Unique Short Term and Subsequent Long Term Solution to Rotordynamic Stability Problem

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Problem Statement & Background

- High vibration levels occurring during periods of operation when suction gas temperatures exceeded 90F on a H2 Recycle Compressor installed at Frontier Refinery’s El Dorado, KS refinery.
  - Vibration was observed to be sub synchronous in nature ~ .47x
  - Overall vibration levels approached 3.0 mils p-p during these time
  - Problem became readily apparent approximately 2 years after initial start up of new compressor internals
Data Trending
Data Trending

Note High 1800 RPM Amplitude & Sub-Synchronous Presence. Cursor on 1X

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Data Trending

Note High 1800 RPM Amplitude & Sub-Synchronous Dominance and 2X. Cursor on 1X
Short Term Solution

Water Delivery System

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2005 Frontier Field Data - Water on Casing

Water Off  Water On

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20 to 30 deg F change in casing temperature

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Analysis

Fishbone Diagram

Remaining Potentials:
Bearing – Seals / Alignment (Soft foot – Foundation Factors)
Long Term Solution

New Tilt-Pad Bearing Design with Spherical Pad Seat

Reworked Floating Seal Ring to add Relief Groove

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Results

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Results – Bearing Cap Readings

**Summer 2005**

**Summer 2006**
Results – Bearing Cap Readings

Summer 2005

Summer 2006

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Results – 2007 Motor Change Out

Bearing Cap Readings

Shaft Proximity Probe Readings

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Conclusions

- **Water Cooling System Controlled Thermal Growth of Compressor Centerline**
  - Bearing Dam Bearing effected

- **Spherical Seated Tilt-Pad Bearing**
  - Increased Damping
  - Accommodating to Alignment Impact of High Ambient Temperatures

- **Grooved Oil Seal Ring**
  - Increased Stability via Reduction of Cross Coupling Forces

- **2006 & 2007 Operation has Low Overall Vibration Levels**

- **Long Term Effects of External Water Cooling not Studied**