ASIA TURBOMACHINERY & PUMP SYMPOSIUM
SINGAPORE | 22 – 25 FEBRUARY 2016
MARINA BAY SANDS

TEES
TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M UNIVERSITY

Case Study on remote diagnostics in resolving random vibration on a steam turbine

Sankar Ganesh – GE

Muhammad Zeeshan Iqbal – GE

Presenter/Author Bios

Sankar Ganesh:

Sankar is the Lead Engineer for GE Bently Nevada Machinery Diagnostics Services for Qatar and Kuwait.

He received a Bachelor of Mechanical Engineering from Bharathidasan University, India, in 1993.

Over 20 years experience in vibration field and 9 years with GE Bently Nevada, including rotating equipment balancing, vibration analysis, diagnostics and root cause analysis. Published case studies in METS and Turbomachinery symposium.

Muhammad Zeeshan Iqbal:

Zeeshan is Remote Monitoring Engineer for GE Bently Nevada in the Middle East and Africa.

Zeeshan holds a Bachelor of Mechanical Engineering from NED University of Engineering & Technology.

Over 10 years of field experience in condition monitoring, including vibration analysis, infrared thermography and oil analysis. Monitoring machines that are hundreds of miles away, Zeeshan's key objective is to support customers with proactive monitoring to maintain high machinery availability.

Abstract

This case study narrates an incident of random vibration spikes which occurred in year 2014 on one of the steam turbine bearings of a propane refrigeration compressor train. The random vibration spikes caused the turbine high vibration to trip leading to a train shutdown. This case study outlines how the random vibration spikes were successfully diagnosed through remote monitoring center, the root cause for the high vibration trips, and finally how it was mitigated. The case study also discusses lessons learned with respect to the discovery methodology using expert system available at site, and the importance of monitoring key operating parameters.

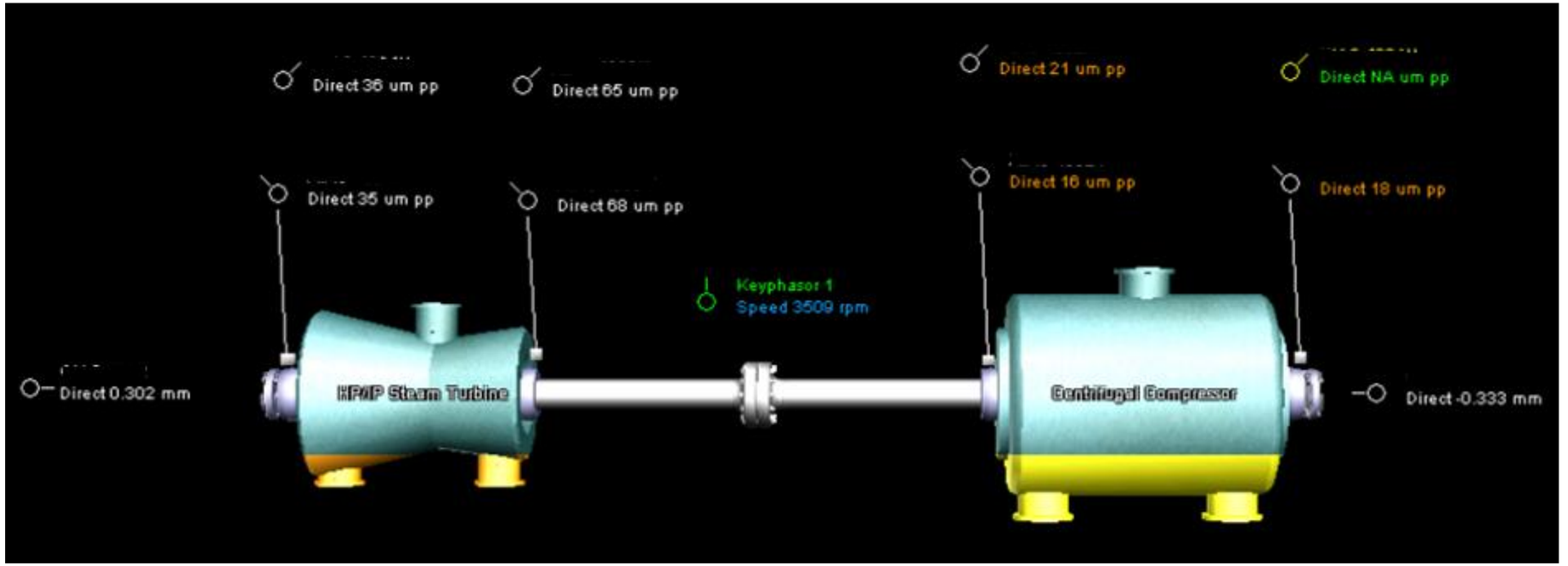
Contents

- Background
- Machine description
- Data analysis
- Initial analysis & recommendations
- Machine inspection results
- Subsequent failure analysis & conclusions
- Results after maintenance
- Lessons learned

Background

- Steam Turbine Driven Propane Refrigeration compressor
  - Only one machine per train
  - Machine upset will bring down the train production
- Random vibration excursions for two months on Steam turbine Non Drive End Bearing
- Tripped 7 times due to Intermittent high vibration spikes
- Plant vulnerable to production loss
- Customer approached Remote Monitoring Center for analysis and recommendations

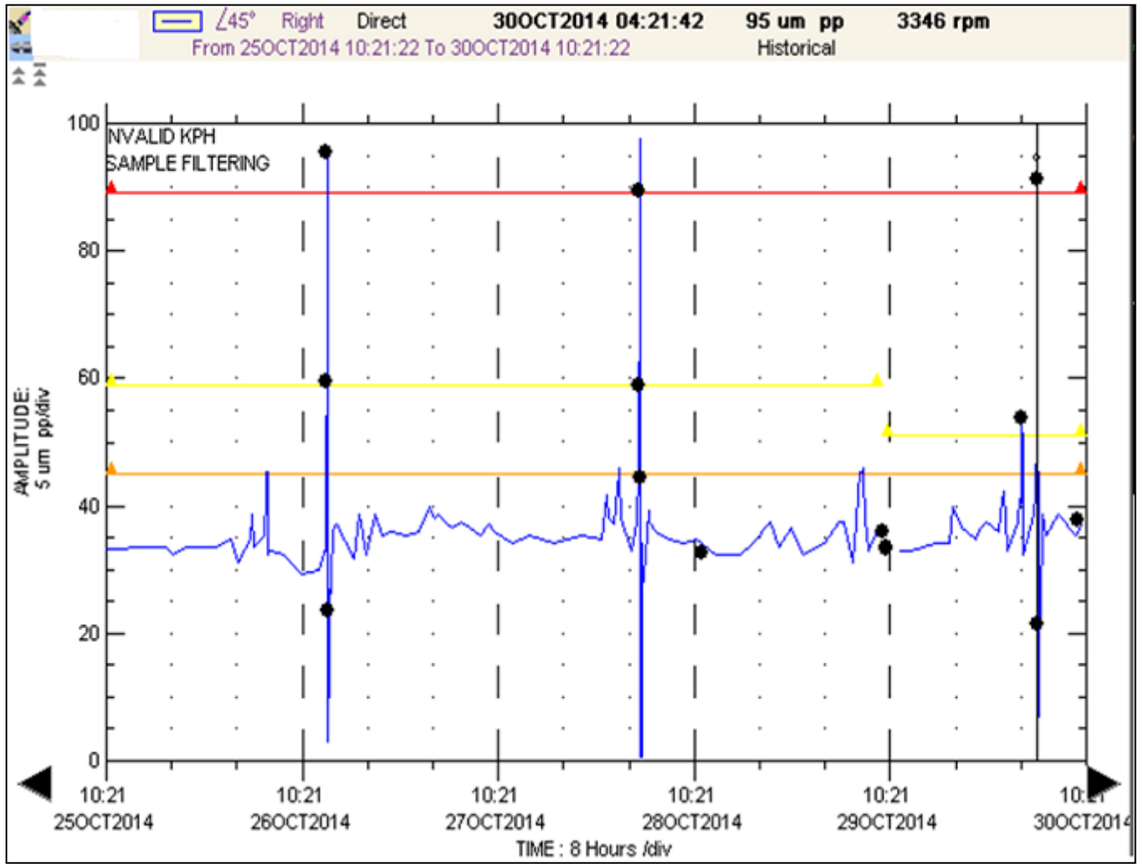
Machine Description



Turbine Type	Condensing Type Impulse Reaction (11 stages)
Turbine Rating	35341 HP
Speed	3850 RPM
Calculated critical Speed	2100 RPM
Coupling	Turbo Tooth Coupling

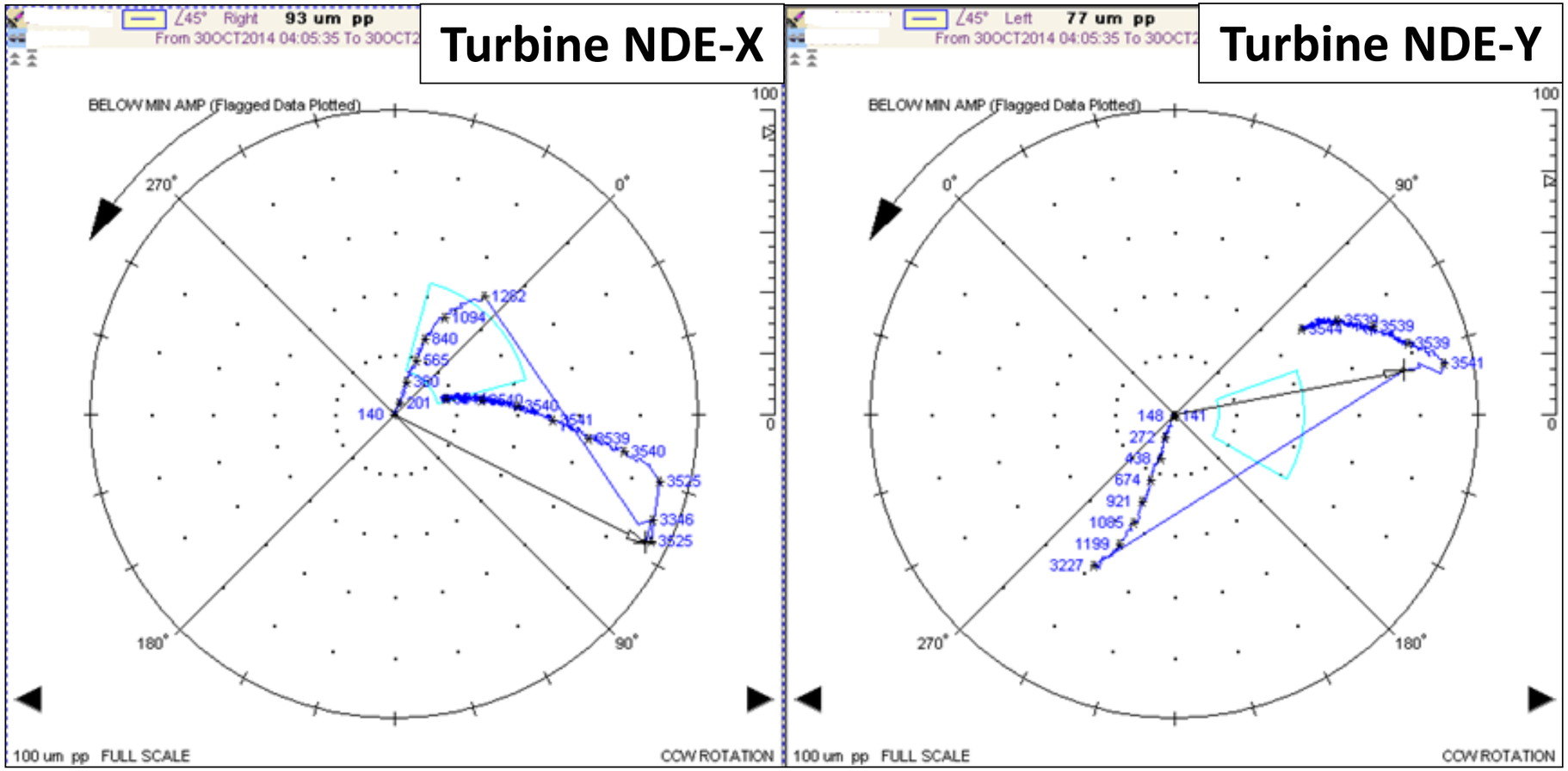
Data Analysis

- Direct Vibration trend shows random vibration excursion at ST NDE bearing
- Sudden increase in vibration crossing the alarm and trip values
- No correlation with the process parameters
- Direct vibration at ST DE bearing has little effect



Data Analysis

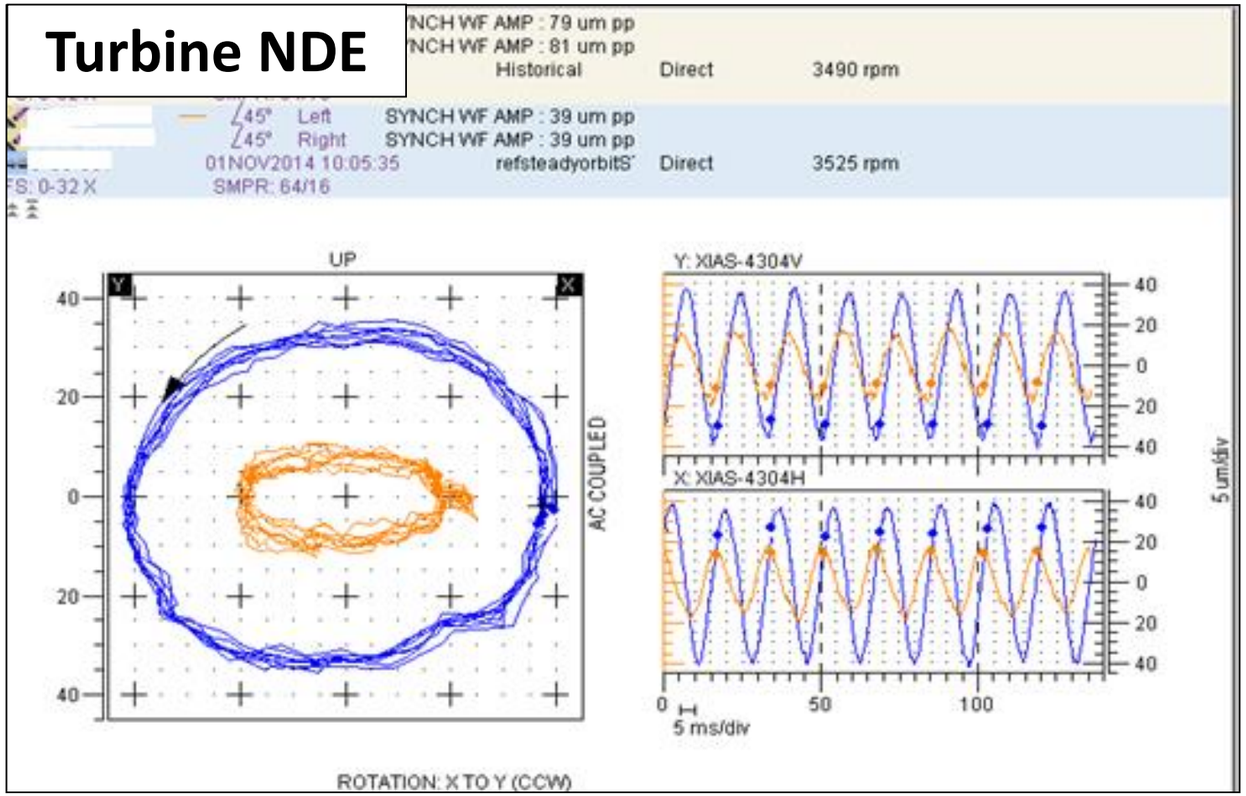
Polar Plot showing 1X Amplitude & Phase Angle



Abnormal behavior - significant phase angle change during vibration increase

Data Analysis

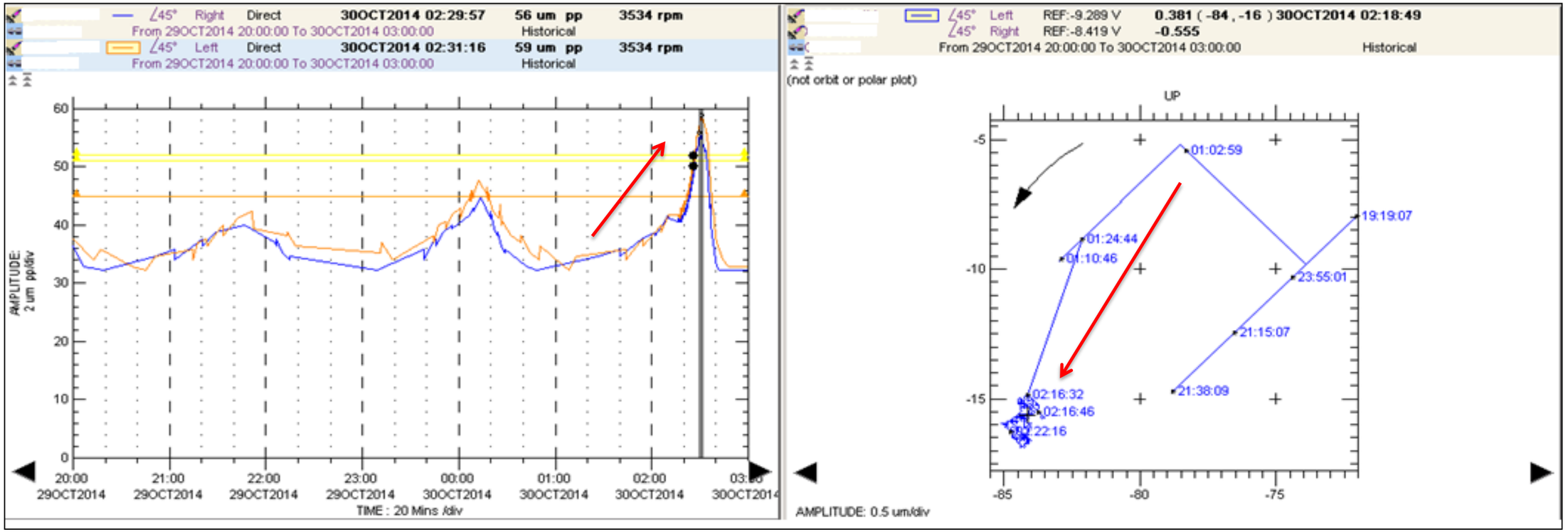
Direct Orbit Overlay – comparison of low and high vibration modes



Significant change in the orbit shape and amplitude due to change in balance condition due to thermal bow.

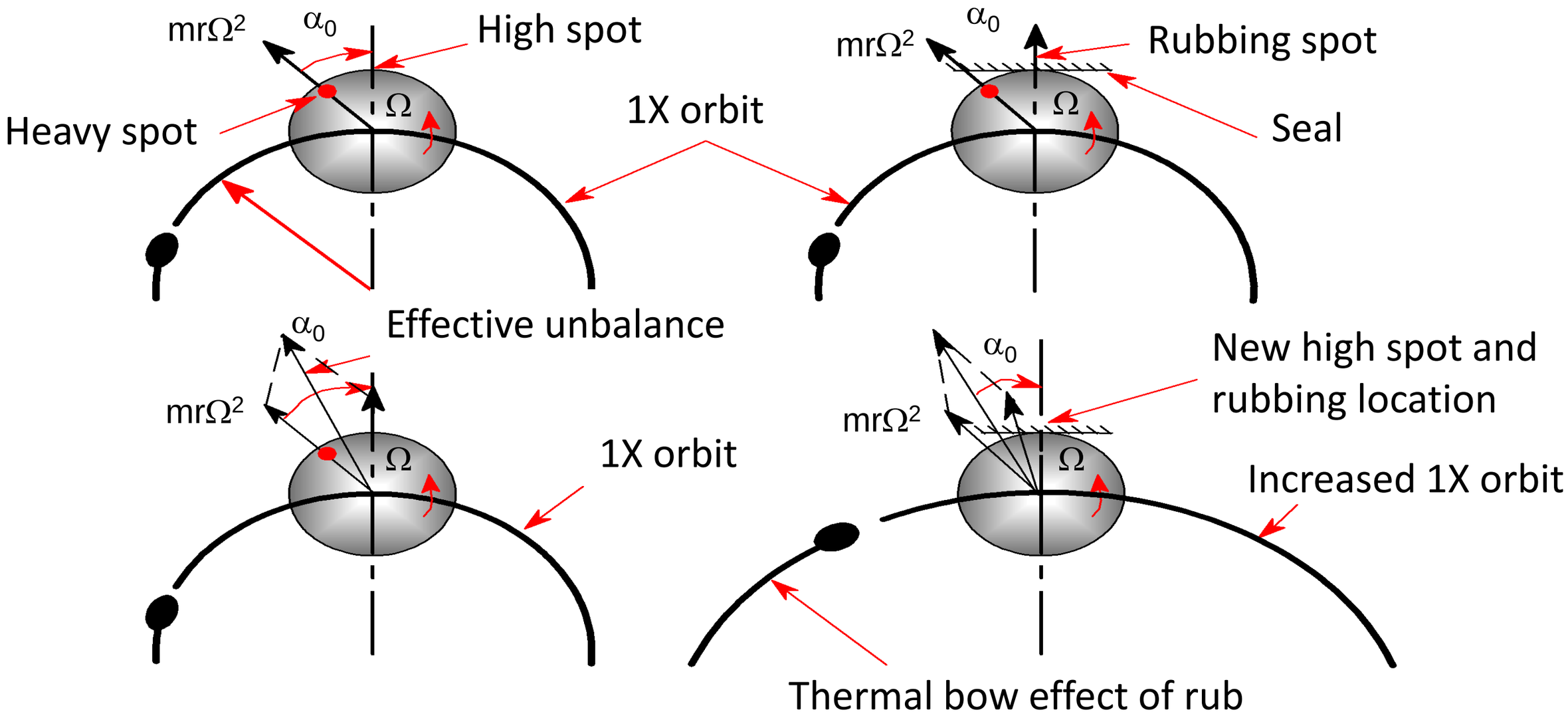
Data Analysis

Trend versus Shaft Centerline



Minor change in shaft centerline noticed with the vibration increase

Data Analysis



Initial Analysis and Recommendation

- Remote Monitoring engineer concluded the rubbing issue is most likely due to ***carbonized oil buildup in the oil deflector and seal area based on the past experience with similar machines.***
- Recommended Action Items:

  Inspect oil/steam seal areas for rubbing marks due to deposit built-up of carbonized oil.

Machine Inspection Results

ST Non Drive End Bearing

Carbonized deposits at NDE seal area

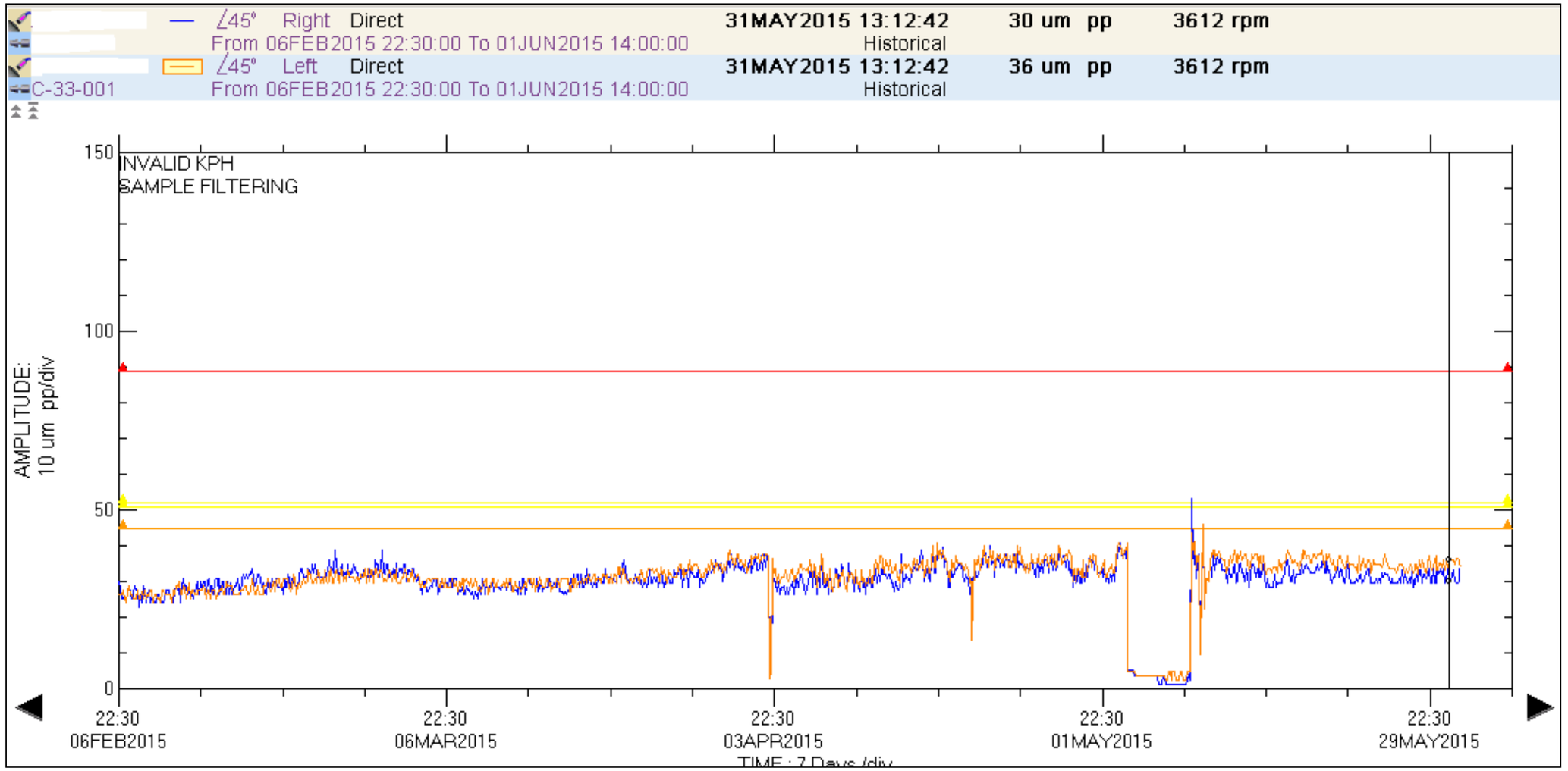
Rubbing Marks on the shaft

Rubbing marks at the seal area and oil carbonization was found.

Subsequent Failure Analysis and Conclusions

- Further analysis at site revealed that the gland condenser was not in service for the past two months.
- Absence of gland condenser introduced steam leakage near the bearing which led to the formation of oil carbonization.
- Gland condenser was put back in service after the cleaning of oil carbonization deposits.

Results after maintenance



No vibration excursions after the maintenance (Trend stable)

Lessons Learned

- ✓ **Reduced Maintenance Cost and Down Time**
  - Quick analysis using the expert system remotely.
  - Accurate analysis by experts helped reduce maintenance down time (Unnecessary trouble shooting with the machine internals avoided).
  - Presence of online diagnostic system helped to plan machine shutdown for maintenance with minimal impact on the production.
- ✓ **Operational issues**
  - Absence of gland condenser in service

Thank You…

Questions??