AZIPOD USER GROUP, 2017-14-06

Electrical Steering Upgrade

General Presentation

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Electrical Steering Upgrade

§ System modernization from hydraulic to electrical steering. System based on Azipod XO design.

• Maintenance Care Agreement for following 15 years

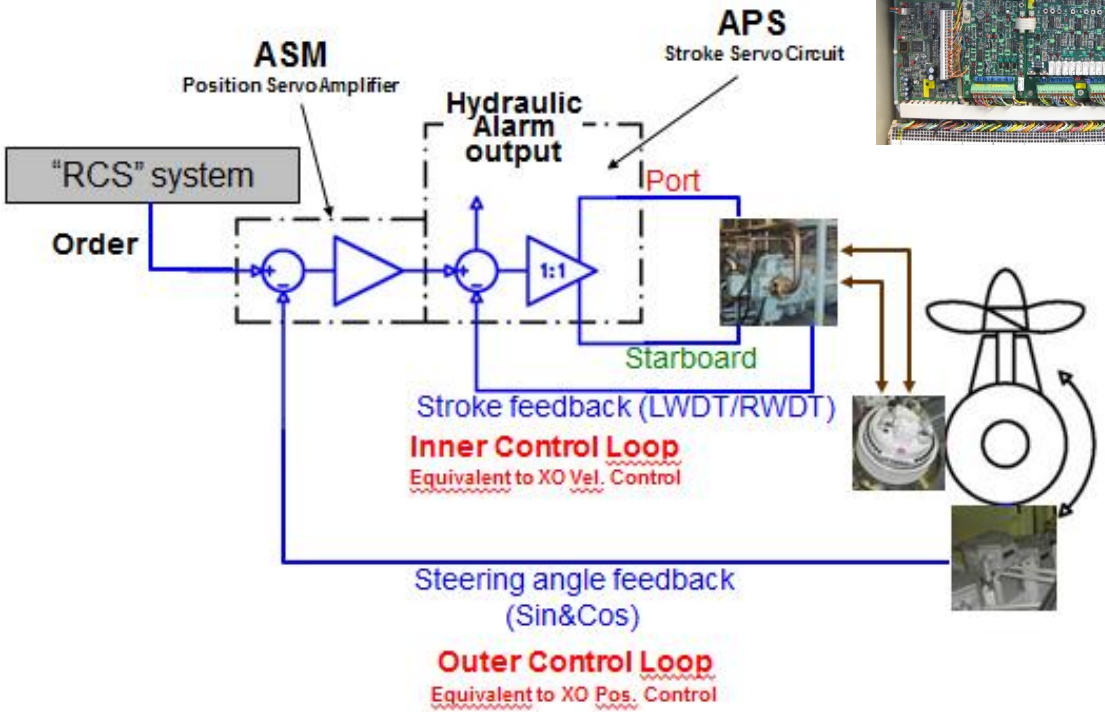
ü Yearly survey of steering system

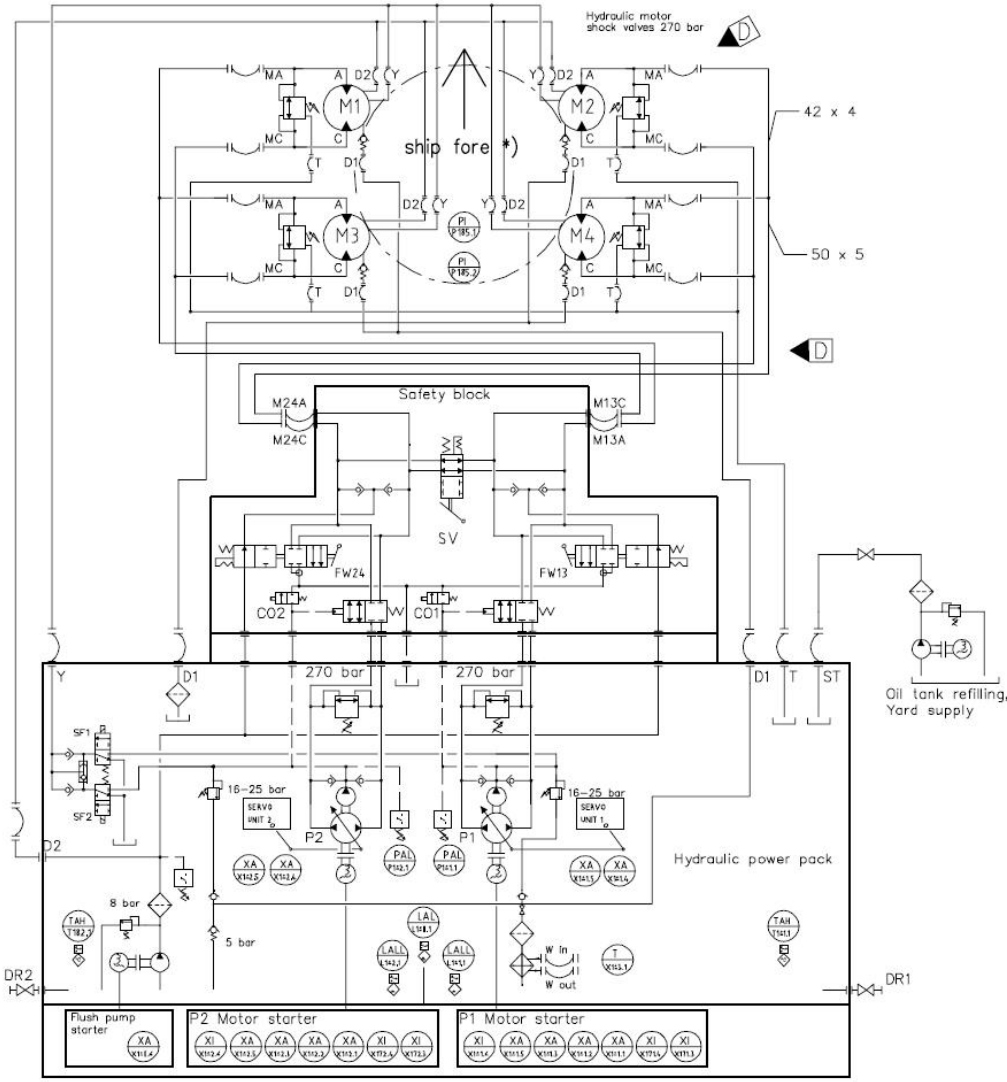
ü Extended maintenance coverage (ABB tools, labour & spare parts) for planetary gears, clutches, electrical motors and steering drives

ü Needed life cycle upgrades for the installed electrical components in case components enter life cycle phase limited

Hydraulic Steering System

In Principle

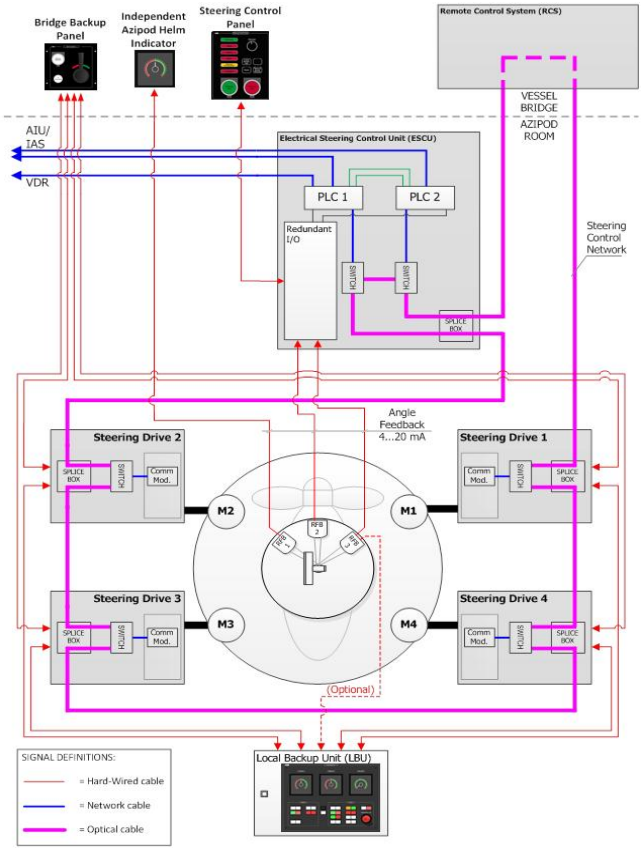


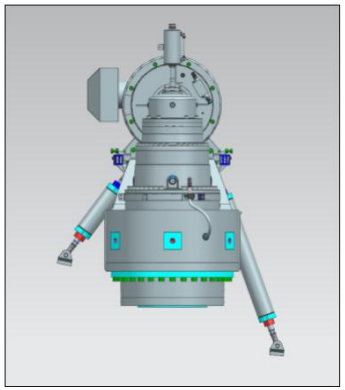


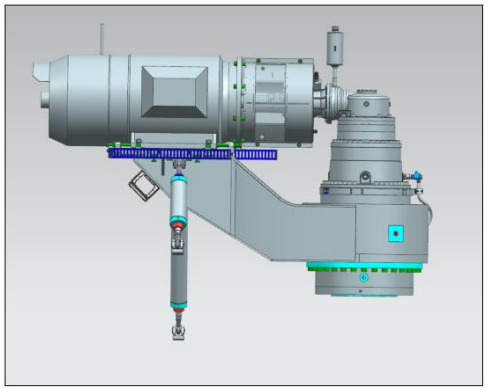
Electrical Steering Upgrade

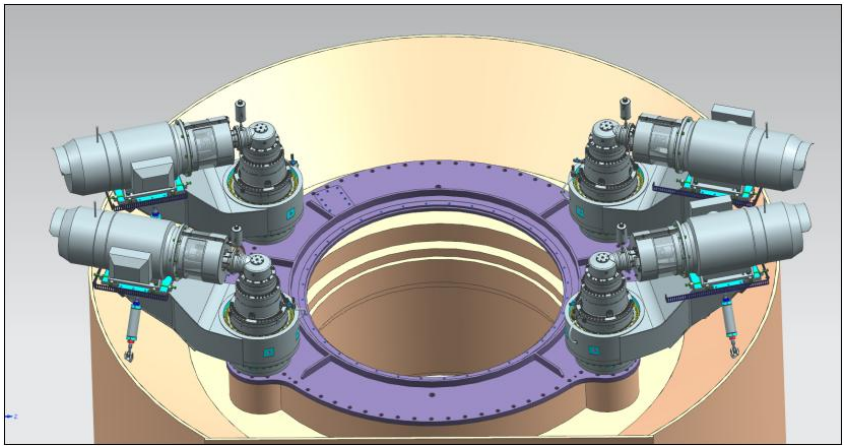
Basic Scope

- Existing hydraulic motors replaced with electrical motor assembly.
- Hydraulic power unit to be removed.
- Electrical steering control system to be built (Drives, Cabinets, communication)
- Interfaces to bridge and ship automation to be modified
- Mechanical Interfaces to be modified
- Steering speeds harmonized to 2.5deg/s and 5 deg/s in fast mode





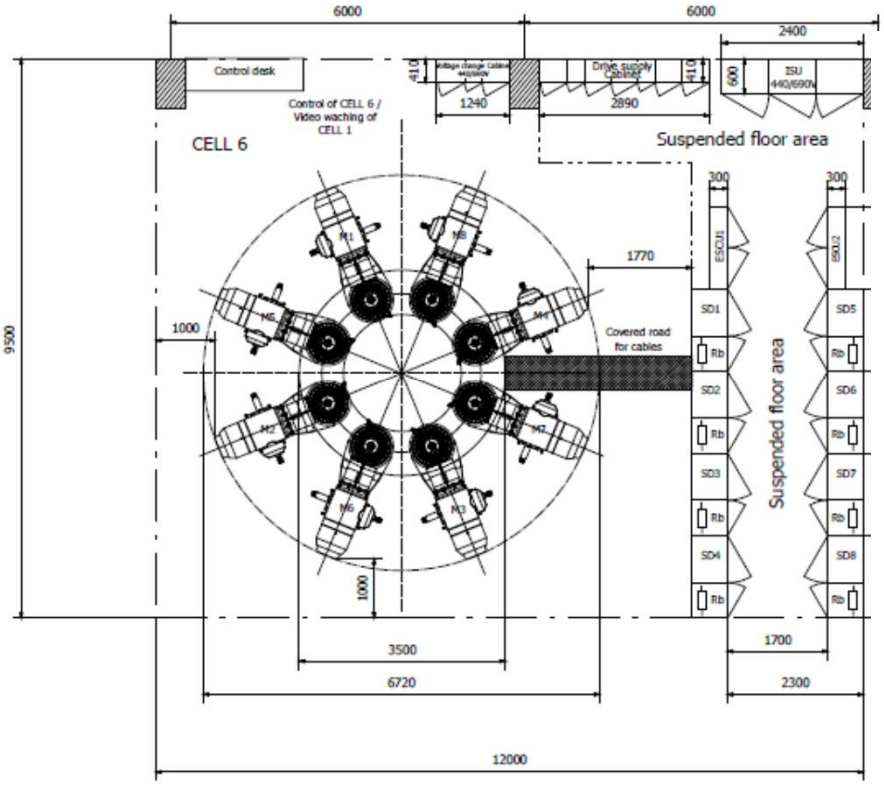


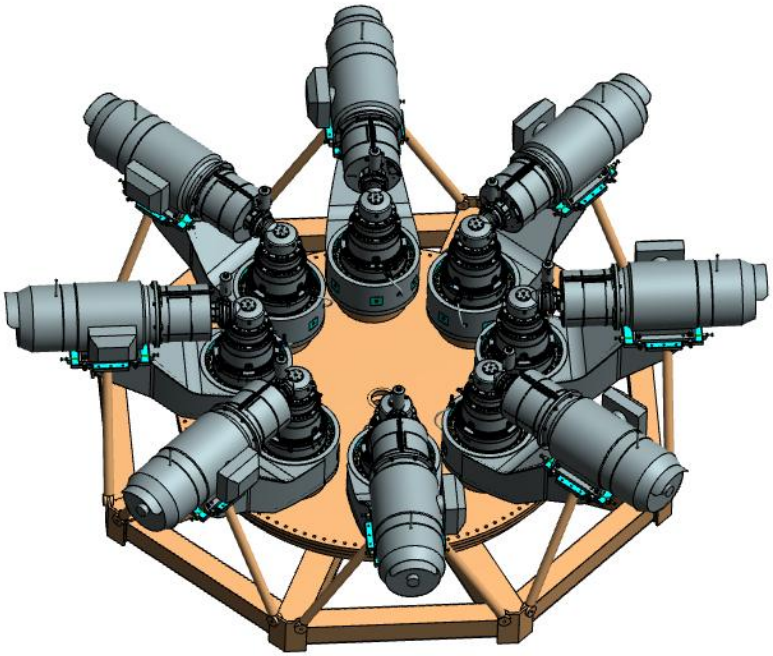


Testing of Steering Upgrade equipment

FAT Test

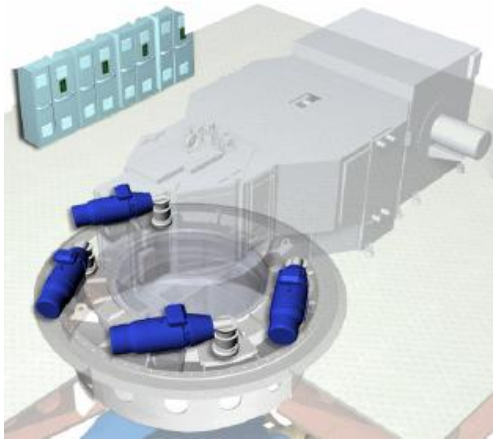
- Each steering upgrade package will be FAT-tested at ABB Factory before delivery to site
- Enables installation and start-up in normal dry-docking
- Reduces risk for unexpected issues at yard
- Tested equipment:
  - Motor unit
  - Drives
  - Control cabinets

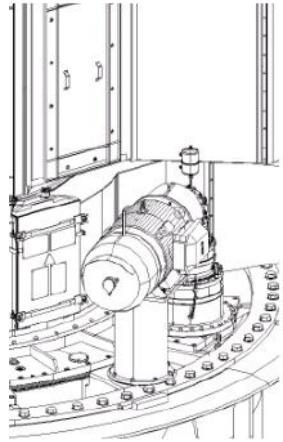




Electrical Steering Modernization
Benefits Summary

- Improved safety – steering motor brakes
- Automatic steering system locking
  in case ref. steering angle deviates from requested (drifting prevention)
- Ability to lock Azipod in Zero Angle position
- Reduced and predictable life cycle costs
- Maintenance care
  - Condition monitoring
  - Periodic maintenance
  - Spare parts and consumables
  - Unexpected repairs
  - Possible life cycle upgrades





Electrical Steering Modernization
Benefits Summary

- Increased redundancy

	Available Torque	
Steering Motor	Hydraulic Steering	Electric Steering
1 Failure	50%	100%*
2 Failures	0%	67%
3 Failures	0%	33%
4 Failures	0%	0%
Steering Pump/Drive	Hydraulic Steering	Electric Steering
1 Failure	100%	100%
2 Failures	0%	67%
3 Failures (drive only)	N/A	33%
4 Failures (drive only)	N/A	0%

Table figures above applies to the most common failure modes. However, for example in case a single motor seizes up the above table figures need to be modified. With electric steering the operation can continue, but seized motor will create counter torque that needs to be subtracted from full torque. With hydraulic steering, one seized motor will force the steering to be locked.

**Fullfilment of SOLAS Torque with no additional safety margin*

- No hydraulic oil – no leakages, improved fire safety
- Improved comfort – lower noise level

Example of typical Scope of delivery

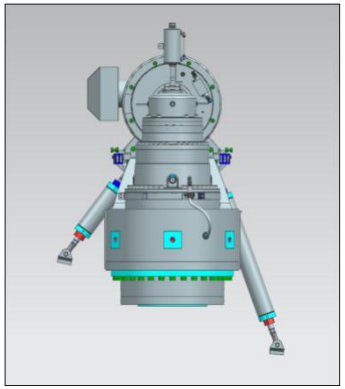
Must be agreed on each project

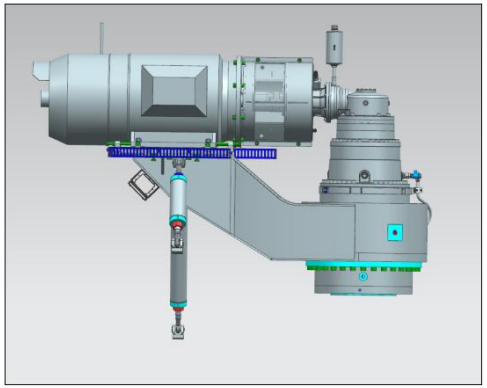
ABB:

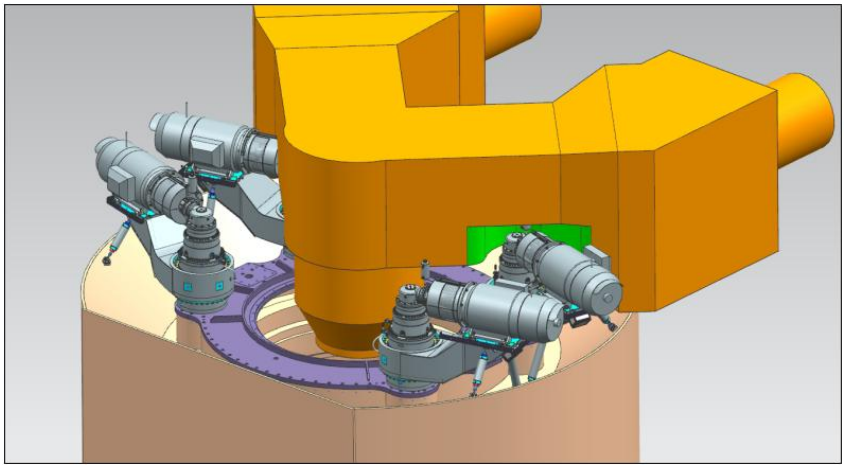
- Steering drives+Electrical Steering Control Unit (ESCU)+Local Backup Unit (LBU)
- Electrical motors with planetary gears and clutches
- Pinion Bearing Replacement
- Panels (local, ECR and bridge)
- Modified drawings and manuals
- Cabling list and specification.
- Mechanical changes in Machinery Deck (Bolts etc.)
- Possible Air Channel modification

CUSTOMER:

- Dismantling of all Hydraulic components
- Heavy Lift works if required
- Electric Cabling works
- Bringing tools and new equipment into Azipod Room
- Needed changes in ship automation interfaces (Alarms etc.)







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