

ABB Marine &
Turbocharging


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Azipod Control Outline Description

Norwegian Cruise Line



| Latitude | Longitude | |
|------------|--------------|---|
| 58°47' N | 12°32,122' E |  |
| 58°31,6' E | 12°31,8' E | 12°32,0' |



Cruise ship remote controls "Star" Class

- This presentation describes as an overview the remote control system deployed on this Class vessels.



- The "EMRI" control system is installed on the Azipod propulsion platform.



Strongpoint local control

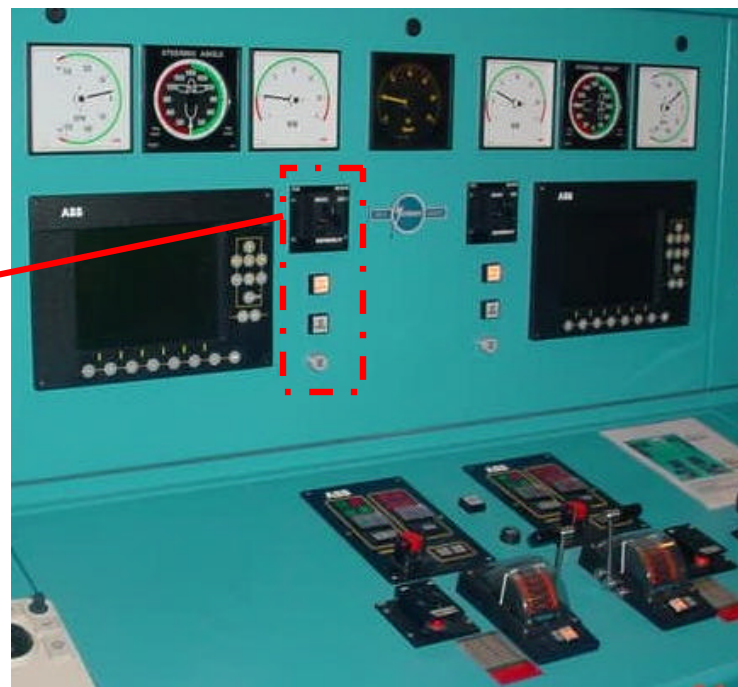
Provided on the “strongest take-over” principle as follows:

1. Propeller RPM
 - A. On the “AIU” Cubicle within the Azipod Room, or
 - B. At the Cycloconverter Cubicle
2. Steering from the servo units within the Azipod rooms.
Also parallel on local (ENP82) push buttons at the mechanical indicator (this located on the propellerpower slip ring)



RPM control change Bridge / ECR

1. For RPM control of each Azipod, the master remote control post is the Engine Control Room.



2. By means of a control hand-over subsystem, the remote control of Propeller RPM can be handed to the Bridge. It has to be acknowledged on the Bridge before the transfer becomes effective.
3. In return, if specifically needed, the RPM control can be taken back forcibly to the ECR. In this case an acoustic and a visual alarm is given on the Bridge.



Steering control change Bridge / Local



- For directional steering control the remote control can be allocated to the Bridge, from the Servo Cabinets in either or both Azipod Rooms. The steering control can be forcibly taken back down to the Azipod Room. Therewith an acoustic and a visual alarm are given on the Bridge.

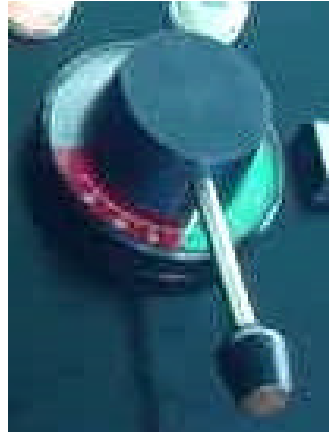
Bridge control: Cruise mode A.

1. Within the Bridge, the strongest point of Remote Control is the Bridge Centre. The basic control mode is Cruise Mode. This uses the RPM yoke function of an Azimuth Lever for each Propeller order, and the Main Wheel (Bridge Centre), or a Follow Up Tiller for Helm order.
2. Max. propeller power (each) of 19.5 MW is available. Bridge Centre is the only post equipped with the master Main Mode Switch and the Emergency Control Select switches, that define the strongest control workstation.
3. Bridge Wings are Call Up stations.
4. Cruise Mode helm steering can also be executed by an Autopilot (Interface to an external system). Additionally, on Bridge Centre only, Speedpilot operation is possible for RPM control (Interface to an external system).



Bridge control: Cruise mode B.

- The basic manual controllers are similar to the ones on a traditional shaftline / rudder ship:



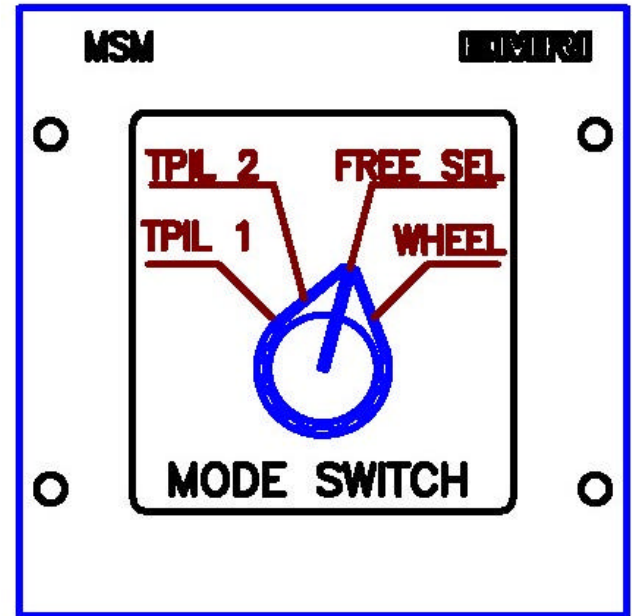
Bridge control: Maneuver mode

1. On Bridge Centre, Port Wing, and Starboard Wing, the Azimuthing Levers are used to operate the Azipod by rotating around, and for the RPM setting.
2. Reduced propeller power of 10 MW per Azipod is available.



The main mode switch

1. Used for the hard selection of a main mode.
2. The switch gives the strongest mode command to the programmable Mode PLC.
3. This command overrules over the mode push buttons
4. In the event of a faulty mode system, the switch is effectively used to define the default control remaining on Bridge Centre.



Bridge emergency control



1. Emergency Control push buttons for RPM and steering are provided on Bridge Centre. These give so-called Non Follow Up (NFU) hard contact orders to the systems.
2. Aheadwise / Asternwise for RPM, and PORT / STBD for steering.
3. Slave push button sets are provided on the Bridge Wings.

Steering gear speed

1. When in open sea mode, the steering gear can be manually selected to run on either one duty steering pump P1 or P2.

Or with both together for double speed.



2. In Manoeuvre mode it is possible to select a FAST sub mode. This is done by reducing the oil volume and available torque of the hydraulic steering actuators. Therefore a higher helm rate is obtained. This FAST sub mode will be cancelled when running only one pump, or going into open sea mode.



Remote control mode table

| | CRUISE MODE | | MANEUVER MODE | |
|--|---|---|---|--|
| Max. Power MW at each Propeller | 19.5 MW | | 10 MW | |
| Available from | All 3 Bridge Workstations: BC, PW, SW | | All 3 Bridge Workstations: BC, PW, SW | |
| Description for Steering Control: | Helm angles Max. 35 degr. | | Helm angles 360 degr. range. | |
| Steering Gear speed rate alternatives: | One or two pumps (P1, P2) 2.5 or 5.0 degr./sec. | | One or two pumps (P1, P2). (On two Pumps, FAST can be selected) 2.5, 5.0 or 10.0 degr./sec. | |
| Sub-option: | PORT or STBD LEVER MASTER | SEPARATE LEVERS | PORT or STBD LEVER MASTER | SEPARATE LEVERS |
| | RPM is controlled for both Azipods, from the selected Lever Helm direction is controlled from the Wheel, Autopilot or from the FU Tiller | RPM is controlled for both Azipods independently Helm direction is controlled from the Wheel, Autopilot or from the FU Tiller | RPM is controlled for both Azipods, from the selected Lever Helm direction is controlled for both Azipods, from the selected Lever | RPM is controlled for both Azipods independently Helm direction is controlled for both Azipods independently |

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