Steam Generator Feedpump High Bearing Vibrations

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Background

- STP has a history of vibrations issues on feedpumps (Bingham-Willamette Type CD, 22x22x17).
- Misalignment between driver (turbine) and pump
- Turbine and pump are on two separate baseplates, and thermally expand at different rates
- Original coupling was gear type coupling near end of life, teeth were rounded, needed a replacement
- Previously installed new fluid pivot journal (Pioneer) bearings, and provided minimal improvement in reducing vibrations
- Contracted 3rd party to perform a new rotor dynamic analysis and provide a recommendation for a new coupling and bearing (Applied Machinery Dynamics Co.)

Rotordynamic Model

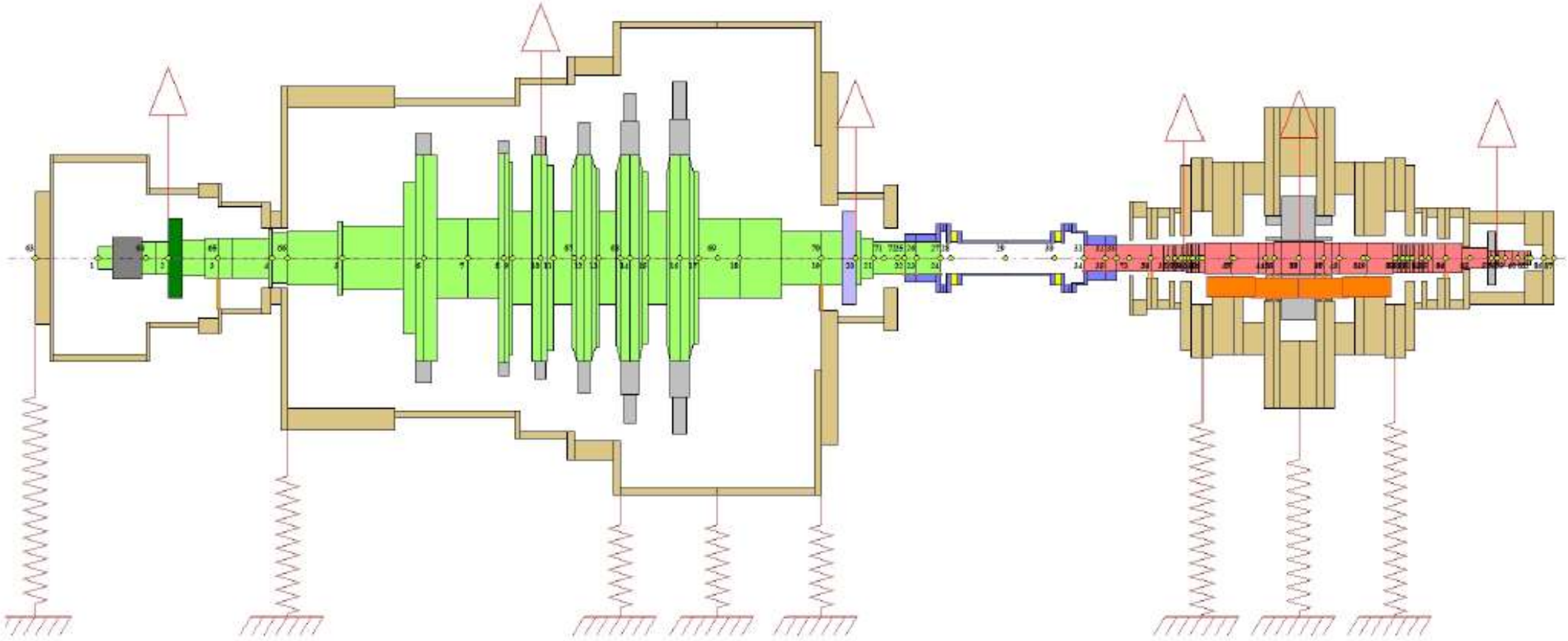


Figure 1 - Main Feed Pump Train Model

Rotordynamic Results

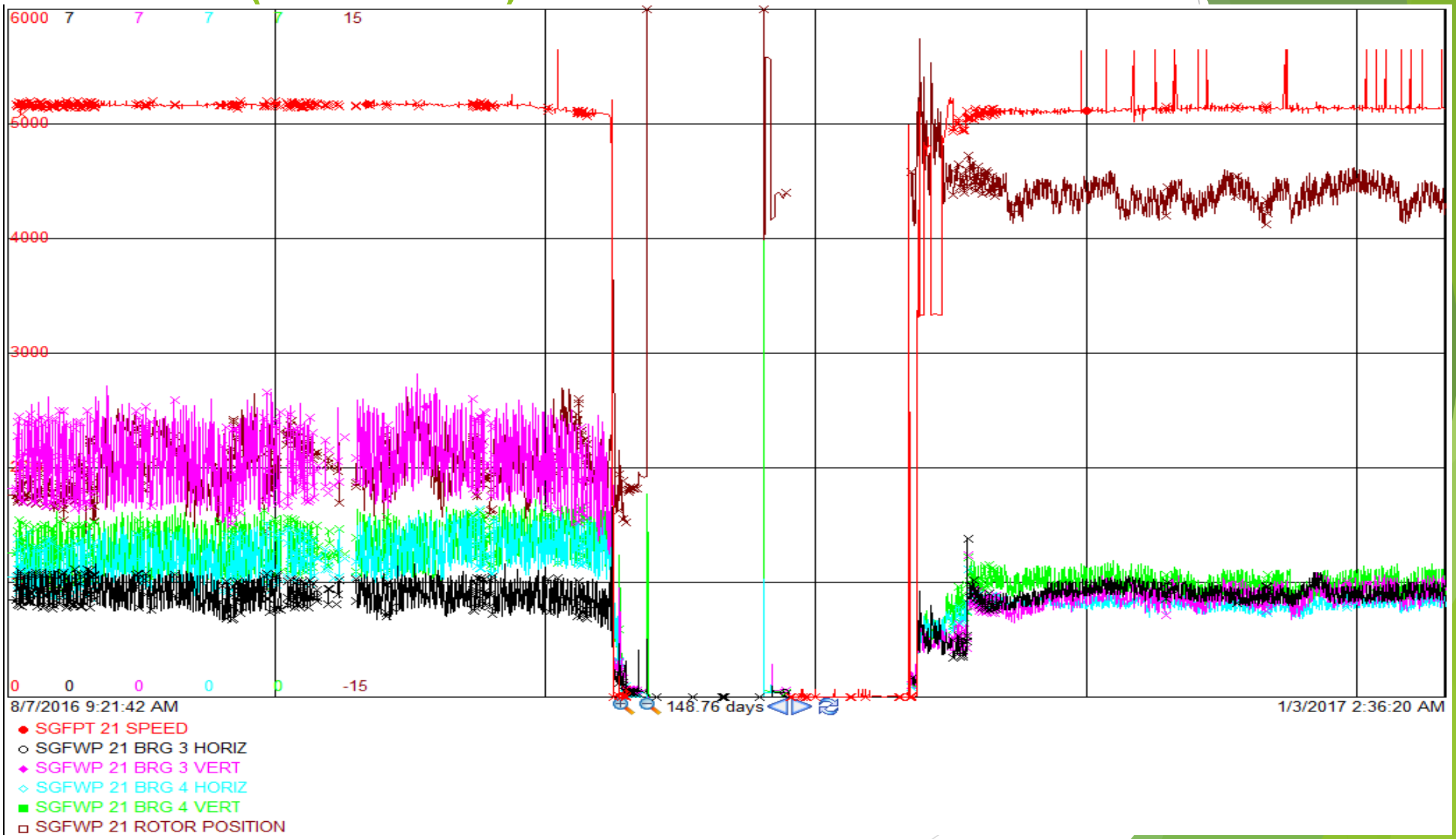
- Identified that pump seals, wear-rings carry about half the rotor weight when the pump is on full load. This unloads the journal bearings and stiffness and dampening properties are diminished.
- New bearing recommendation: offset pivot tilting pad design
  - Let the radial pump bearings “take over” from seals and grab rotor
  - Optimized for greater stiffness and dampening, lessen the control that seals exert on pump rotor
- The results show that several significant improvements can be made. First, a flexible element coupling was designed that produces only 10 percent as much force due to misalignment as the existing worn gear coupling. This will cut the pump vibration caused by misalignment by about 75 percent.

New bearings and Coupling

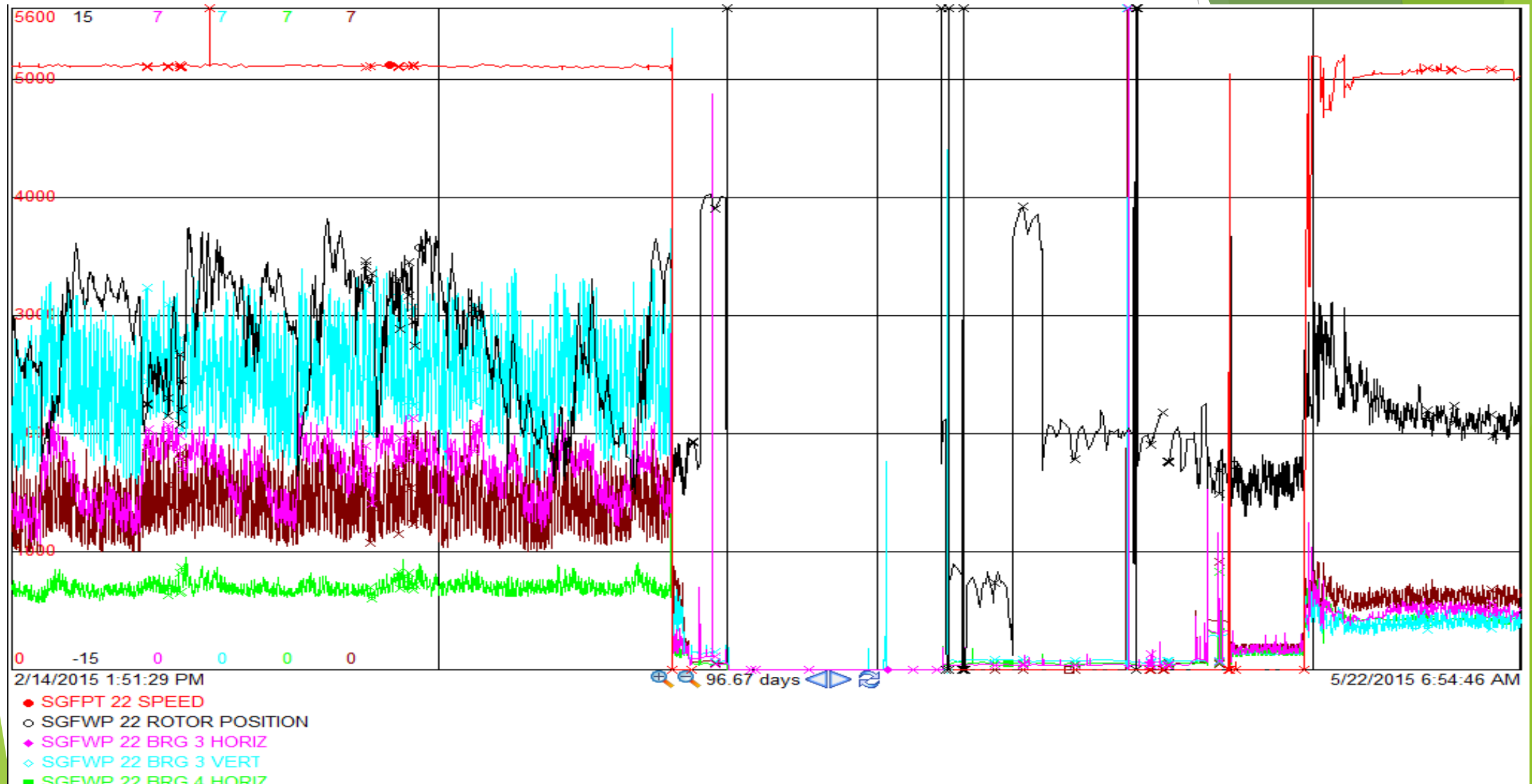
- John Crane Engineered Bearings, 5 pad offset fluid pivot bearing
- FlexElement Texas Inc., High performance coupling, disc type

Parameter	Existing	Proposed TPJ
Type	Fluid Pivot	Conventional TPJ Bearing
Number of Pads	3	5
Diametral Set Clearance	0.009 to 0.0095 IN	0.006 to 0.007 IN
Diametral Pad Clearance	0.009 to 0.0095 IN	0.008 to 0.009 IN
Preload	0 (assumed)	13 to 33%
Pivot Offset	50%	60%
Load Orientation	Load On Pivot	Load Between Pivots
Pad Length	2.0 Inches	2.0 Inches

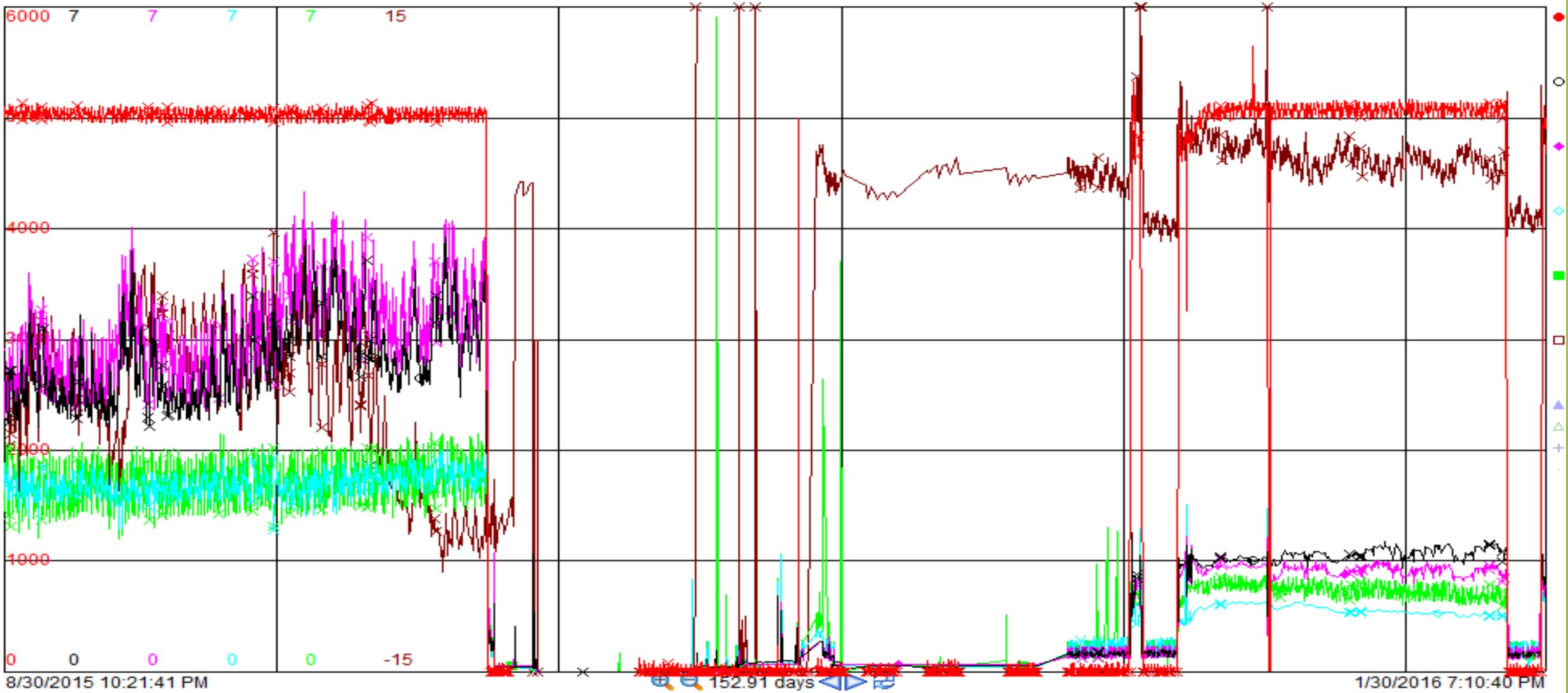
Results (SGFP#21)



Results (SGFP#22)



Results (SGFP#13)



Results

- Vibration levels reduced on all pumps to < 1mil
- Lower peak-to-peak vibrations
- Rotor position remains stable, previously changed with weather, day/night cycle.
- Temperatures on all bearings reduced to < 140 degF
- Lowest vibration levels seen in STP History
- SGFP22, installed coupling and bearings at separate times
  - Installed coupling during the cycle
  - Noticed about 50% improvement with coupling only
- SGFP23, prior to mod, had low vibrations, but high temperatures on outboard journal bearings (~195degF). After mod, vibrations did not improve, but bearing became unloaded and temperature dropped to 135degF