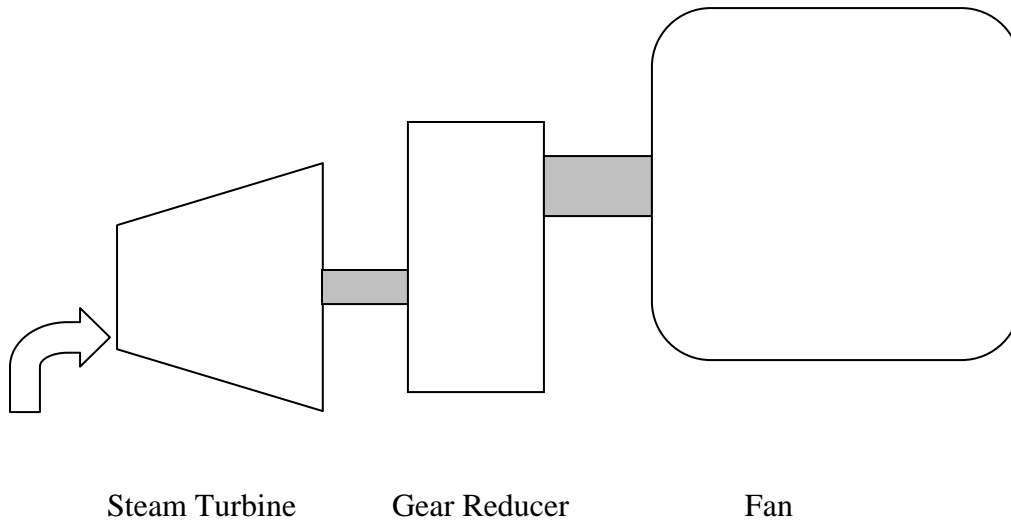


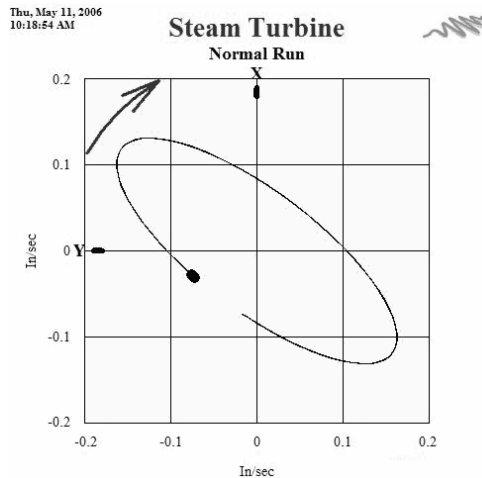
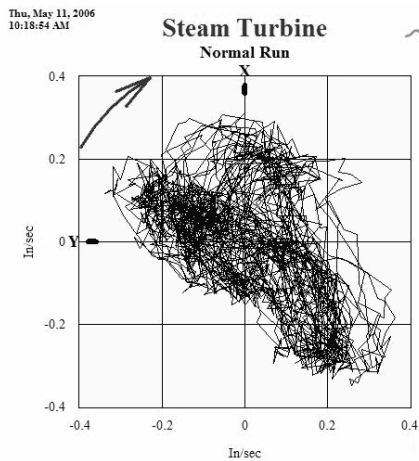
Case History
Cocked/Misaligned Sleeve Bearing
Ray Kelm, P.E. Category IV
Kelm Engineering
ray@kelmengineering.com

Introduction: A steam turbine in a paper mill was recently overhauled. The turbine drives a forced draft fan for a boiler. After overhaul, the turbine was found to have high vibration on both ends of the turbine, with amplitudes of about 0.2 - 0.3 in/sec overall operating between 4600 and 5600 RPM. Maximum speed for the turbine is 5650 RPM. The layout is shown below:



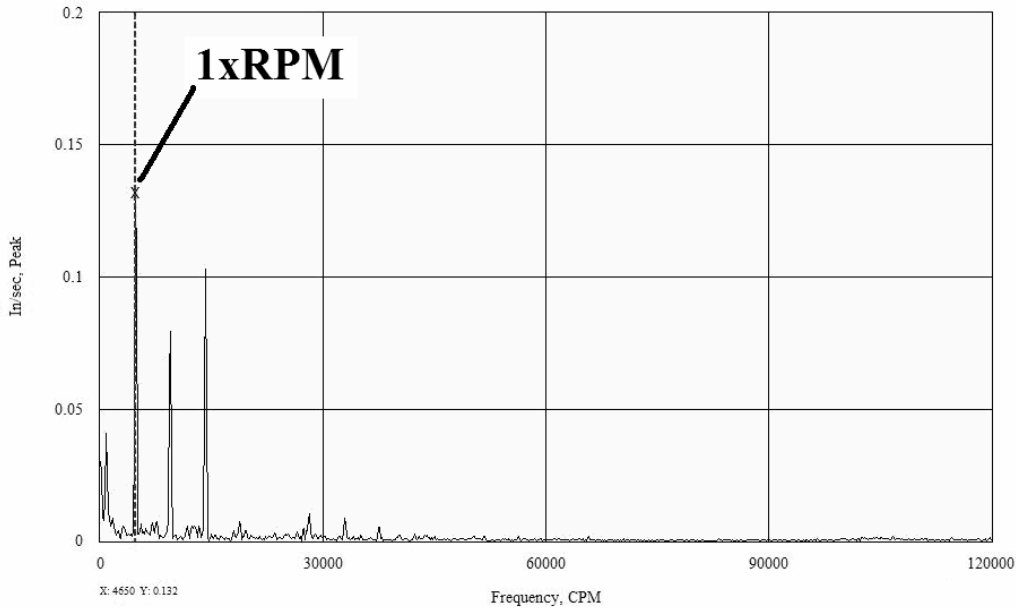
The steam inlet and thrust bearing are located on the outboard end of the turbine.

Measured Data: Accelerometers were mounted in the vertical, horizontal and axial positions on each of the bearing housings when this data was captured, with the signals integrated to velocity. The vibration on the turbine outboard was found to have predominant vibration at 1xRPM, with harmonics of running speed as shown in the attached FFT plots. The same data was displayed as raw orbits and orbits filtered at 1xRPM.



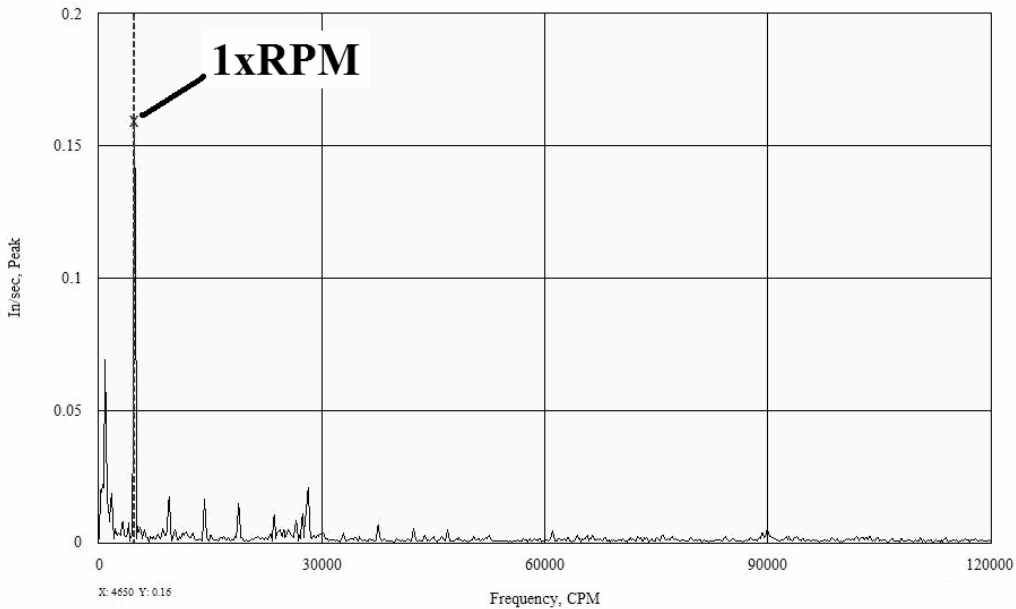
Thu, May 11, 2006
10:18:54 AM

Steam Turbine Normal Run



Thu, May 11, 2006
10:18:54 AM

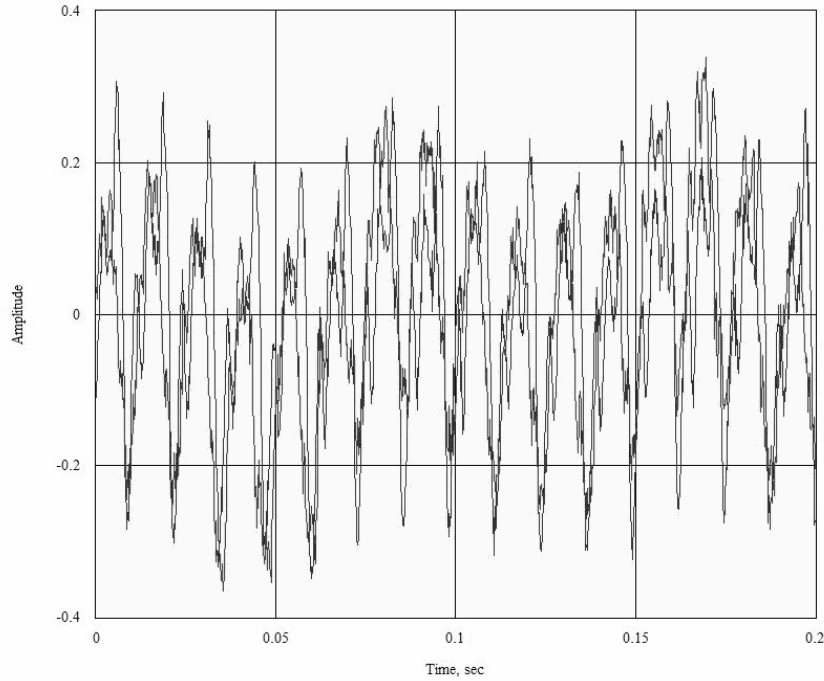
Steam Turbine Normal Run



Analysis: The data indicated that the vertical and horizontal readings were pretty much in phase, with indications of a “preloaded” orbit that is typical of restricted motion in one direction.. This along with the presence of harmonic vibration 2x, 3x, 4x, etc. suggested that the outboard bearing liner may be cocked or not parallel with the journal. The drive end bearing also showed about 0.2 in/sec, with the vibration primarily at 1xRPM, but with the vertical and horizontal about 90° different phase.

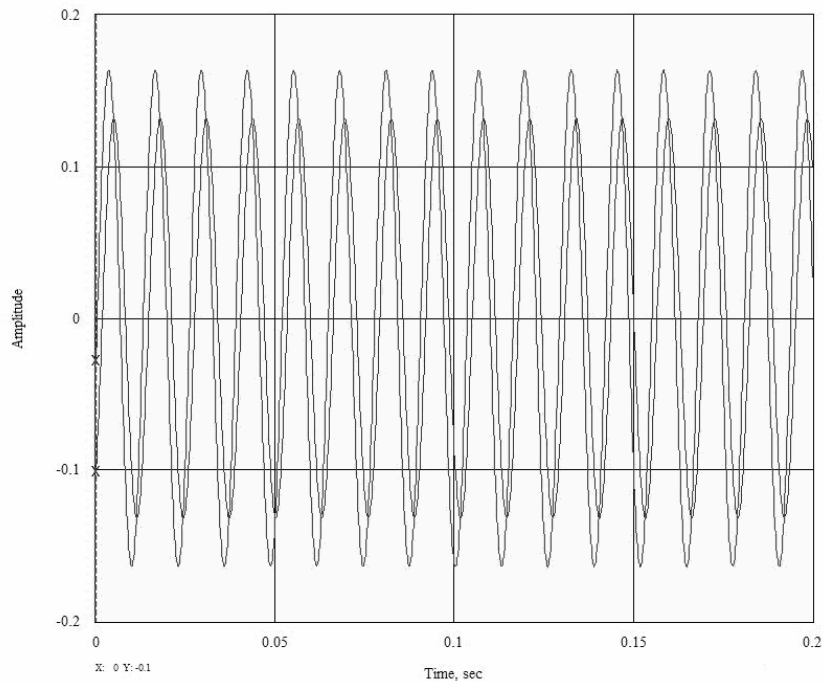
Thu, May 11, 2006
10:18:54 AM

Steam Turbine Normal Run



Thu, May 11, 2006
10:18:54 AM

Steam Turbine Normal Run



Findings: Conversation with the mechanical contacts in the plant indicated that they had a lot of trouble installing and aligning the outboard bearing to the journal. Their comments strongly supported the likelihood that the bearing liner was not properly aligned to the journal.