GT#12
Oil Whip Induced By Misalignment
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Gas Turbine Configuration

BRG1

BRG2

Parameters:
- 39VS-102 BR04 X: 1.08 mil pp
- 39VS-92 BR03 X: 2.19 mil pp
- 39VS-91 BR03 Y: 5.98 mil pp
- 39VS-11 BR01 X: 1.21 mil pp
- 39VS-21 BR02 X: 0.87 mil pp
- 39VS-22 BR02 Y: 0.04 mil pp

Additional Details:
- 77RF-11 Keyphaser: 3001 rpm
- 98VC-11 Thrust: -5.8 mil
The Case Overview

- The Generator DE bearing has shown an increase in the vibration trend which triggered the alarm.
- The Direct Vibration readings exceeded 17 mils which is above the Trip alarm for this machine.
- All The Vibration was subsynch vibration at 0.275X.
1. During Startup or Shutdown, this subsynch vibration used to appear and disappear suddenly at 2700 RPM.

2. The Bode Plot has shown that 825 CPM is the 1\textsuperscript{st} Fn of the generator.

3. The orbit has shown multiple key phasor markers which were moving around the orbit. This indicates that the peak isn’t an integer submultiple to 1X.

4. Orbit precession is forward.

5. The 1X vibration didn’t appear at all during Startup or cost down.

6. The SCL has indicated a shift to the center of the bearing.

7. Vibration has a direct relation to oil Temp
The Orbit Was Elliptical not circular since it is a lemon bore bearing. The KeyPhasor marks were moving in the live mode.
The peak at 825 used to appear and disappear suddenly during Run-up or Cost Down.
The Analysis
**Subsynch Vibration can occur Due to one of the following:**

1. Bearing Babit damage.
2. Bearing Loose in Housing
3. Rubbing
4. Oil Instabilities (Whip or Whirl)
5. Process instabilities (Surge, Stall) *Not applicable here.*
Looseness And Rubbing Were Ruled Out Due to the Following Reasons:

1. Rub & Looseness excite sub-integer multiple of 1X like 0.5X or 0.3X. In this case the component was at .275X with is a non integer submultiple of 1X.

2. The first point was further confirmed from the keyphasor markers on the orbit. Looseness and rub cause a fixed marker location while in this case they were traveling around the orbit.

3. The Resonance location didn’t change which again rule out rub and looseness.

4. In the cases of rub and looseness the 1X amp gets effected. In this case, the 1X wasn’t effected at all during the different operating conditions.

5. In looseness, during Rundown, the subsynch peak trace 1X and then disappear and 1X dominates. This didn’t happen in this case.

6. The SCL Plot doesn’t indicate a rub condition or looseness.
It is Oil Whip due to the following:

1. Oil Whip causes a non integer submultiple of 1X.
2. Disappear and appear suddenly during SU & SD.
3. Doesn’t trace 1X during Shutdown.
4. Doesn’t Change the location of the resonance (no change in the stiffness).
5. Causes a forward precession orbit.
6. Increases system nonlinearities and therefore some multiples appear in the spectrum.
7. The SCL Plot indicated that the event occurred while the shaft was moving toward the center of the bearing.
8. The Whip Was further confirmed when changes in the oil Temp resulted in changes in the vibration and strong correlation was found. This is shown in next slide
OIL Temp Vs Vibration
The Causes of the Oil Whip

- Bearing Looseness in the housing.
- Bearing Over Clearance.
- Improper preload.
- Changes in the oil condition and its properties.
- Some Changes in the Oil Pressure or the Flow.
- Misalignment.
Oil Properties were tested by analyzing the Oil Condition and no abnormalities were found.

The Oil Pressure and Flow were found normal.

The Oil Temp changes had a strong correlation with the vibration changes.

The Alignment was tested and a Sever Misalignment was found.
THE ALIGNMENT REPORTS FROM GE INDICATED SEVERE MISALIGNMENT AS SHOWN IN THE FOLLOWING SLIDES
The Generator was lower than the turbine by 77 mills while it should be higher than the turbine by 9 mills.
Vibration Trends After Alignment
SCL After Alignment
Vibration Spectrum After Alignment