DZ, which was launched in April 2015 and was presented in subsequent DPC paper in Oct 2015 [3].

This paper will discuss in more detail three new unique advantages of Azipod DZ thrusters: (i) Extended thrust range up to 130 tonnes, presenting the hydrodynamic benefits of the design, (ii) new faster and safer underwater (UW) mounting procedure, and (iii) ABB's new patented early warning bearing health monitoring system showing the significant development in bearing monitoring algorithms.

Azipod D thruster series

ABB have been 25 years the pioneer and No. 1 maker of podded propulsion units in the world. Today, ABB is not only the biggest pod maker but most probably also the largest azimuthing propulsion maker overall in the world. This is thanks to continuous development of pod technology and hugely successful gearless Azipod family, which covers power range from 1.5MW to 22MW. The latest addition to gearless Azipod family is Azipod D series for lower powers in the range of 1.5MW…7.5MW.

Azipod DZ thruster. Maximum power 7.5 MW.

Azipod DZ: maximum 130 tonnes thrust per unit

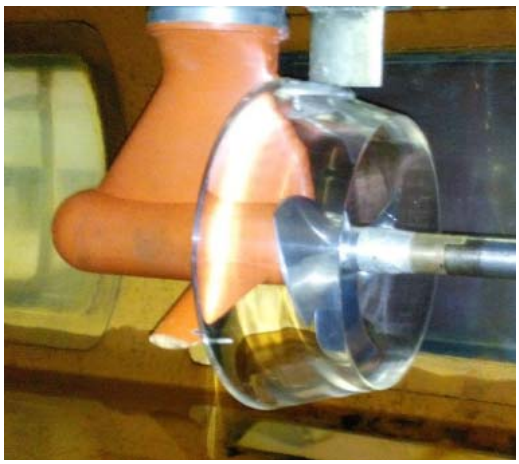
Azipod DZ is the ducted version of Azipod D thrusters and includes five different frame sizes ranging from rated power of 2.4MW with Azipod DZ980 up to 7.5MW with Azipod DZ1600. While inside the Azipod family (1.5-22MW) the DZ1600 size represents a "medium" power unit, for the ducted azimuthing thruster market Azipod DZ1600 represents one of most highest-power unit delivering 130 metric tons of thrust at 0kts – while still keeping very compact size and weight as well as the UW

mounting capability. This compact sized high-power unit will open up new possibilities for vessel designers to achieve better DP plots with the same or less amount of thrusters.

Azipod DZ open water test model.

Tailorable dimensions for optimum performance in each particular vessel design

Modular design of Azipod D enables to adjust the critical dimensions of the thruster in order to secure the best possible hydrodynamic performance for each particular vessel design as well optimised use of available space for inboard equipment. These adjustable dimensions include, for example, nozzle and propeller diameter, propeller blade design, strut height, shaftline inclination angle, mounting tilt angle and shape of the nozzle.



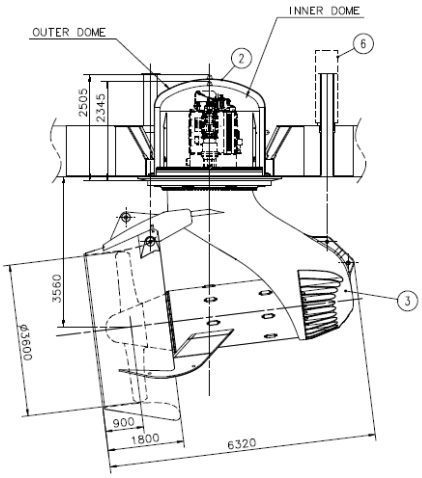
Azipod DZ cavitation tunnel test model.

As an example, Azipod DZ type nozzles are available with three different profile alternatives to fulfil different customer needs: one nozzle profile optimised for highest thrust at 0 kts and having limited speed range up to 10 kts, one profile with still good 0 kts performance but higher speed range up to 15 kts and one transit optimised nozzle with maximum speed up to 17 kts. Each nozzle profile have been tested in CFD, model tests and in cavitation tunnel and verified against available full scale measurements.

Faster and safer domeless underwater mounting solution

Traditional solution to enable UW change-out/change-in feature for a thruster is to use large domes installed on thruster outboard part and on vessel side to fill the hole left by change-out thruster. See the pictures below.

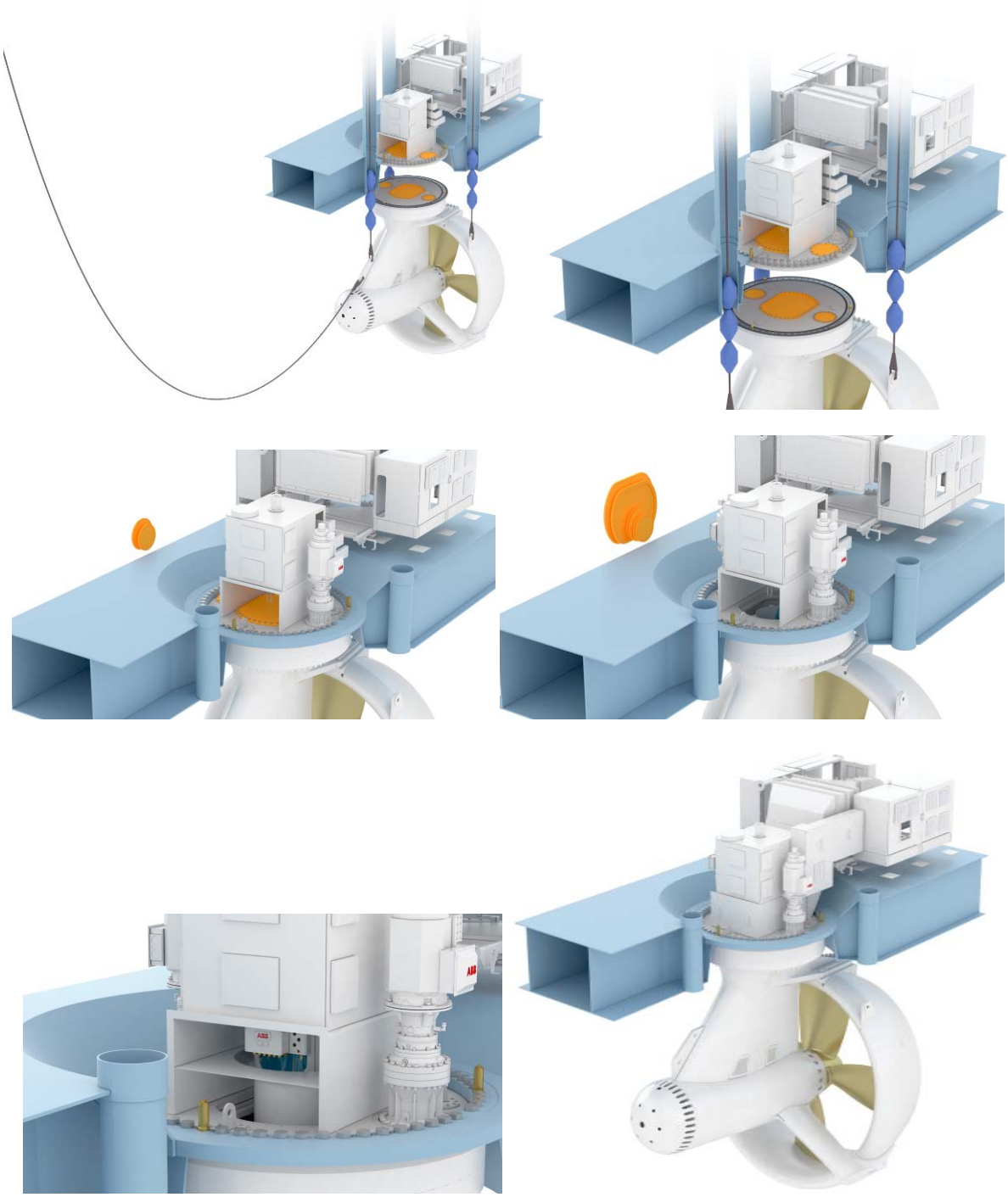
Azipod CZ thruster with dome during UW mounting and the corresponding slightly larger dome in the vessel thruster room



Azipod CZ1400L with inner and outer dome

While UW change-out solution with two large domes is rather simple and straight forward procedure, the downside is large space needed for the domes on-board and heavy weight of the domes requiring specific lifting arrangements in the thruster room.

For Azipod DZ, new “domeless” UW mounting procedure was developed. Instead of two large domes, it uses six small flanges; three flanges on thruster side and three, slightly larger in diameter, on the vessel side. These flanges are highlighted with orange colour in below pictures visualizing the UM mounting procedure. Weight of each individual flange is only a fraction of large dome and they can be lifted and installed by quickly without any special lifting arrangement in thruster room.

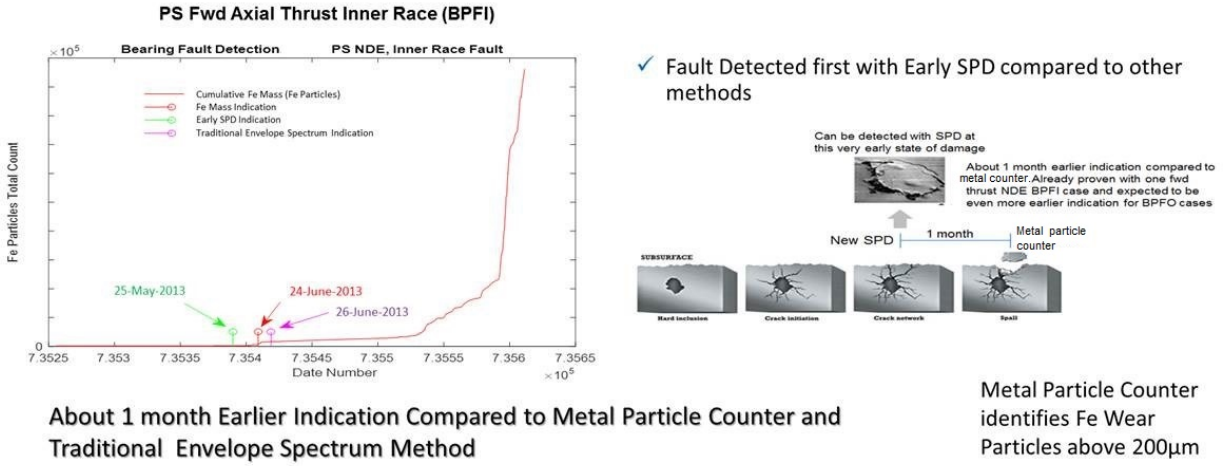


UW mounting procedure of Azipod DZ

The domeless solution saves considerable amount of space on-board the vessel, which can benefit certain vessel designs. It also saves time as the light flanges are fast to handle and the amount of piping and electrical cables that needs to be disconnected during the UW mounting is decreased. Further, the weight of the outboard propulsion module is considerably lower because steering module, including steering motors and slip ring unit, stays on the vessel side. This may be beneficial for vessel design considering the crane lifting capacity, for instance.

New patented early warning bearing condition monitoring system

Thanks to being pioneer of azimuthing propulsion technology for up to 22 MW propeller power, ABB have researched and developed in detail many aspects of large bearings and gained knowledge and competence even beyond of what the most known bearing makers themselves have. One results of this high-end R&D with bearings is a patented bearing health monitoring algorithm, which is also available for the power range of Azipod D series bearings. The algorithm is called Early Shock Pulse Detection (ESPD) and it indicates and alarms the start of a raceway surface crack earlier than any other system currently available in the market for large bearings.



ABB's new ESPD bearing monitoring algorithm is available exclusively for Azipod products.

Benefit for vessel owner is that in case of rare – but still possible – bearing defect there is more time to react and plan for the best mitigating action without short-term need to stop the operation of the thruster or vessel. For example, just balancing operation power for the defected thruster reduces the further development of a bearing defect in very early phase and improves likelihood to continue the operation till scheduled maintenance to the thruster can be performed.

Azipod D series power range

Azipod D thrusters are available in both with pushing ducted propeller (DZ) and with pulling open propeller (DO) in several frame sizes and powers, as seen in below table. Azipod D units are available also with ice classes up to Polar Class 5 (PC5).

Frame size	Azipod DZ	Azipod DO
980	2.4 MW	2.5 MW
1100	3.1 MW	3.3 MW
1250	4.2 MW	4.8 MW
1400	5.5 MW	5.5 MW
1600	7.5 MW	7.5 MW

Summary

Gearless Azipod DZ thruster series include new unique advantages that will benefit the ship design and operation. These advantages include:

- High maximum power of 7.5 MW per thruster with maximum thrust of 130 tonnes @0 kts, giving new possibilities for vessel designs to reach superior DP plots.
- Tailorable thruster dimensions and nozzle profiles for optimised performance for different vessel types, operation profiles and hull designs.
- Faster, safer and lighter domeless UW-mounting procedure enabling more optimised onboard space usage, less crane capacity and leaner UW change-out operation.
- Patented early warning ESPD bearing monitoring algorithm giving extra layer of safety and confidence for ship owner decision making with the most accurate data available in the market.

References

[1] Varis, J. & Laakkonen, E., “Electric Pod Thrusters Extend Maintenance Intervals”, DP Conference 2011

[2] Kokkila, K., Varis, J. & Aho, J., “10 years overhaul interval with gearless Azipod thruster”, DP Conference 2014

[3] Kokkila, K. & Aho, J. “Major new development on gearless thrusters: more power, less cost, improved maintainability”, DP Conference 2015.