Thrusters

Health Monitoring of Propulsion and Steering Devices

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Condition based maintenance of Steerable Thrusters

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Wärtsilä Propulsion

Propulsion Products

Brand name LIPS
Health monitoring

- saving fuel consumption
- extend lifetime of components
- increase maintenance intervals
Design philosophy LIPS steerable thrusters

- Double supported pinion and gear wheels
- High quality forged steel gearwheels machined after hardening: Klingelnberg cyclo palloid HPG process
- Separate dedicated bearings for axial and radial loads
- Triple Viton lip type seals running on liners with ceramic coating
- Product range 900 kW – 7,000 kW
What can go wrong

- Seal damage: water content in lub oil reduces the life time of bearings and gears with 50%.
- Inadequate lubrication due to late filter / oil change
- Overloading of the thruster
- External impacts

Eventually this leads to early wear of gears and bearings
- Wear particles spread through the unit and affect other “healthy” components

THE HEALTH OF THE THRUSTER SLOWLY BUT STEADILY DETERIORATES
Results of malfunctions

- Unplanned maintenance / repairs
- Replacement parts
- Loss of redundancy (Class)
- Docking
Where to go

today               tomorrow                    future
alarms             monitoring                  diagnostics/
                   early detection of deteriorating components
                   • vibrations
                   • moisture
                   • particles

→
result: signals
• make trend line

• combine signals, remaining lifetime
• database
From alarming...

- temperature alarms
  - lubrication
  - steering

- pressure alarms
  - pumps
  - steering motors
  - filters

- level
  - gearboxes
  - header tanks

- Rely on expertise on board, Wärtsilä’s service
- Alarm: (too?) late, not source related
… to monitoring…

- Add sensors to system
  - Accelerometers
  - Moisture sensors
  - Particle detector

With signals:

- Detect early changes in behaviour
- Establish trend lines
• Accelerometers:
  ■ damage to race way / roller element
  ■ damage to gearing
  ■ vibration
  ■ determine frequencies → relation to damaged element
  ■ signal analyzing
Moisture sensor:
- Water affects gear and bearings
- Decrease of lifetime

Particle sensor:
- Detection wear bearings, gearing
- Cross reference to other sensors
Human interface

- Off-line monitoring
- Robust software
- Fit to purpose
- Easy to use
- Trend watching
Health monitoring

- local readout of individual signals
- health gears
- health bearings
… to (in future) diagnostic/prognostics…

- Use data from monitoring
- Add “belief” rules, expertise from practice
- Build neural network
- Self learning system
Health diagnostics system

- Signal Modulator
- Transmitter
- Electric Power Generation
- Receiver / Transmitter
- Receiver / Signal Demodulator

- Accelerometers near Roller Bearings
- Accelerometers near (Bevel) Gears
- Oil Moisture and Particle sensors
- Pitch actuating pressures

- Envelope Spectra
  - Roller Bearings
  - Gears
- Oil data processing
- Response identification

- Data Fusion & Decision Support

- GPS
- Pitch
- Azimuth
- RPM

- In rotating part
- Gear Box Section
- Stem Section
- Log-File

- Ship Network

- Oil Temp.
- Ambient Temp.
Conclusion

• Today: alarms
  ■ periodical maintenance / operating hours
  ■ alarms

  → actions too early / (too) late

• Tomorrow: monitoring:
  ■ early detection of deteriorating components
  ■ less unplanned dry-docking
  ■ decrease down time
  ■ decrease stock

  → less “surprises”, saving money

• Diagnostics/prognostics: in future