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VSD Motor Intermittent Vibrations Excursions

TEXAS A&M UNIVERSITY
TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Authors

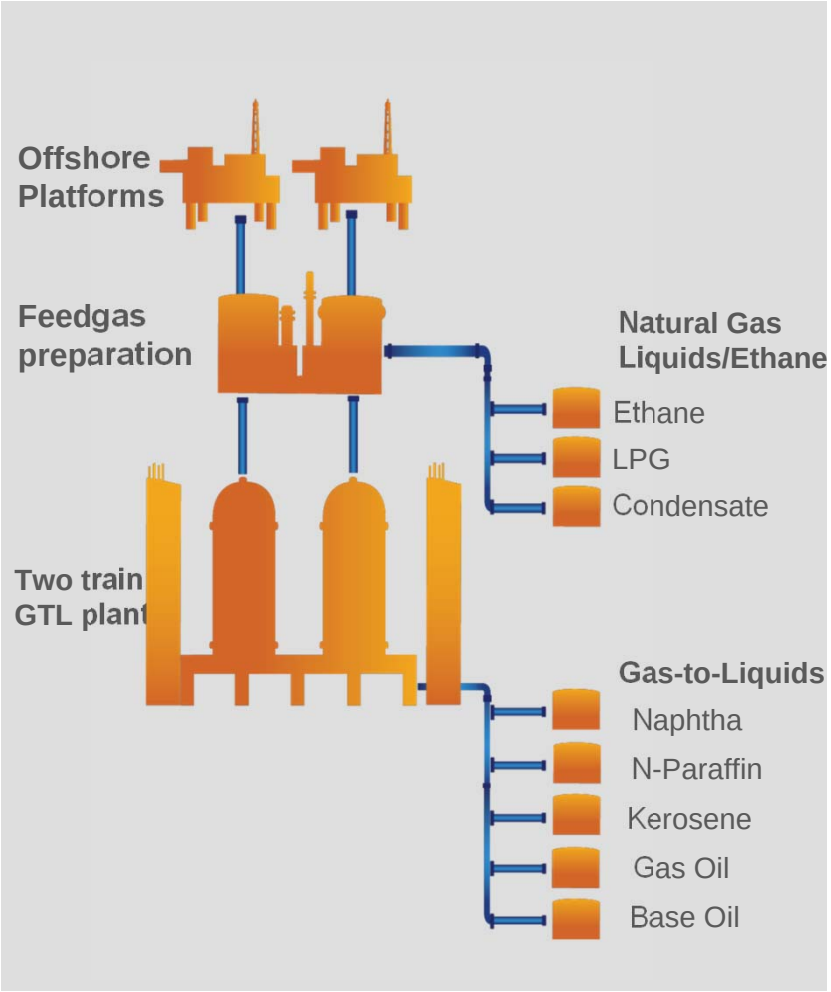
Gertjan Van De Flier-

Rotating equipment Discipline Manager

Asad Anwar Syed

Rotating Equipment Discipline Engineer.

PEARL GTL – INTRODUCTION

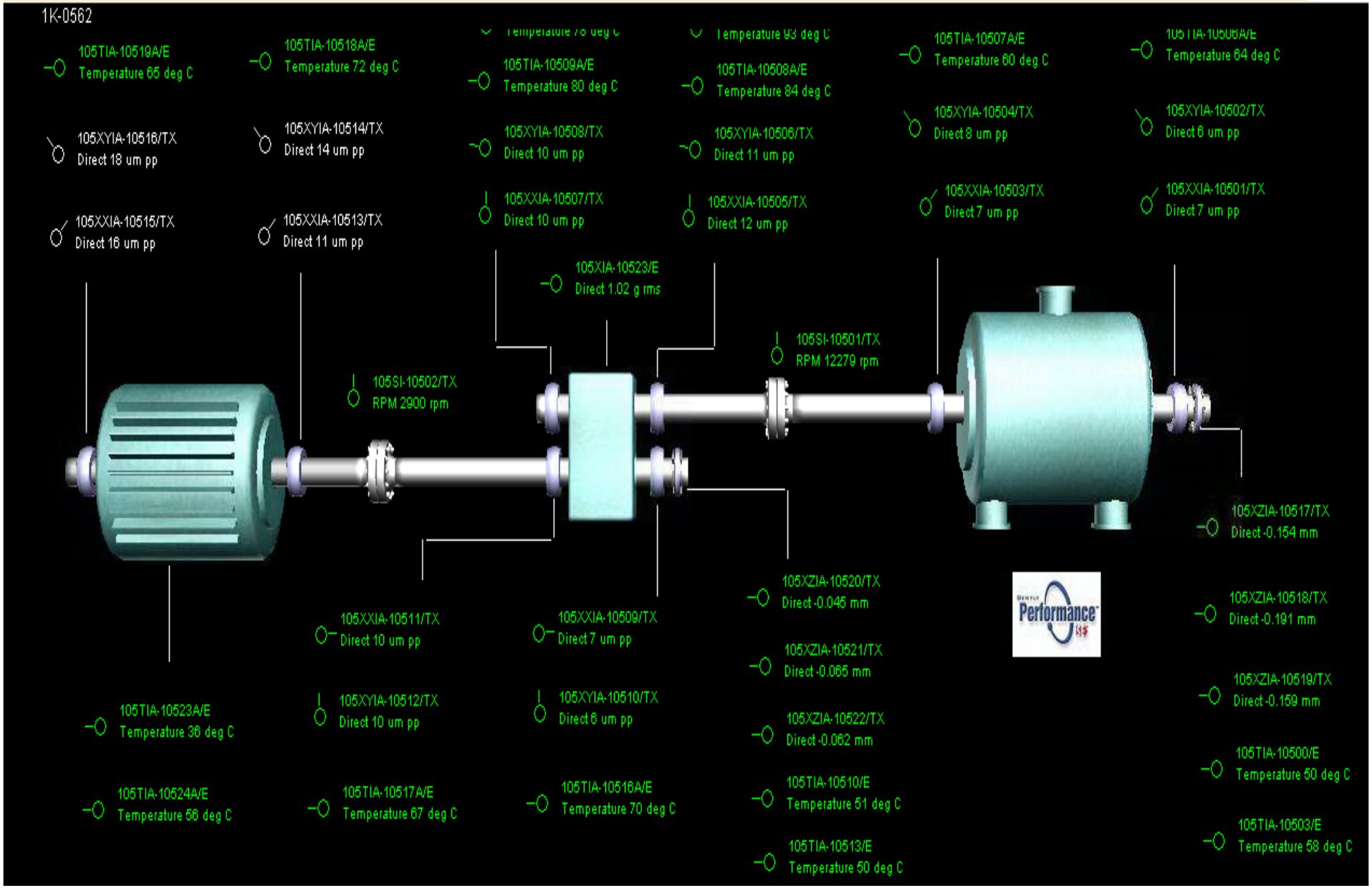


—1.6 Bcf/d of Wet Gas
  —120 kbbl/d NGLs/Ethane
  —140 kbbl/d GTL products
—$ 18 – 19 billion investment cost
—Project 100% financed by Shell
—The Largest energy project in Qatar

Compressor/ Driver Details

- Type/Size/Model- STC-SV, 2 Stage, Barrel Type Cent. Compr.
- Driver - Motor 1.4 MW, Driven Through VSD (Variable Speed Drive)
- Operating Speed- 12800 RPM
- Insulated Motor Bearings , Grounding Unit For Induced Voltages.

Machine CM Diagram



Problem Statement

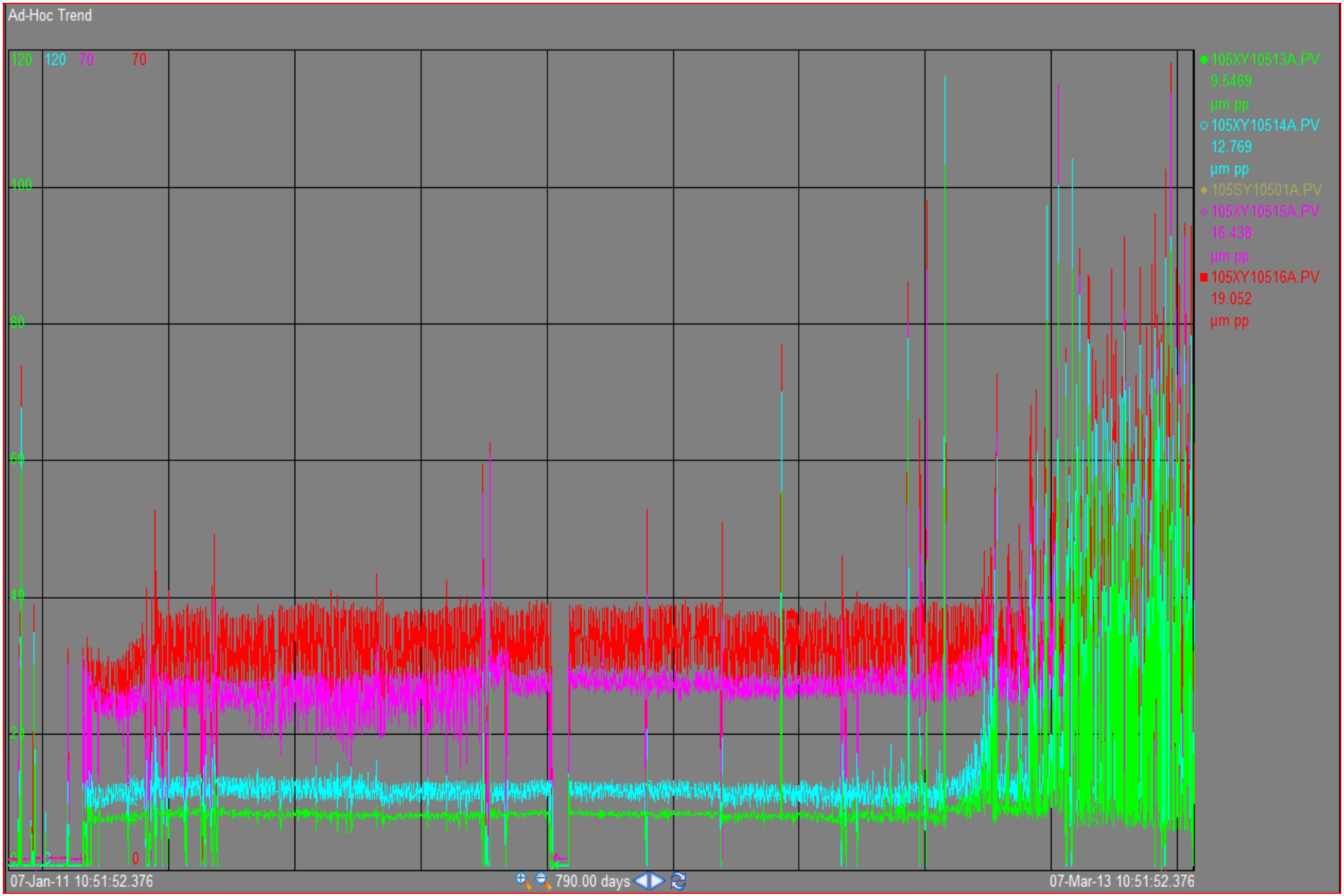
- Compressor Drive Motor DE/NDE Bearing vibrations started increasing, from June'12 onwards, without any change in the operating conditions of the machine.

- Compressor & Gear Box were not affected and kept running at normal vibration levels.

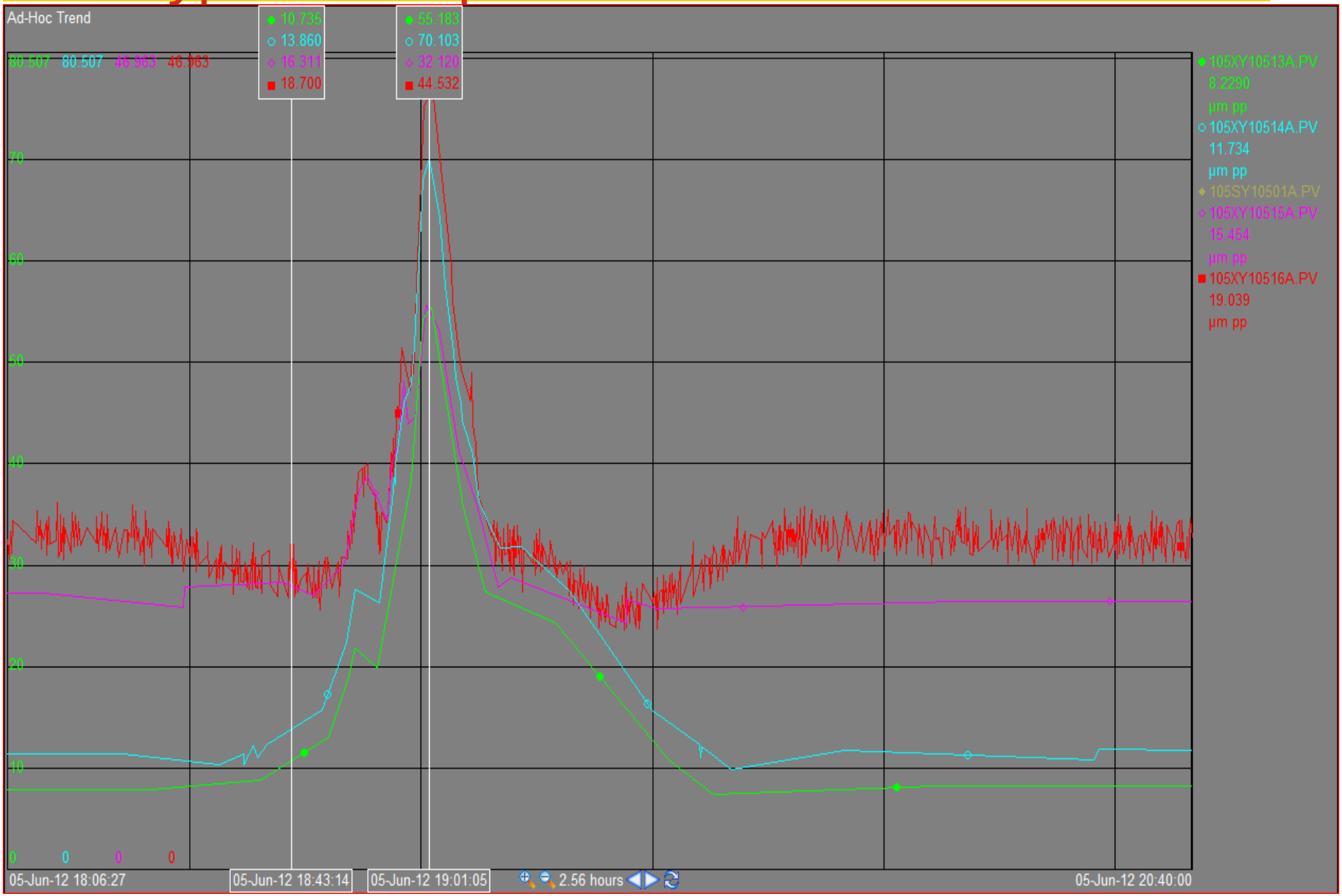
- The incident of high motor bearing vibrations started repeating every few weeks initially and slowly the frequency of the incident and vibration amplitude started increasing near to trip limits.

- Trends showed vibrations slowly rising up to and beyond alarm limits, and slowly subsiding and falling back to acceptable, normal limits

Excursion Trend



Typical Sample Excursion



Motor Grounding Unit

Grounding Unit Carbon Elements

Carbon Elements For Grounding

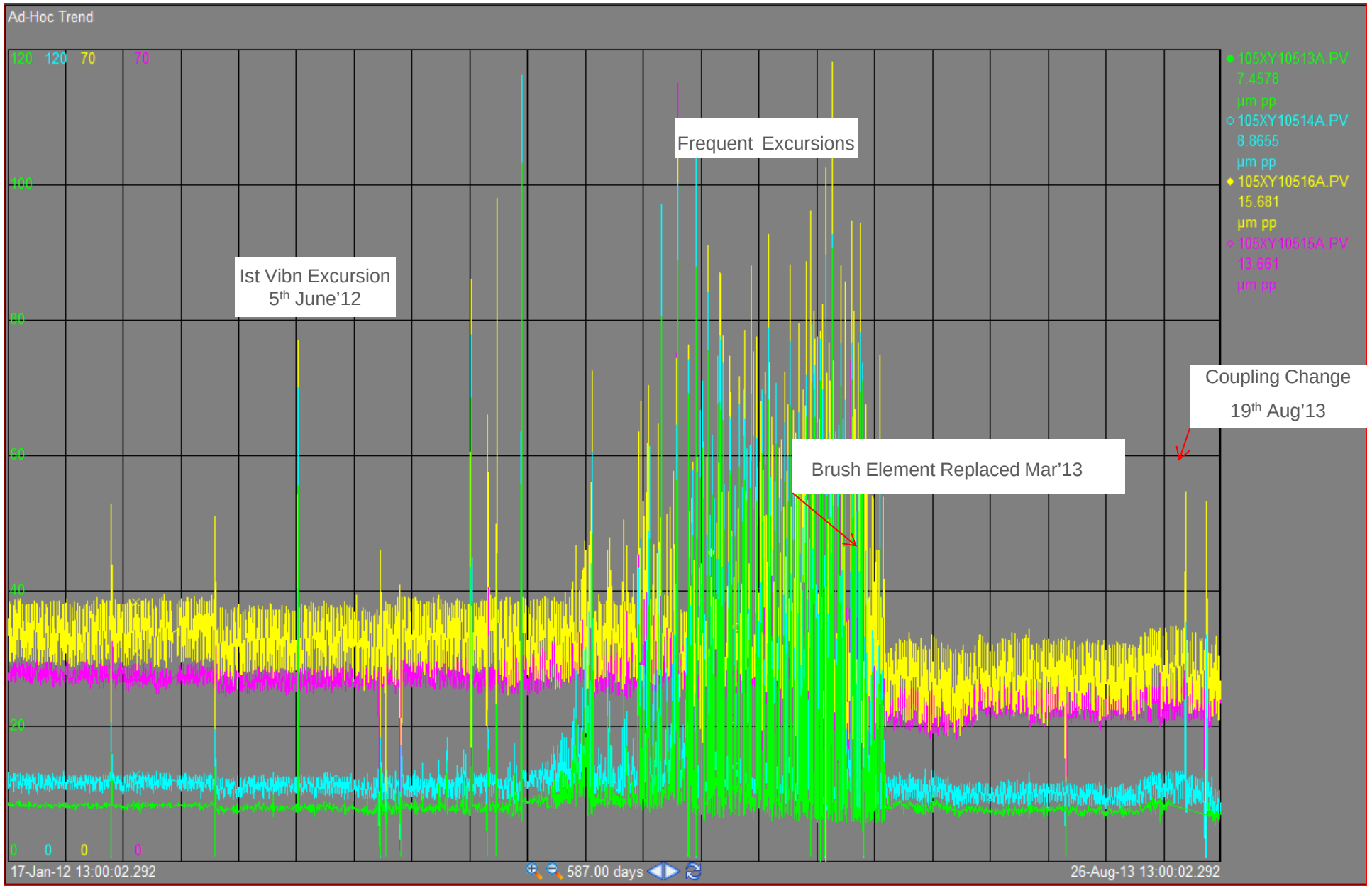
Observations

- Grounding fitted with 2 pairs of carbon elements.
- One of the element pairs found snapped off.
- Carbon elements oriented at bottom.
- Elements working length within limits.

Mitigation

- Elements replaced.
- Grounding unit orientation changed.
- Holding spring tightened to increase the element seating tension.
- Grounding cable connections cleaned and retightened.
- Grounding unit inspection scheduled in PM list.

Vibration Trend Jan’12 Onwards



Explanation Of The Phenomenon

- High voltage motors with VSDS, induce parasitic currents/voltages on the Rotor.
- Motor Rotor gets magnetized, overtime, if not grounded properly.
- GB/Comp. high impedance, insulated motor bearings, and absence of proper grounding connection prevents induced parasitic currents/ voltages to go to earth.
- Electromagnetic forces having same rotational frequency as of rotor, led to an unbalanced rotating magnetic field.
- The rotating magnetic field interacting with static magnetic field, resulted in unbalance in the rotor and led to high vibrations.
- The amplitude of vibrations depended on the magnitude of unbalanced electro magnetic forces.

Explanation Continued

—Vibrating Motor rotor got de-magnetized, due to grounding connection establishing during vibrations/ excursions/jerks .

— De-magnetization of Rotor, reduces vibrations back to normal.

— Magnetization & de-magnetization cycle kept repeating till the grounding connection was rectified.

— Vibration came to normal after 10 days of carbon element replacement. This is run-in-effect of the new elements , to build up a new patina at the slip ring surface.