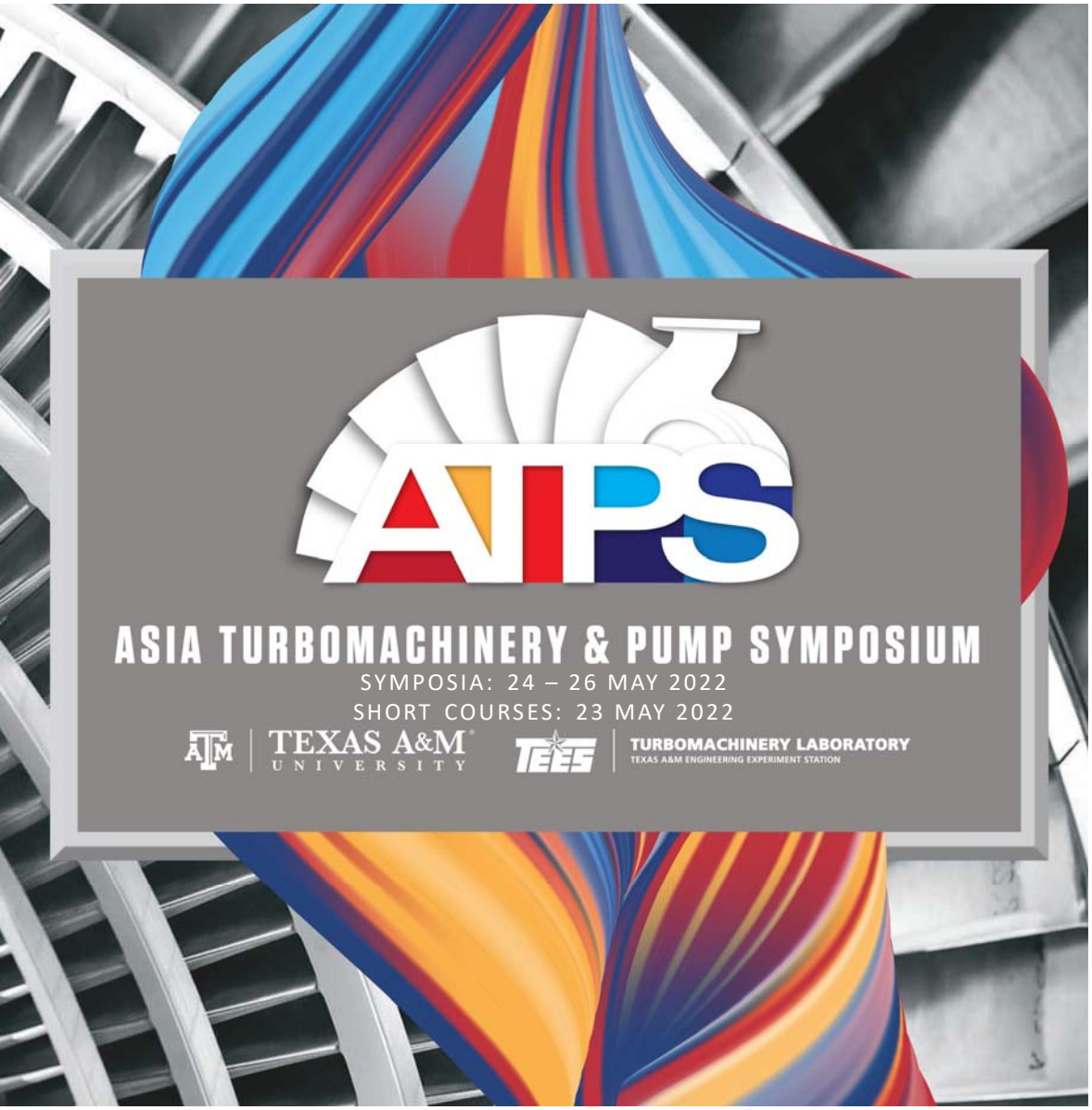

ELECTROSTATIC DISCHARGE- STG COMPRESSOR

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ABSTRACT

Electrostatic discharge (ESD) can cause catastrophic mechanical damage and lower the life span of an asset if not detected early and rectified. Continuous discharge of static electricity can cause micro pitting of bearing or shaft surface leading to material loss and eventual failure.

This presentation outlines a success story where an ESD malfunction was detected on turbine compressor and subsequent diagnosis lead to prevention of asset failures. Changes in shaft centerline plots/DC gap trends and raises in bearing metal temperature were some of typical symptoms of ESD along with spiking pattern in orbit plots. These malfunctions and subsequent diagnosis to prevent failures and solution to resolve the issue are discussed in this presentation.

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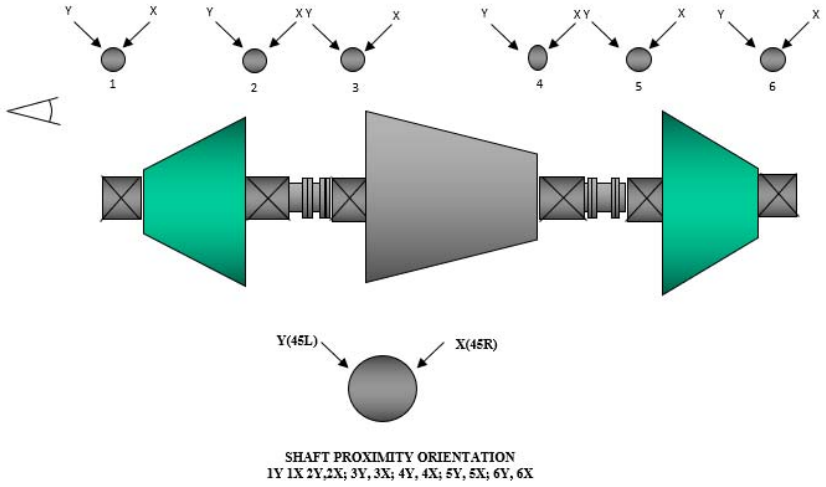
INTRODUCTION

- Ammonia plant located in a remote area.
- The unit consists of LP and HP compressors driven by a steam turbine which is of Extraction cum condensing type. with a speed of ~ 10700 rpm.
- All bearings are hydrodynamic, and the shaft vibration is monitored by X and Y proximity probes.
- Highly critical plant asset with continuous operation.



SHAFT PROXIMITY ORIENTATION
1Y 1X 2Y,2X; 3Y, 3X; 4Y, 4X; 5Y, 5X; 6Y, 6X

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WHAT IS AN ESD ?

Due to mechanical and electrical properties of asset components like friction due to flow, tight tolerances, conductive/insulating properties, electric charges are developed on the surface. This has to be managed by the presence of dedicated grounding brushes to dissipate the charges to the ground, otherwise the charges will seek an alternate path generally through the bearing or the seal.
These discharges could erode metal surfaces and if left undetected could potentially damage the shaft/bearing, resulting in an unplanned outage causing production/financial losses.

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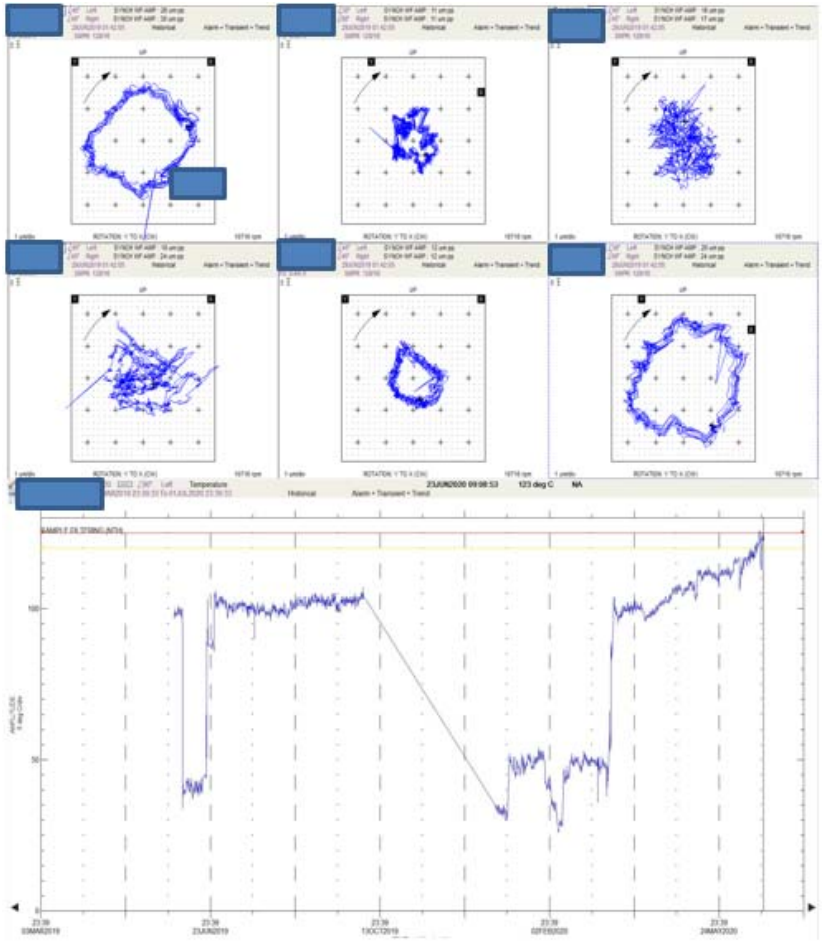
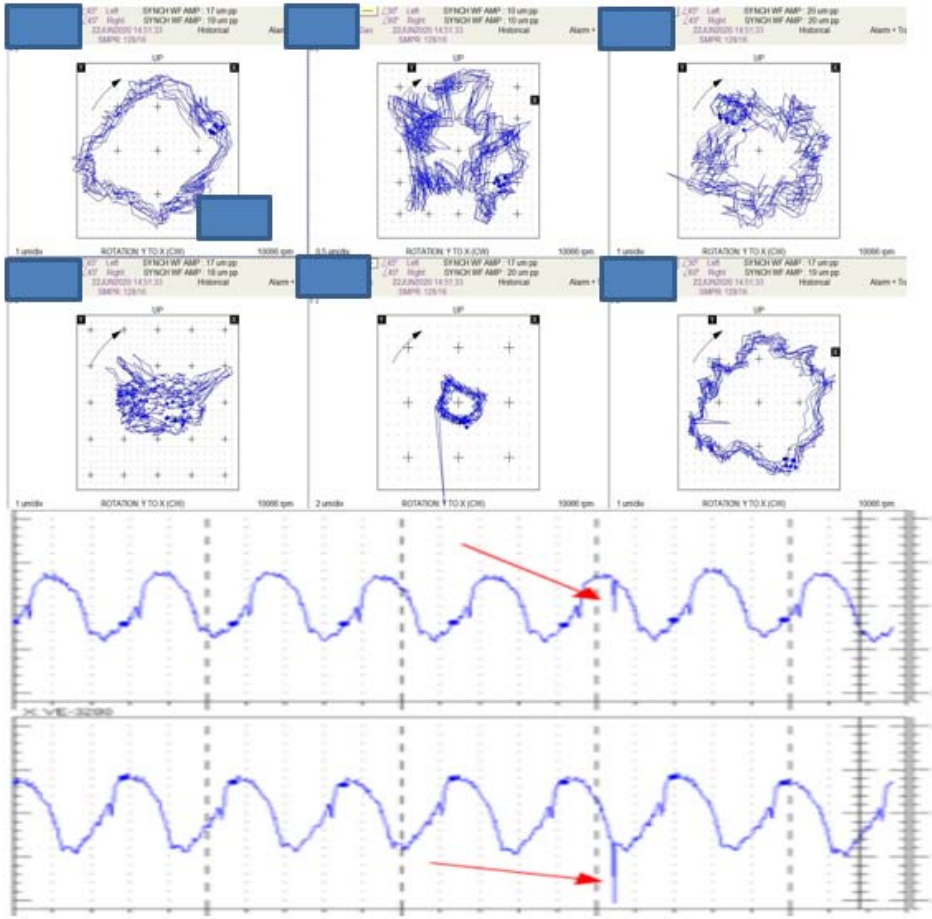
PROBLEM STATEMENT

- High intense spiking pattern noticed in orbit plots for all the bearings in 2019.
- ESD was diagnosed, with recommendations to check/replace brushes and to monitor DC gap trends.
- After one year in 2020, there was noticeable increases in bearing metal temperature at turbine LP side from 100 deg C to 120 deg C



DATA REVIEW

- High intense spiking pattern was still noticed in orbit plots at some bearings even after change of brushes. But it was not as intense as it was in 2019.
- Time waveform plots also showed the corresponding spiks at X and Y probe at the same time.



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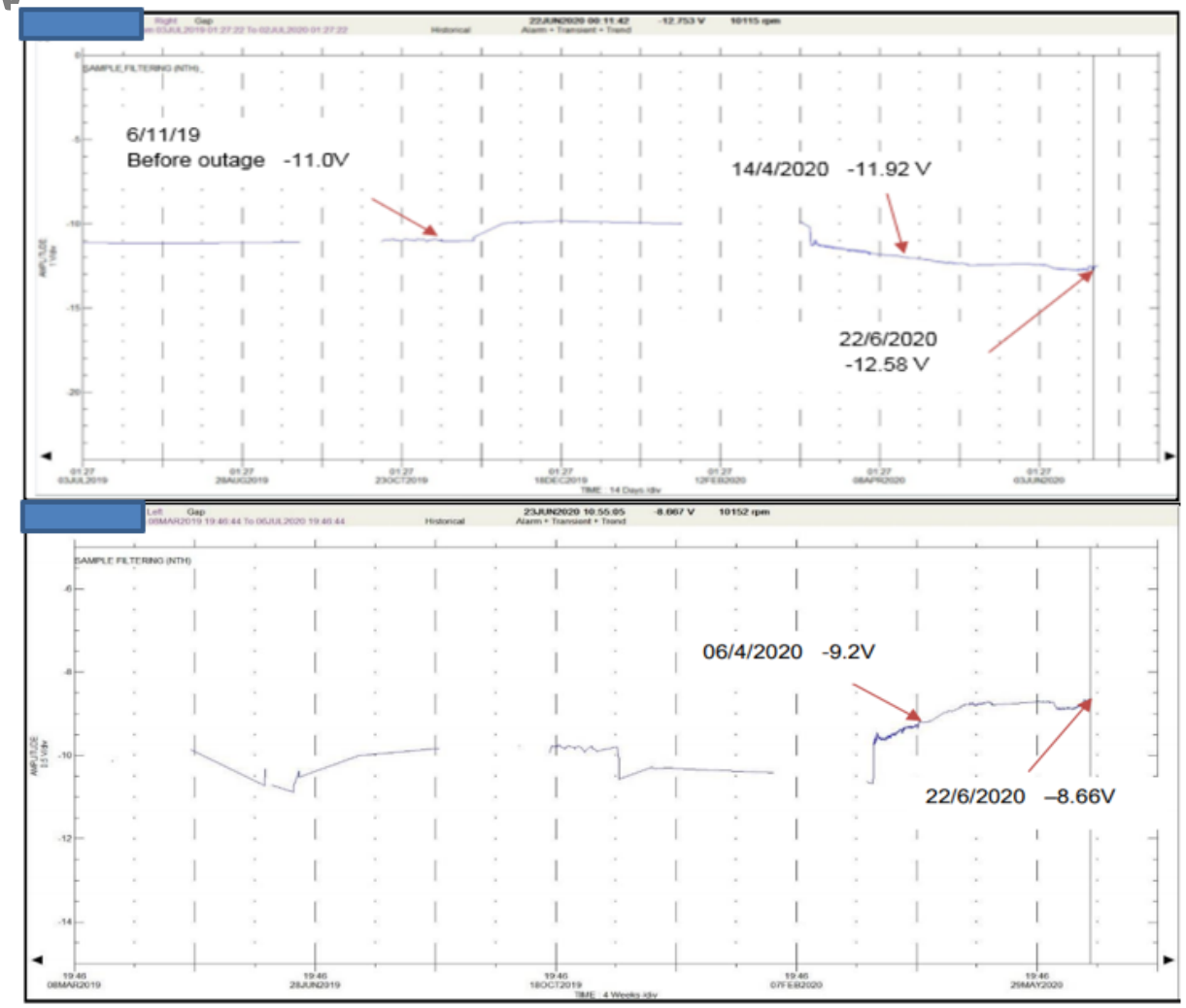
DATA REVIEW

- DC gap trend appeared to shift at turbine LP side over two-month period.
- Deviation was around 1.5 volts which is around 190 microns (200mv/mil) shift, which is substantial.



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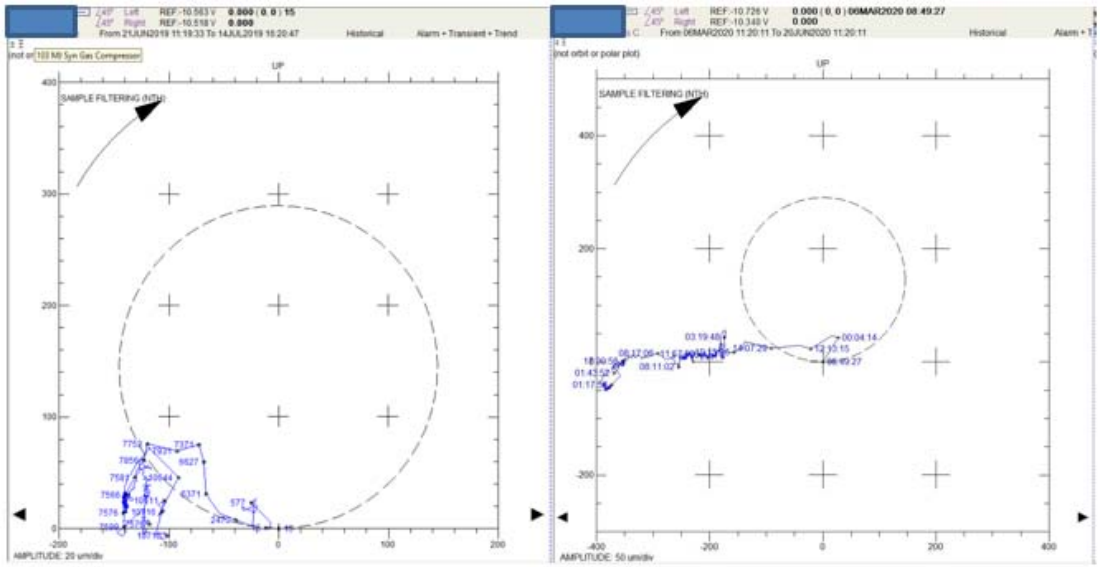
DATA REVIEW

Shaft centerline (SCL) plots also showed substantial shift in position when compared with data from 2019 and 2020
It is also important to remember that SCL plots would also be influenced by thermal growth of the sensors and the bearings.



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CONCLUSIONS

- Can it be a scratch in the shaft ?

  Unlikely, because in time waveform we could see spike at both X and Y probe happening at the same time and not with a 90 deg delay.
- Can it be faulty sensors ?

  Definitely not, as readings are reliable.
- Can there be a rub ?

  Quite possible, change in shaft centreline plot shows significant shift indicating shaft breaching bearing clearance and possible loss of material
- Electrostatic Discharge?

  Very likely. Random spikes in orbit plots, significant deviations in DC gap trends along with increases in bearing metal temperature show possible bearing damages due to ESD leading to material loss

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RECOMMENDATIONS

- Bearing inspection to be carried out immediately.
- Check grounding brushes and to replace if found damaged
- Conduct oil analysis.
- Inspect all other bearings at next available opportunity

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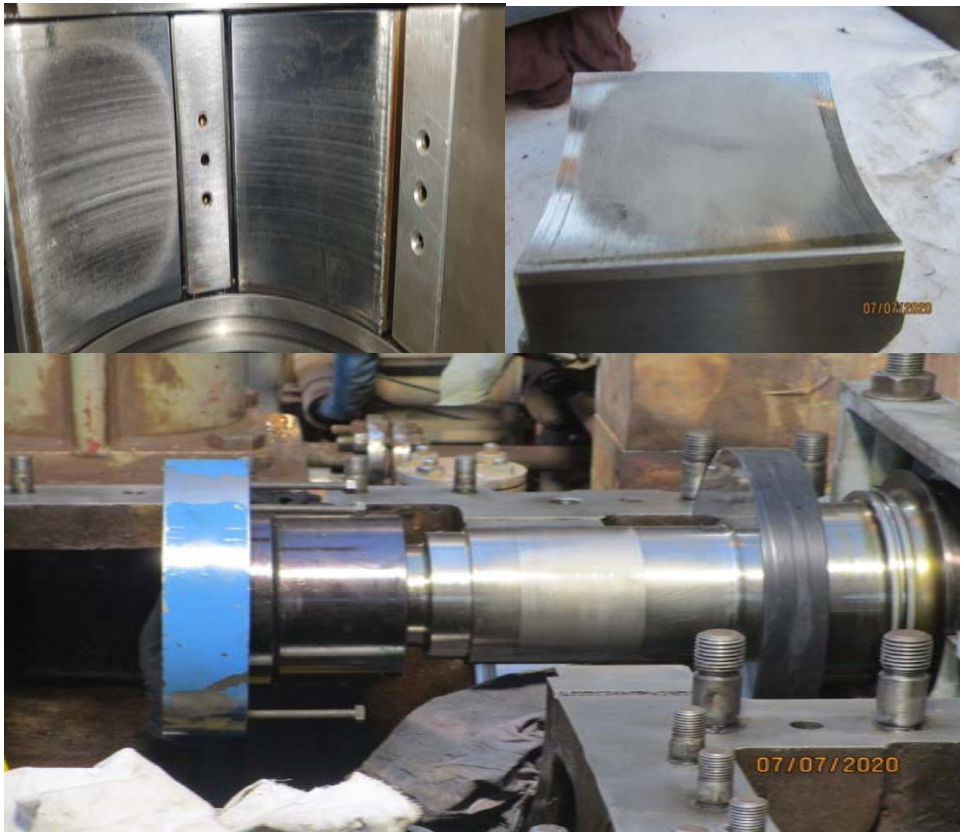
FINDINGS

- Frosting effect was noticed in the shaft journal area which is typical on ESD affected machines.
- Similar effect was also noticed on bearings.
- Brush spring mechanism was found to have failed causing ineffective contact.
- Post replacement of brush mechanism and demagnetizing bearing surrounding, ESD issue was resolved



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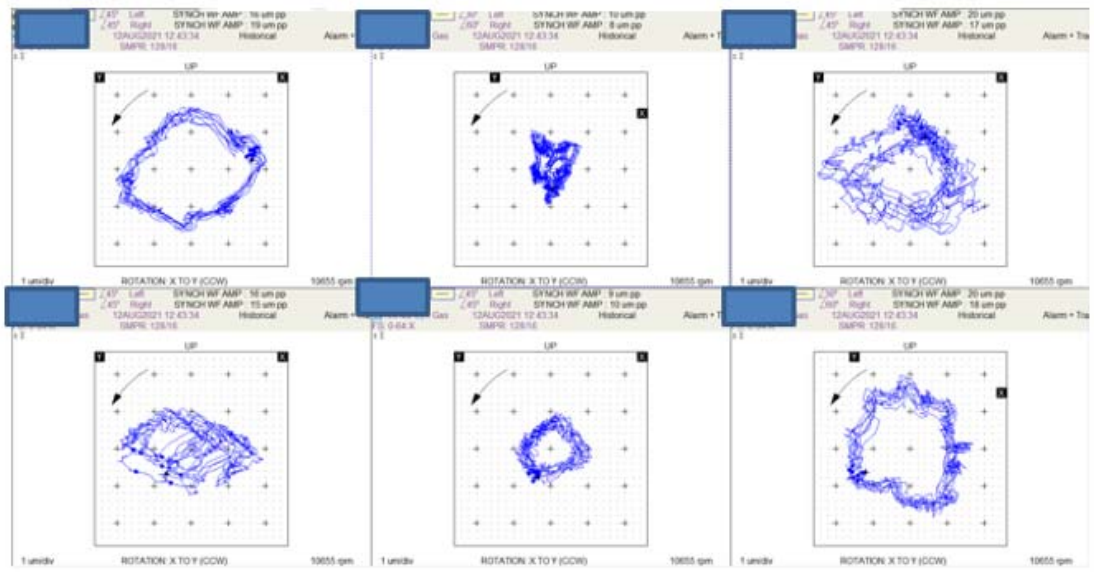
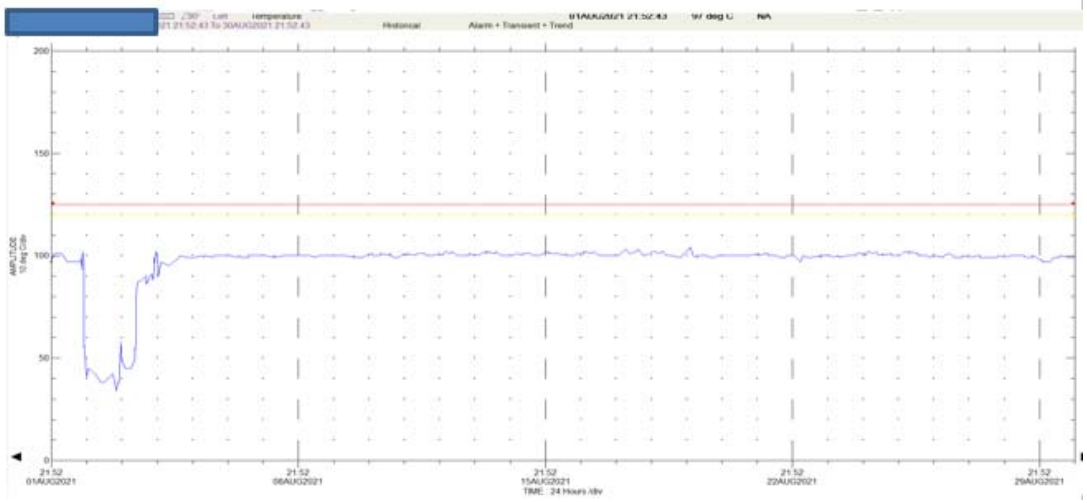
FINDINGS

- Post repair ESD spikes were not evident in any of the bearings
- Temperature levels also came back to the normal operating levels





LEARNINGS

- Steam turbines are more prone to build up static discharges due to droplets of water.
- It is important to inspect grounding brushes routinely to check for good contact, Improper contact can result in ESD through oil film, thus causing pitting of the bearing material that eventually leads to bearing failure.
- When suspected of an ESD issue it is always best practice to monitor DC gap trends and set up an alarm.
- Monitoring shaft centerline plots will also help to determine the level of bearing material erosion.
- An ESD issue, if left unattended for a significant amount of time can lead to catastrophic machine damage.

QUESTIONS ?

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