Thruster unit (3300 & 4500 kW designs, up to 60...84* tons thrust) with a nozzle intended for high thrust applications such as

- Drilling rigs and ships
- Pipe layers and other DP vessels

* In typical drilling vessel application
ABB Thruster - Technical Concept

- Electric power transmission
  - No gear losses
  - No gear lubrication oil
  - Less maintenance

- Permanent magnet synchronous motor
  - Very high efficiency over a wide power range

- Thruster unit directly cooled to surrounding sea water
  - No separate cooling system
Transocean Development Driller I and II

- Azipod CZ1400 – R1800
- Propulsion power 3,2 MW
- Available static thrust min. 62 metric tons per unit
- 8 + 8 thruster units
- 5 spare units
Maintenance Rotation In Existing Semisubs

- Planned maintenance rotation of thrusters was started with 4 thrusters changeout in DD2 in June 2009 after over 32,000 hours of operation.
- Second set June 2010, 5 units from DD1 after over 40,000 hours of operation.
- Third set, Feb 2011, 4 units on DD2 after 47,000 hours of operation.
- Rest of the thrusters will be changed during year 2012 after almost 8 years of operation.
- Change out schedule is based on the drilling schedule.
Lifting The Unit
Thruster Overhaul

- Thrusters have been transported to ABB Marine, Houston workshop for maintenance check and possible upgrades to meet latest design upgrades
- No major indications of defects on critical components have been reported
- Overhauled units have been prepared to be as the next replacement set
- All units have been electrically tested and pressure tested before delivery to the vessel
- Critical components have been examined by the component manufacturer’s specialists during overhaul
Shaftline Bearings

- Thrust bearings and propeller bearings have been dismantled and inspected during the overhaul
  - Condition of bearings was good
  - Propeller bearings have been replaced and thrust bearings have been refurbished
  - Bearing manufacturer’s judgement has been that the bearings would have been good for continuation of operation
Dismounted Propeller Bearing After Six (6) Years In Use
Dismounted Thrust Bearing Elements After Six (6) Years In Use
Shaft Seal

- Shaft seal has showed some marks of normal wear and tear
- Used shaft seal packages have been examined with sealing manufacturer
  - Result of the test is estimating life time of 7,5 years
- Shaft seal design has been modified to extend the lifetime of the seal
Propulsion Motor Components

- Rotor and stator have been inspected
  - Rotor and stator has been washed and relacquered
  - Measurements show that motor components are in good condition
Slewing Bearing

- Slewing bearings have been inspected and refurbished
- Some slewing bearings have been found slightly corroded on rollers and raceways
- Bearing manufacturer’s judgement has been that most of the bearings can be reassembled with the old raceway components
- No evidence of water leakage was found that would indicate leak on the slewing seal
Slewing Gear And Seals

- Slewing gear teeth have been in good condition
- Slewing seals have been replaced by new ones even though the seals have been in good condition.
- There has been marks of normal wear and tear in slewing seal liner
Summary

- Maintenance interval is primarily driven by the shaft seal life
  - Number of improvements made to extend life time of the shaft seal
- There has been almost no wear observed in the slewing bearings
  - Only minor corrosion marks
- In the slewing seal liner there has only been minor grooves
  - Grooves are not affecting sealing performance
- The shaft-line bearings inspected have been in very good condition
  - No signs of premature wear or damage
  - Shaft-line bearing life is not seen as constraint in units that are operating mainly in DP mode
- Performance of permanent magnet motor has achieved expectations
Conclusion

- ABB Thrusters have provided for DD1 and DD2 the reliability and efficiency necessary in DP operations.
- ABB has re-estimated maintenance sequence of critical components that may face wear and tear during DP-operation (slewing bearings, slewing seals, thrust bearings, propeller bearings and shaft seals).
- Based on the well-documented operational and maintenance history, and the findings of the maintenance overhauls, a ten-year recommended maintenance interval for a podded thruster operated on a dynamically positioned vessel is certainly justified.