DYNAMIC POSITIONING CONFERENCE

THRUSTERS AND DRIVE SYSTEMS

The Benefits of Podded Propulsion in the Offshore Market

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Synopsis

Over the last few years, the concept of podded propulsion has gained wide acceptance in the Merchant Marine Market. The benefits associated with this type of propulsion are equally applicable to the offshore market both in monohulls and semi submersibles.

What is Podded Propulsion?

Figures 1 and 2 explain podded propulsion when compared to a conventional propulsion shaft line and an conventional thruster.

Figure 1

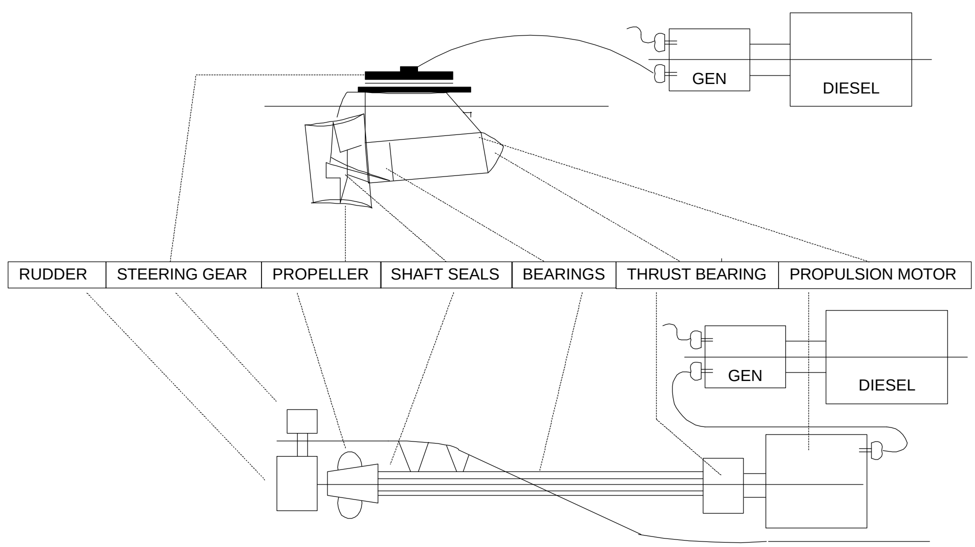
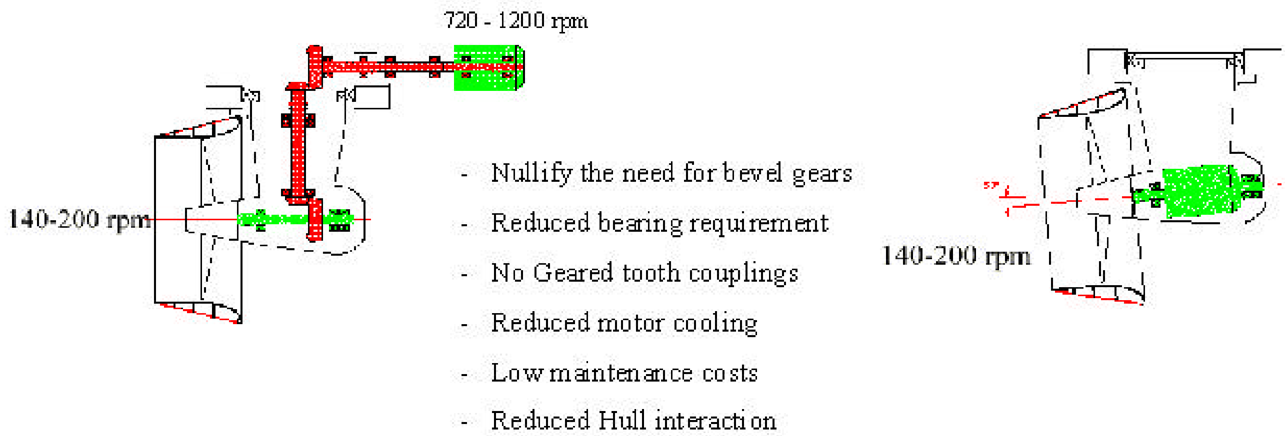


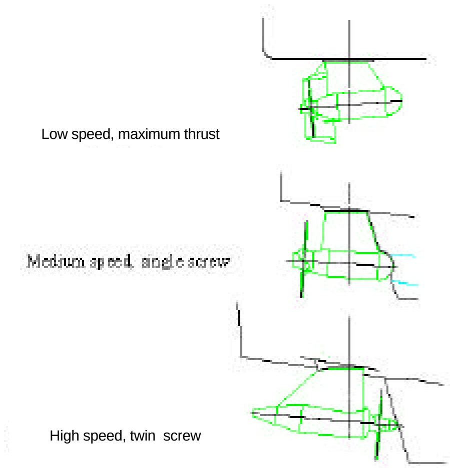
Figure 2



The two illustrations above demonstrates the reduction in number of parts required to achieve the same result.

Presently three different designs podded propulsion are available for different markets.

The medium speed pushing design is ideally suited to offshore shuttle tanker, however this paper will concentrate on the slow speed maximum bollard pull design which is ideally suited to mobile offshore drilling units.



Why use Podded Propulsion!

Experience shows that conventional azimuth thrusters are limited in size to 5-6 MW range. Examples of larger ones are known for special purpose applications such as Ice Breakers. Because of the design of a podded propulsion unit it is ideally suited for the 5 to 12MW range for mobile offshore drilling units.

What is special about an podded propulsion unit suitable for the Offshore Industry!

1. It needs to be designed to provide better reliability than conventional thrusters.

2. It needs to retain the underwater mounting/dismounting features available in the conventional thruster market.

3. It needs to have a better sealing arrangement than a conventional azimuth thruster with facilities for underwater maintenance of the seal and propeller.

4. It should deliver more bollard thrust when installed in the vessel than a similar thruster.

5. It must demonstrate a larger period without maintenance, and further more provide more real time monitoring of important items like bearings.

6. A smaller number of high reliability podded propulsion units of a high output can be more effective than a larger number of conventional thrusters.

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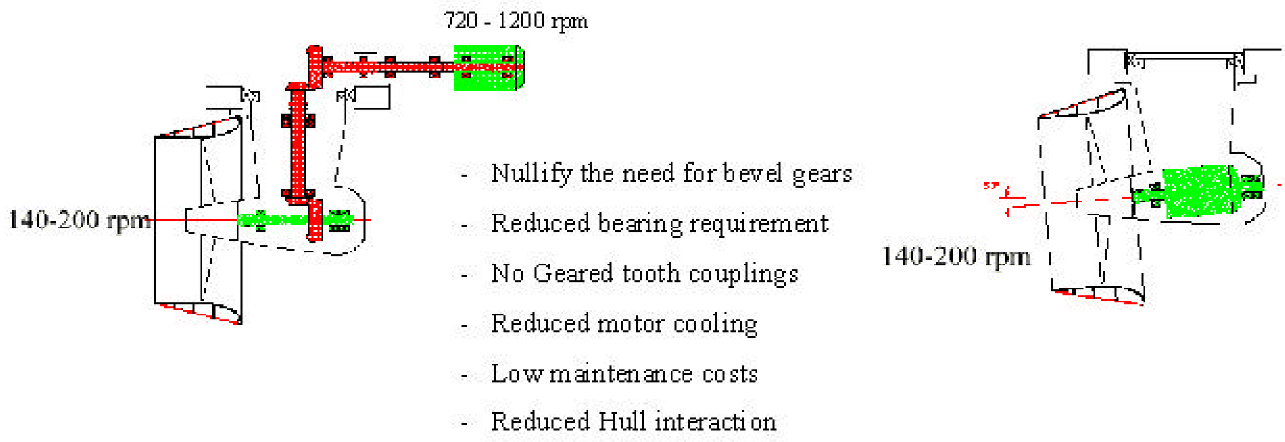
Reliability

Figure 5 shows the evolution of a conventional thruster into a pod.



It is clearly shown that the number of bearings is vastly reduced and the absence of the bevel gearbox in the podded propulsion unit. Both of these items have been known to cause unreliability.

The pod propulsion unit, as part of an electric power and propulsion system, utilises elements considered as traditional technology.

An electric pod propelled vessel comprises the following established elements.

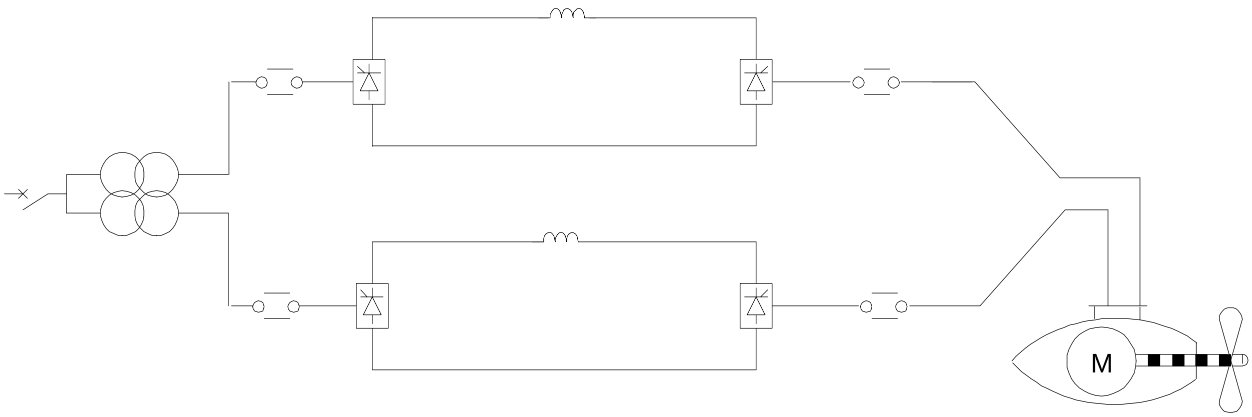
- Integral part of the electric power and propulsion system
- Interface with the Dynamic Positioning and Automation Systems.
- Proven variable speed technology
- Well established electric design of motors
- Well established thruster design
  - Slewing bearings
  - Steering motors
  - Steering sealing system
  - Propeller - shaft sealing system
  - Underwater propeller handling
  - Sleeve type propeller mounting

From the electric variable speed drive to the thruster auxiliaries the pod system is designed as a highly redundant system.

Selection of the variable speed drive system can be made to optimise the most reliable drive for the thruster rating and vessel application. This selection can be made from the highly reliable Synchro converter or PWM system for application such as drilling semi-submersibles or shuttle tankers or, the Cyclo converter for applications requiring 100% torque at zero speed such as an ice breaker.

For a typical offshore drilling vessel a dual channel (12 pulse) variable speed drive supplying a double wound motor will provide the highest required redundancy.

Figure 6



It is possible to run the motor at 50% power using a single channel whilst isolating the other channel for maintenance.

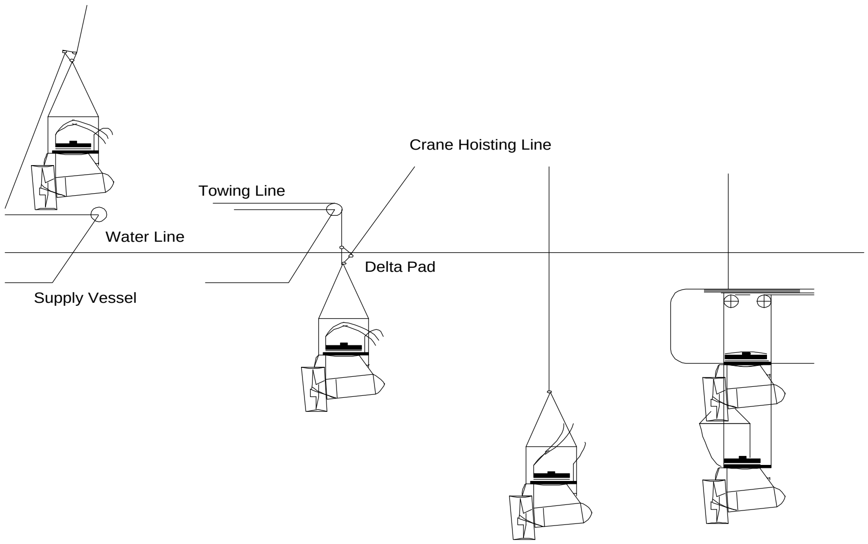
The pod auxiliaries also have a high level of redundancy including duty/standby bilge pumps and redundant air cooling fans and hydraulic pumps.

Under Water Mounting and Dismounting

Main underwater components including the actual pod unit can be dismounted and replaced in open water, at either operating or transit draughts.

Should it be necessary, the removal of the complete pod is based on similar dome aperture sealing methods to that used for a traditional thruster. Ease of handling is achieved using the lifting capacity of either the drilling derrick, or on board winches to load the pod onto a support vessel or the operating vessel.

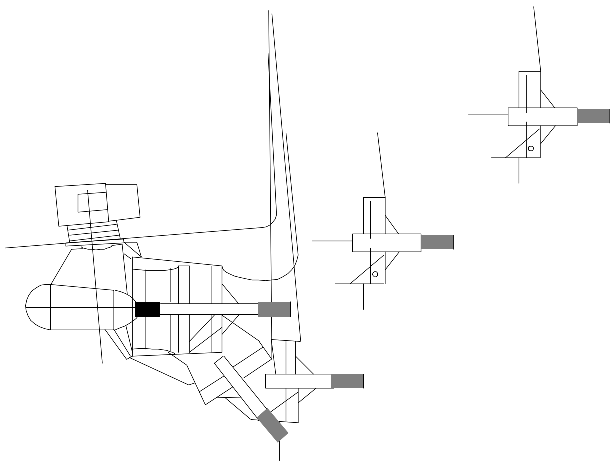
Figure 7



Propeller + Seals Maintenance

Utilising a sleeve type mounting arrangement and a hydraulic release mechanism the propeller can be removed and securely held in a basket for retrieval to the deck

Figure 8



After removing the propeller and activating the inflatable seals the complete seal assembly can also be removed for maintenance or replacement.

Oil proof shaft sealing arrangement ensures the pod meets strict environmental conditions. Seal condition can be continually assessed by analysing the fluid content found in the drainage sump - be it sea water or oil from a bearing leak

Long Maintenance Free Operation

The maintenance philosophy of the pod propulsion concept is one of ensuring the unit remains in the water for as long a period as possible. As Classification Societies gain more experience this will also enable them to revise their requirements and increase the present 5 year inspection period.

The design life for the pod bearings are already in excess of 10 years at MCR.

Remote monitoring of bearing vibration, and bearing and winding temperature is provided. In addition, on the larger ratings, access within the pod enables internal inspection and minor maintenance, eg change motor diodes etc. A motor shaft disc brake prevents the motor wind milling and an addition worm wheel gear gives added security and the possibility of barring the rotor.

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Reduced Thruster Requirement

As a comparison the capability of a 5th generation 10,000ft deep water semi has been assessed with 2 different thruster layouts. Fig 9 shows a semi with 4 x 7MW Pods. Fig 10 shows a semi with 6 x 4.5MW Thrusters.

Figure 9

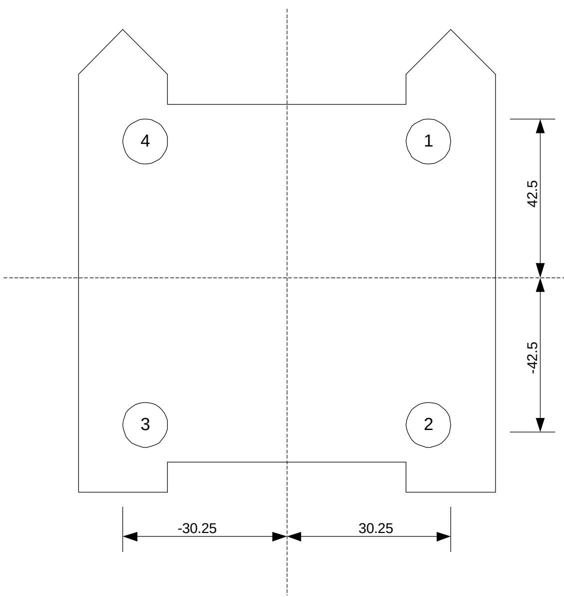
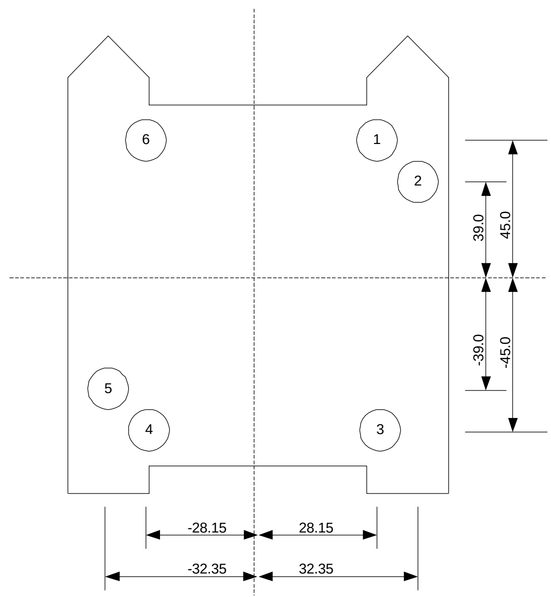


Figure 10



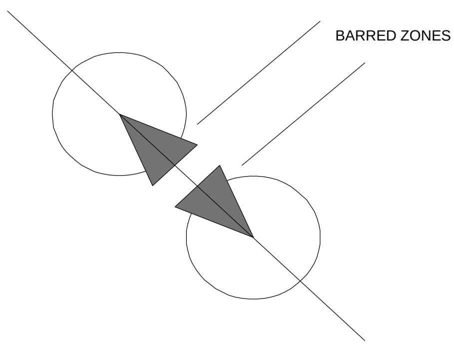
For the purposes of the capability analysis the following assumptions have been made.

7MW Pod ⇒ 1144KN of guaranteed thrust taking into account hull interface and 3% reduction for the 5° angle of the pod.

4.5MW Thruster ⇒ 640KN of thrust based on 118KN/1000HP with a 10% reduction for hull interference.

In addition a ±20° barred zone has been taken into account for where two thrusters are located in one corner of the rig.

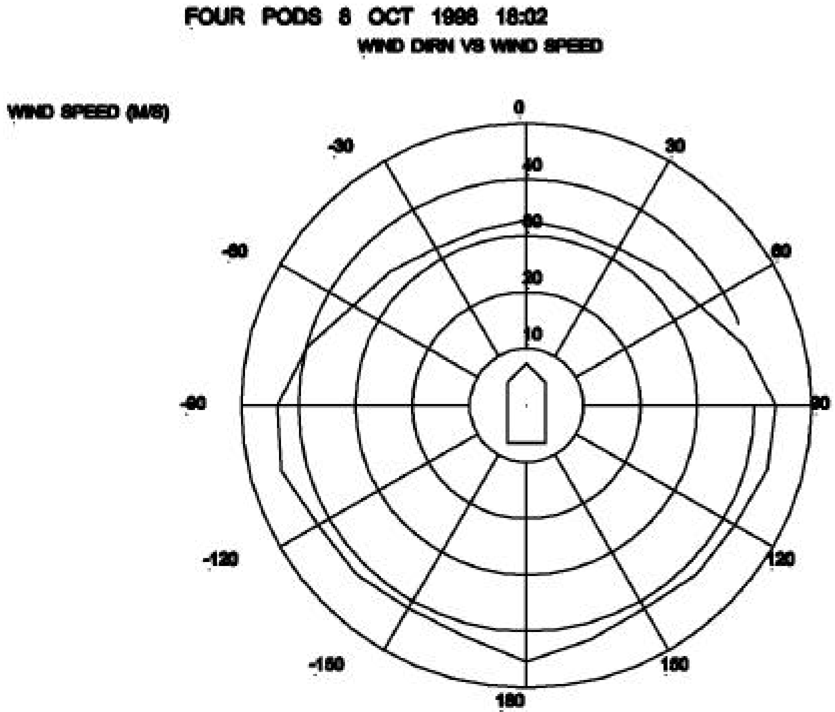
Figure 11



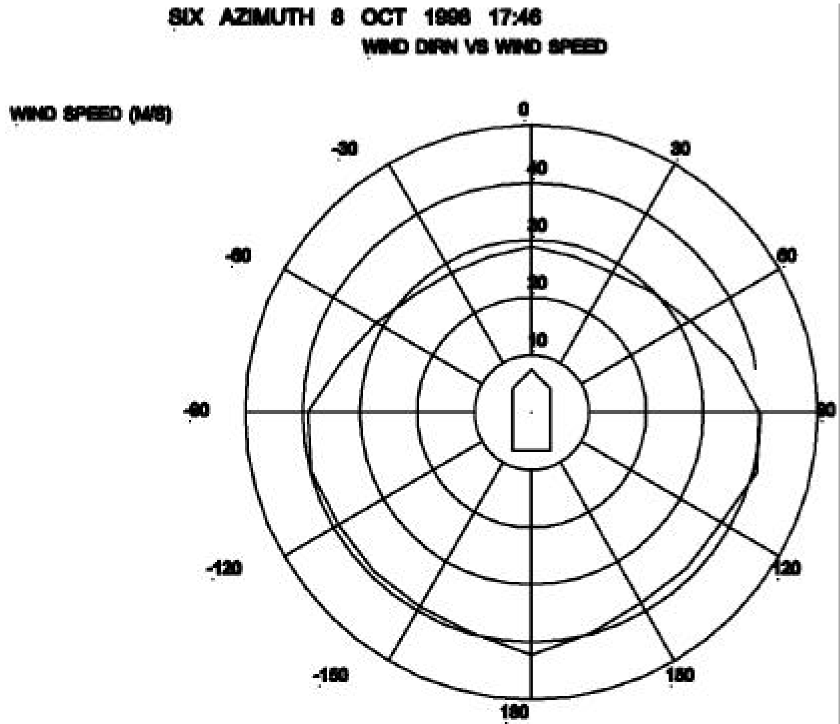
Typical Gulf of Mexico conditions have been used for the weather.

Plots 1 and 2 show the capability of the vessel with all thrusters intact and the vessel heading into a 3.5 knots current.

PLOT 1



PLOT 2

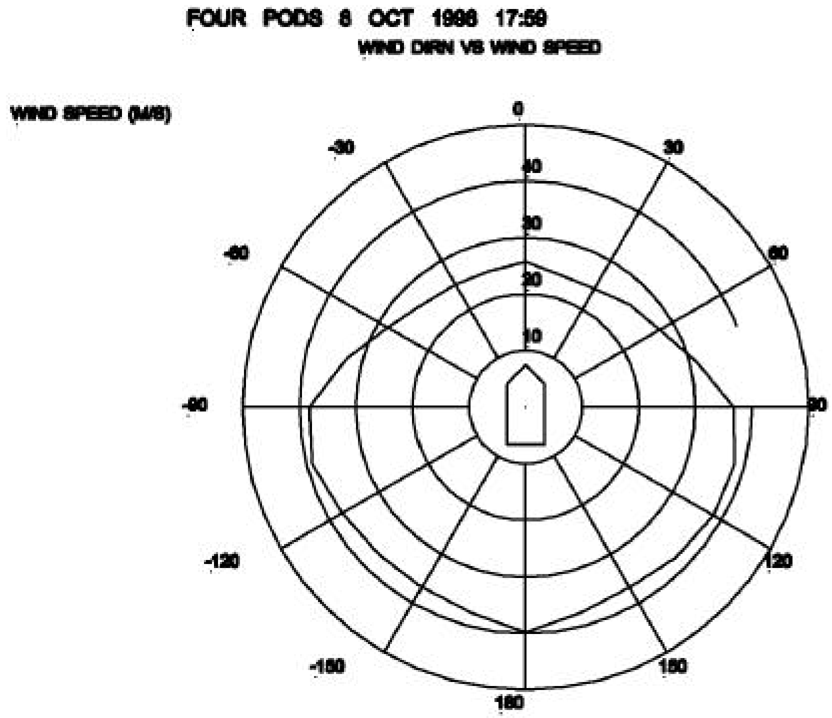


Results

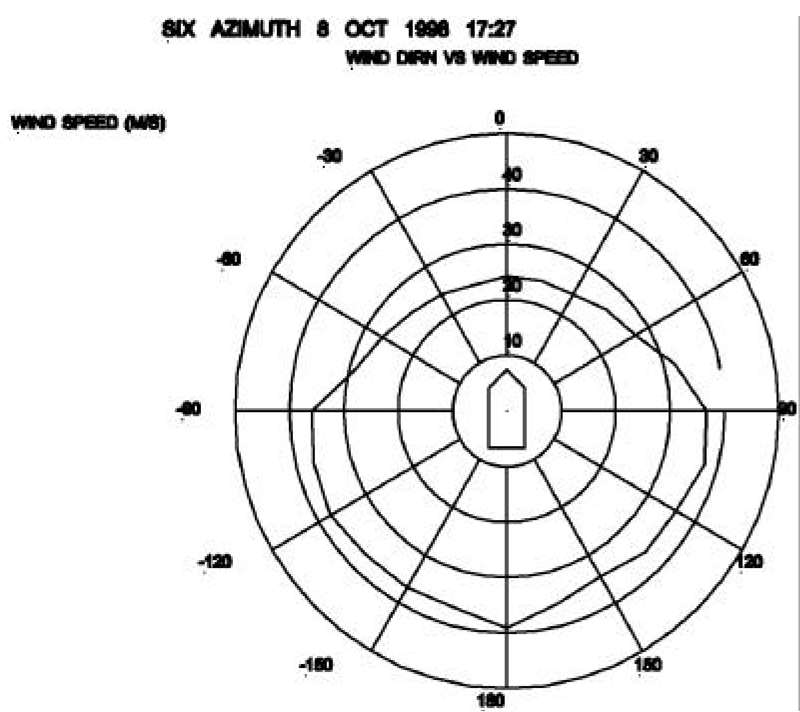
	4 x 7MW Pods	6 x 4.5 MW Thrusters
Minimum Capability	3.5 knots current on bow. 64 knots wind & 10.1m wave height at ± 30° from hull	3.5 knots current on bow 56.2 knots wind & 8.4m wave height at ±30° from hull
Maximum Capability on the beam	3.5 knots current on bow 87.6 knots wind & 15.1m height at ±90° from bow	3.5 knots current on bow 13.1m wave height at ± 90° from bow

Plots 3 and 4 show the capability of the vessel with the most significant thruster failed.

PLOT 3



PLOT 4



Results

	3 x 7MW Pods	5 x 4.5 MW Thrusters
Minimum Capability	3.5 knots current on bow 50 knots wind plus 7.2m wave height at ± 30°to the bow.	3.5 knots current on bow 48.4 knots of wind & 8m wave height at ±30° to the bow
Maximum Capability on the beam	3.5 knots current on bow 73.4 knots wind plus 12.1m wave height at ±90° to the bow	3.5 knots current on the bow 73.4m knots of wind plus 12.1m wave height at ± 90° to the bow

As a summary the benefits of using podded propulsion are as follows

- Increased reliability due to fewer components.
- Reduced maintenance due to fewer components and the reduced RPM of the components.
- Underwater maintenance of the propeller and seal arrangement plus the dismounting capability.
- Possibility to convince class to increase the time between inspections if correct real time monitoring procedures are adhered to.
- Increased bollard pull for the installed MW of thruster power.
- Reduced number of thruster units if the 4 pod philosophy is used. As a general rule 3 x pods should give an equivalent thrust of 5 x conventional thrusters when choosing the size of the pod.
- Reduced complexity of the switchboards and cabling due to the reduction in number of thrust units.
- Reduced CAPEX and OPEX. If the pod concept is introduced into the vessel at the design stage.

Please remember that there is no new technology in a pod merely a new way of thinking!