Protecting Magnetic Bearings from External Factors and Process Contaminations

(Case Study)

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Shah Deniz Magnetic Bearing Turboexpander – Compressor Units

• Shah Deniz is one of the largest turboexpander gas processing plants in the world (900MMSCFD pipeline dew point control).

• Several failures due to external factors / process contamination was affecting magnetic bearing sensors, hence the AMB control system.
• Each Turboexpander train is rated for 9 MW (12,000 HP)

• Expanding the process gas from 105 bar to 60 bar (1520 to 875 PSI)

• Glycol (MEG) is injected at turboexpander inlet to inhibit Hydrate formation
Turboexpander – Magnetic Bearings

- Thrust Bearings
- Radial Bearings
- Bearing Sensors
Turboexpander – Magnetic Bearing Rotor

- Sensor Laminations
- Bearing Laminations
- Labyrinth Seal
- Magnetic Thrust Disk
- Aux. Brg. Landing Sleeve
Potential Turboexpander Issues with Hydrates:

- Blockage of inlet screen – possibility of collapsing
- Freezing of IGV segments – loss of process control
- Rotor Unbalance – high radial vibration
- Blockage of discharge piping – reducing turbo expander $\Delta p$
- Blockage of wheel axial balancing ports – high axial load
- Ice particle impingement – erosion of wheel and IGVs
Original Sealing System:
Labyrinth Seal Porting for Marginal Seal Gas Pressure:
Operation History:

- There are two Turboexpander/Compressor trains
- Production loss $0.5 million per day
- First failure, a few months after commissioning
RFCA – Process Issues:

- During certain upset conditions, process trips & sales compressor trips, the seal gas differential pressure was not available.
- Turboexpander discharge pressure would rise from 69 bar (1000 PSI) to above 85 bar (1230 PSI).
- Seal gas supply pressure was set at 80 bar (1160 PSI)
MEG Ingress to Bearing Housing During Process Upset
Polar Liquid Affecting AMB Sensors, Hence Loss of Bearing Control
Damaged Rotor / Bearing System
MEG Ingress to Compressor Casing
Modification of the Sealing System
Summary of Modifications:

- Shaft Seal vent routing
- Installation of a dump valve to reduce the shaft seal vent port pressure
- Seal Gas header pressure was raised to Max. allowed by the process (85 bar ~ 1230 PSI)
- Change of control logic, quickly opening to avoid sudden back pressure on the seal
- Controller was tuned for faster action
Conclusions:

- Magnetic bearings should be protected from process contamination such as MEG, wet H2S, Mercury, etc.

- Effective counter measure for protection against ingress of contaminant shall be provided.

- All up-set conditions shall be checked during initial process simulation and results considered during system design.
Questions?

Thank you for your interest and attendance!