Managing an Induction Motor Vibration

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BP
Whiting Indiana

Main Air Blower Motor

- 10000 Horsepower 13,200 volt 4 pole motor
- Purchased Fall 1994
- Required in-rush current limit design for startup
- Vibration Acceptance criteria on test stand
  - 1.1 mil (p-p) 1X shaft vibration
  - 0.8 mil (p-p) 2X shaft vibration
  - 2.0 mil (p-p) overall

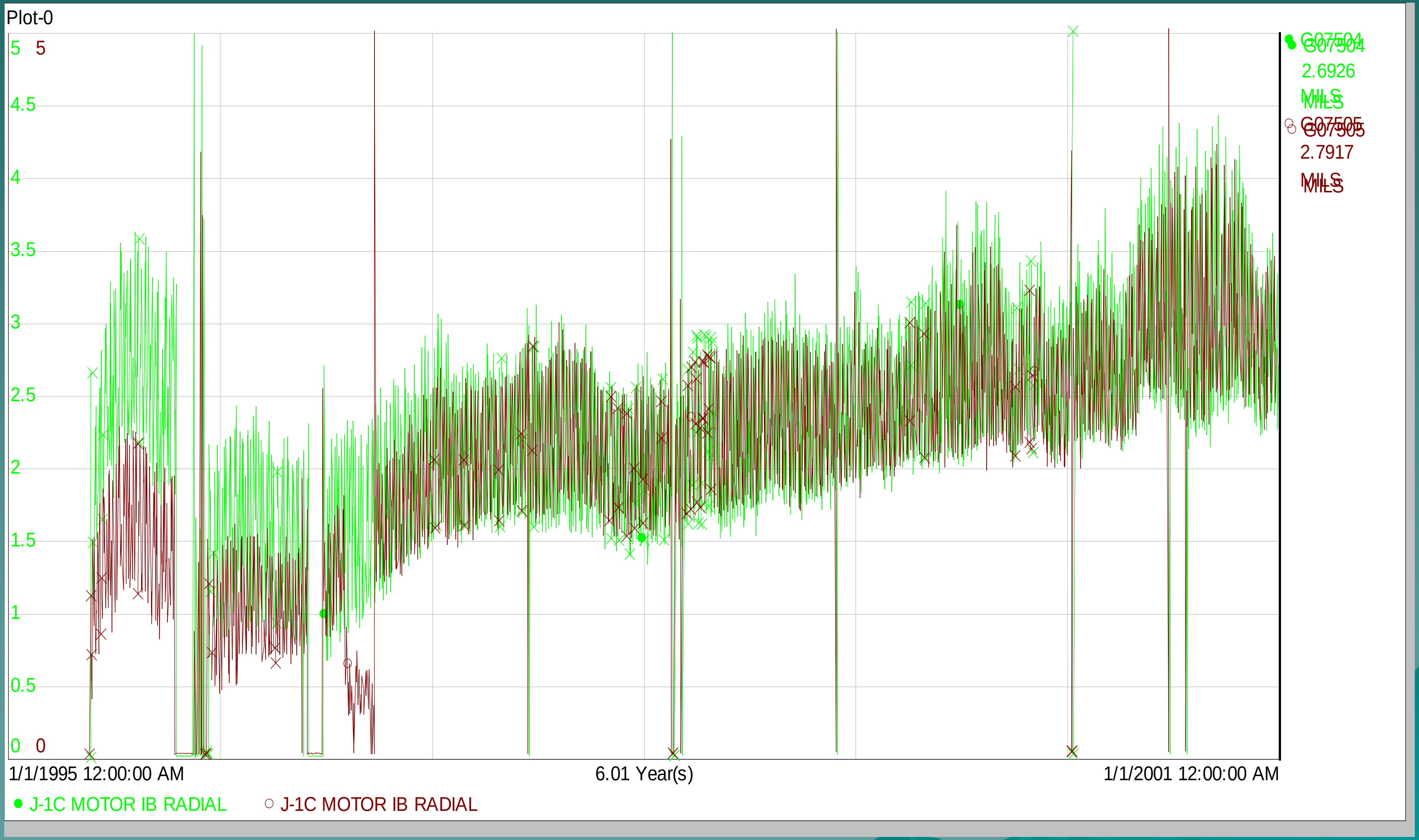
Early History

- Startup May 1995
- Vibration at startup was 1 to 1.5 mils
- By August 1995 shaft vibration levels increased to 2.6 mils
- October 17, 1995 had a failure of the IB air deflector ring to ground tripping motor
- December 1995 new design air deflector installed and motor field balanced

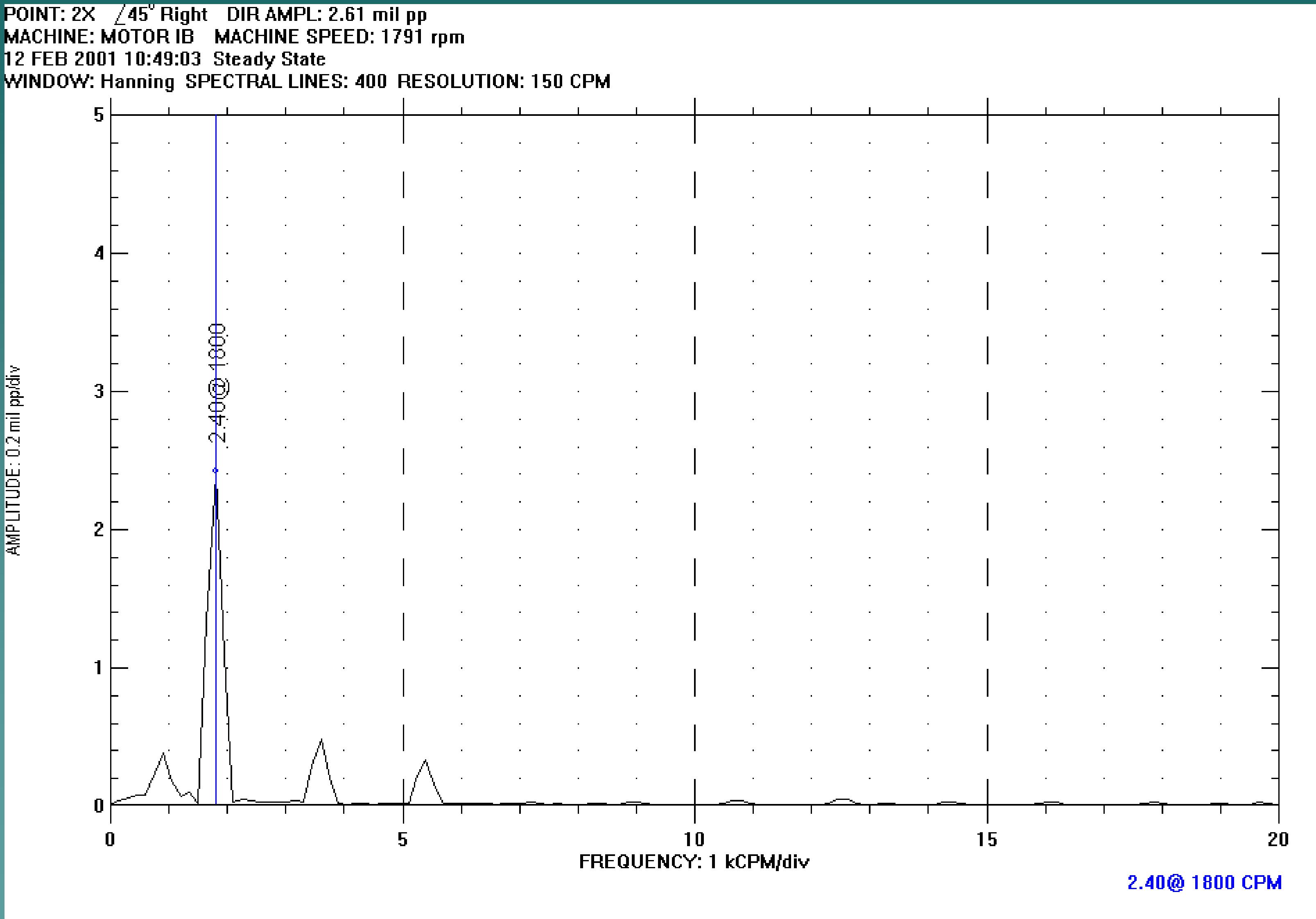
Vibration Levels Increased over Time

- IB vibration levels slowly trend upward from 1996 to Spring 2001
- Verified vibration was due to some motor problem
- Eliminated “red Herring” of “bad grout”

May 1995 – Jan 2001 Vib



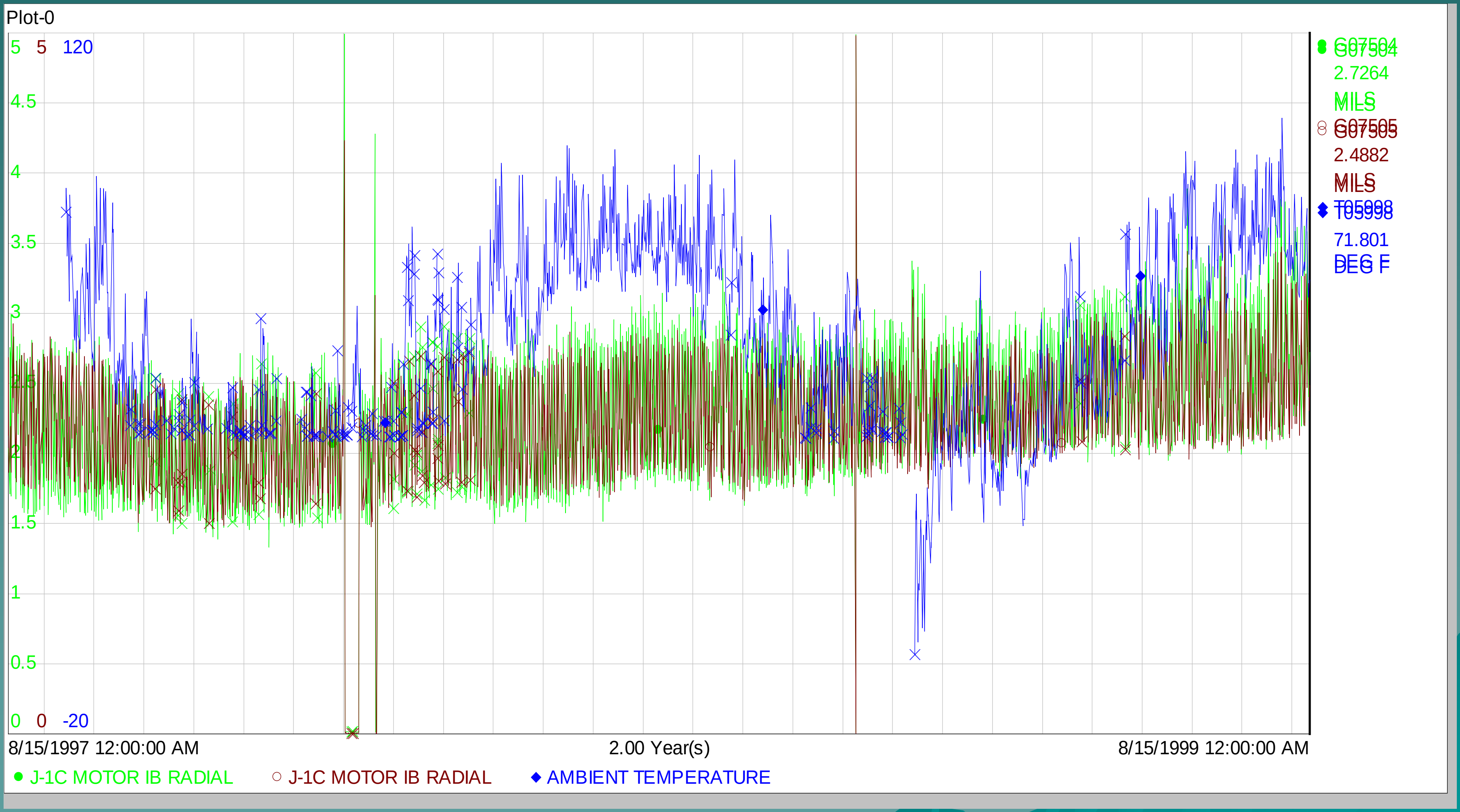
Motor Spectrum Feb 2001



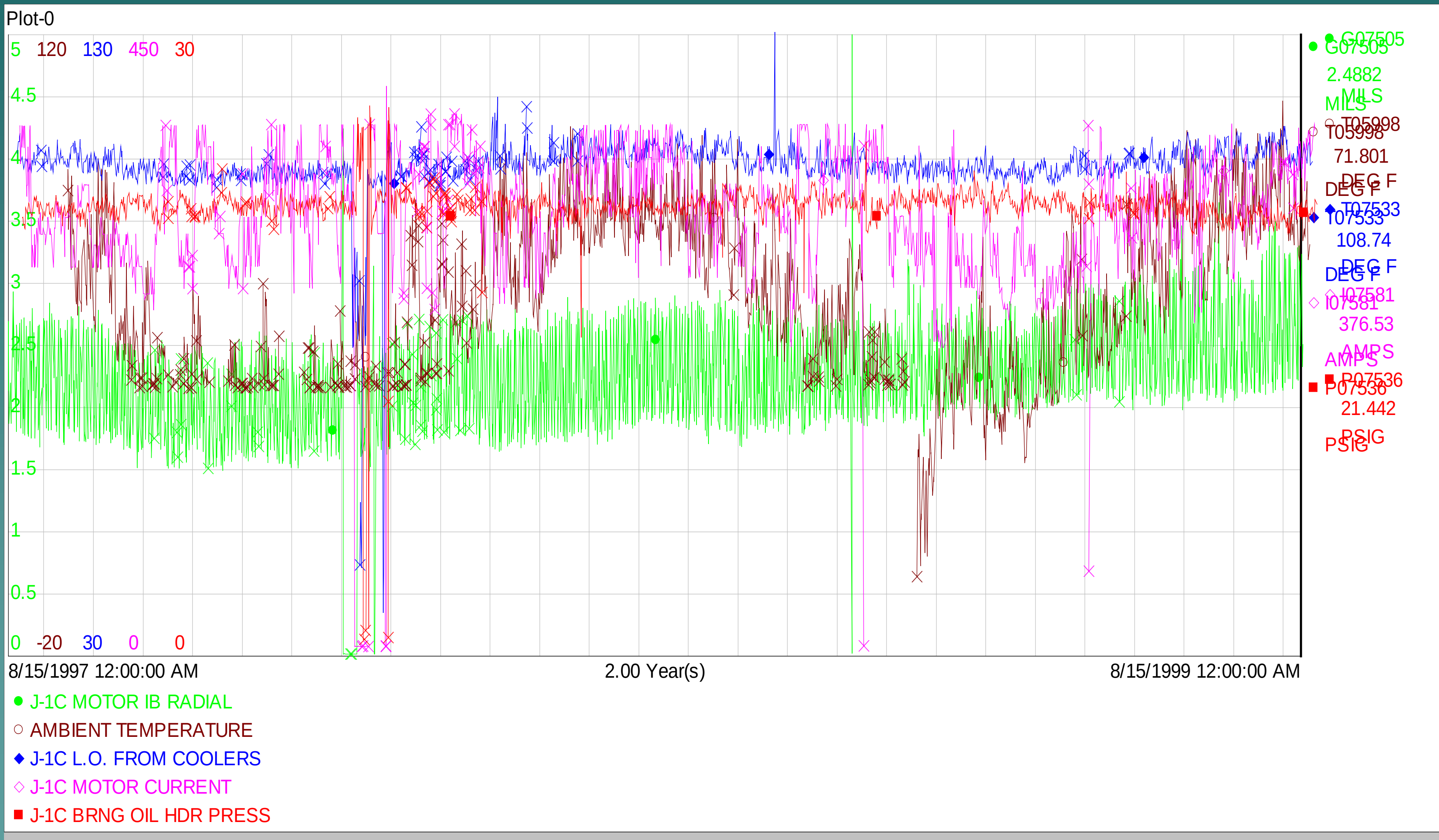
Vibration Limits

- 0.0075 inch bearing clearance
- Limited Vibration to 85% bearing Clearance both probes
- Shutdown levels 0.0064 inches P-P
- Needed Preemptive activity to assure we could keep the machine in operation

Aug 98 - Aug 00 Amb vs. Vib



Vibration vs. Operational Conditions



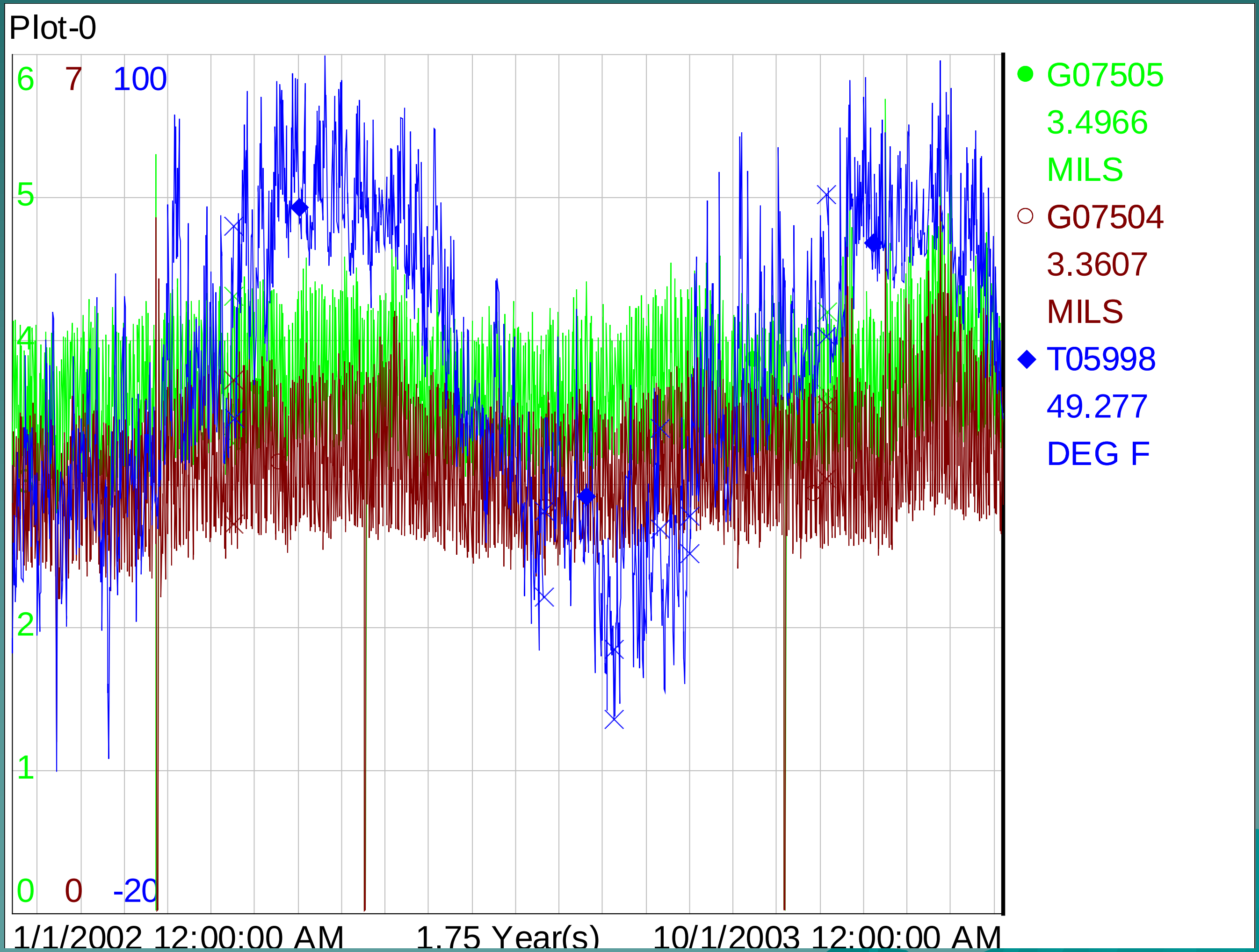
Ambient Temperature increase causes increase in motor vibration

- Added air 2 conditioner units to cool inlet air to the Motor
- Cost effective
- Deferred motor maintenance


2001. 8. 27


DANGER
HIGH VOLTAG
2001. 9. 12

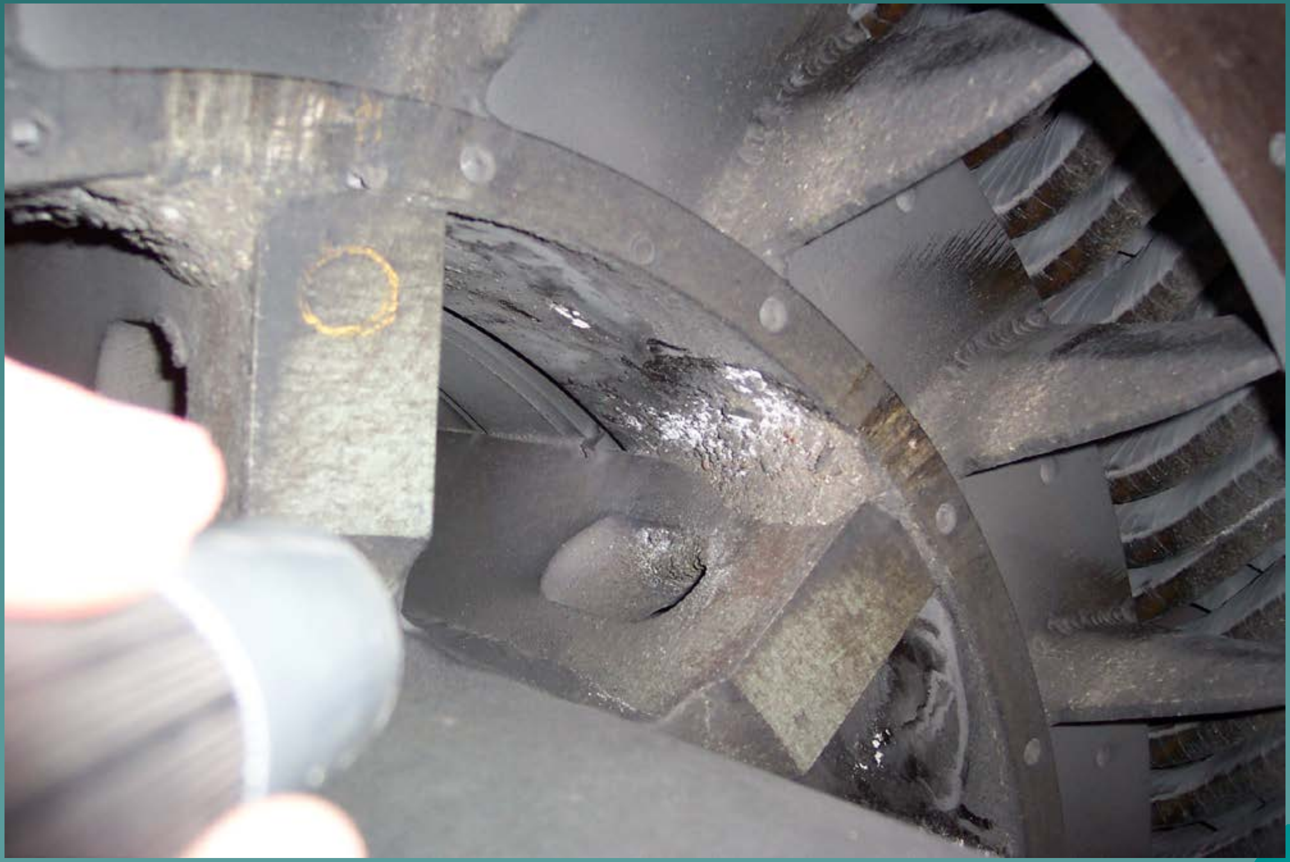
Jan 02 – Oct 03 Vibration with Air Conditioning



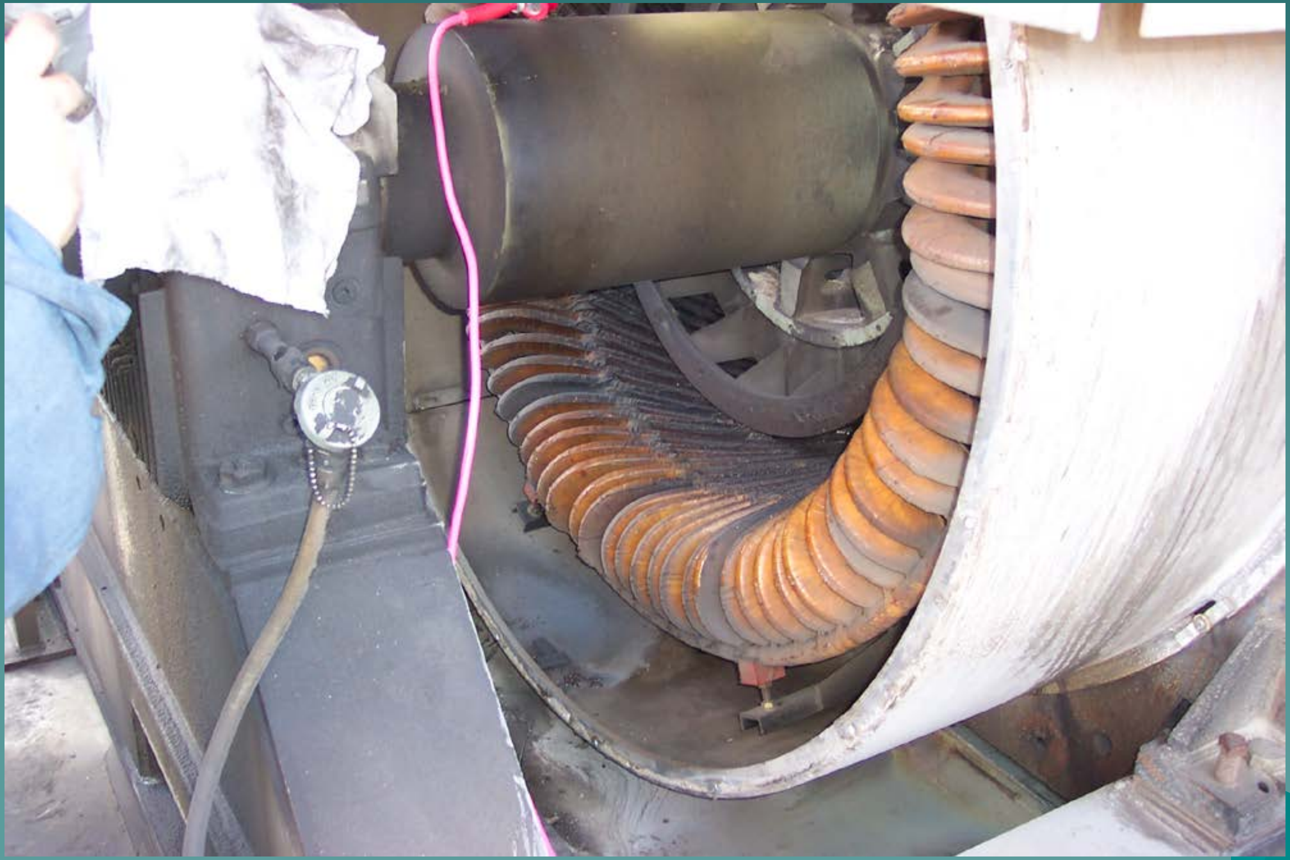
Rotor Problem

- Rotor could be in axial bind causing bow
- Possible loose bars
- Plan on pulling motor at best opportunity

Uniform buildup



Additional Inspection decided to pull rotor



Lamination Pieces found in bottom of motor

- Original design required limited inrush current
- Acceleration time increased
- More air flow required
- Vendor eliminated every other row of duct spacers in order to increase air flow

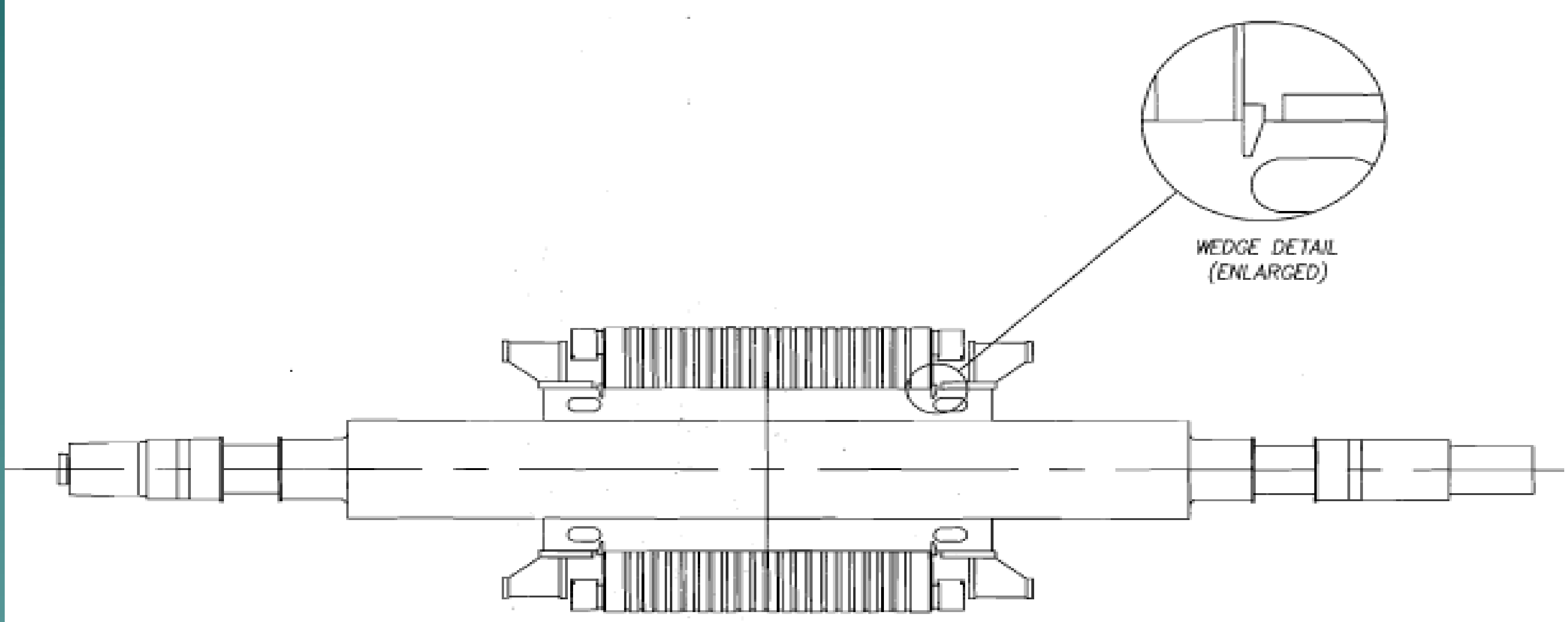
Loose and missing Laminations

Missing duct spacers

Vibration Cause

- Laminations without duct spacers shift to block air path and break off when not “clamped” by spacers.
- Increases at each startup could be explained by additional laminations breaking off on acceleration (not likely)
- Rotor expanded during heating and could not return to original position due to excessive restriction of tapered positioning pins. (most likely)

Original Rotor Configuration



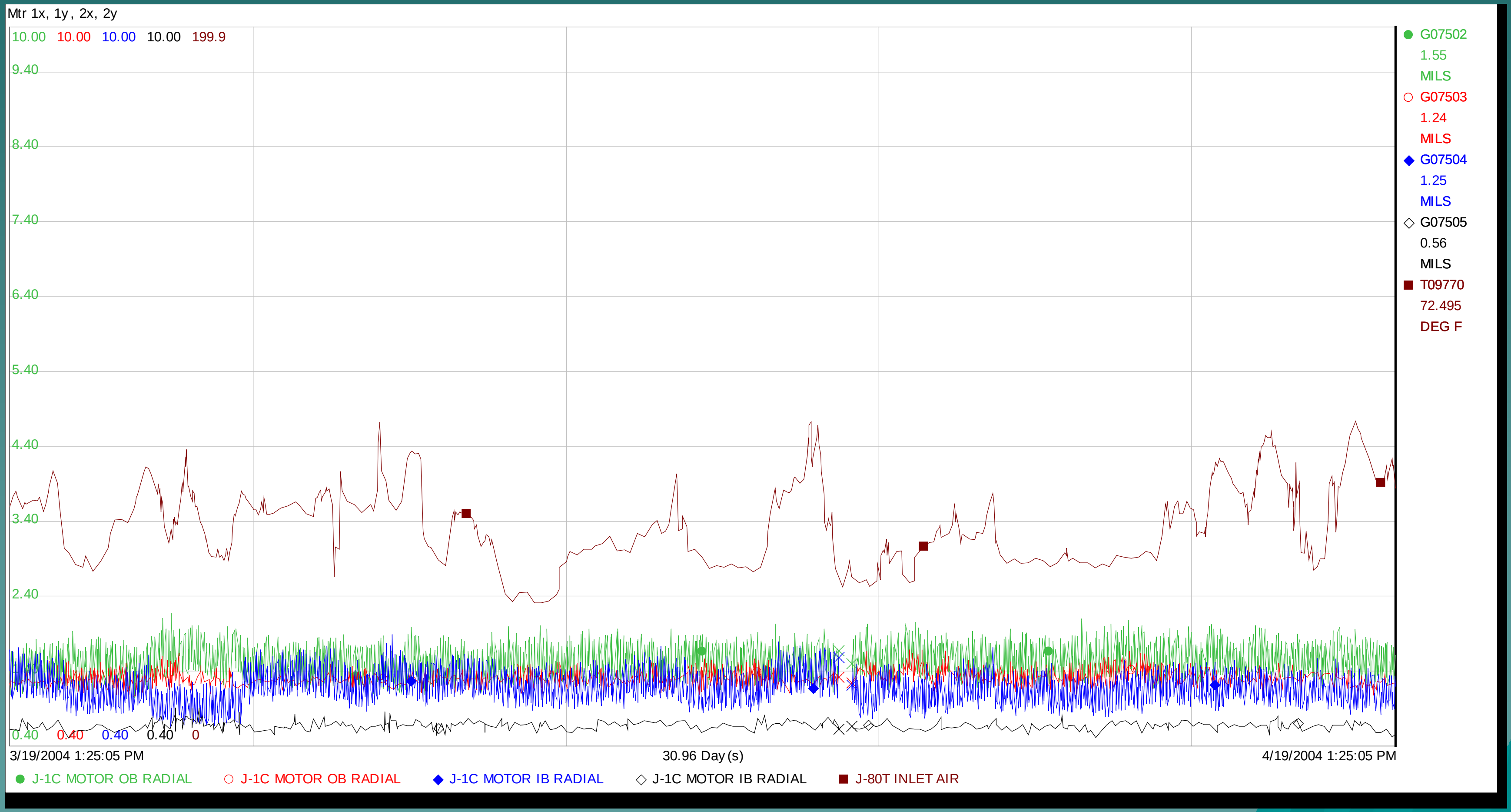
Repair

Visual inspection after welding

Machined O.D.

Balanced

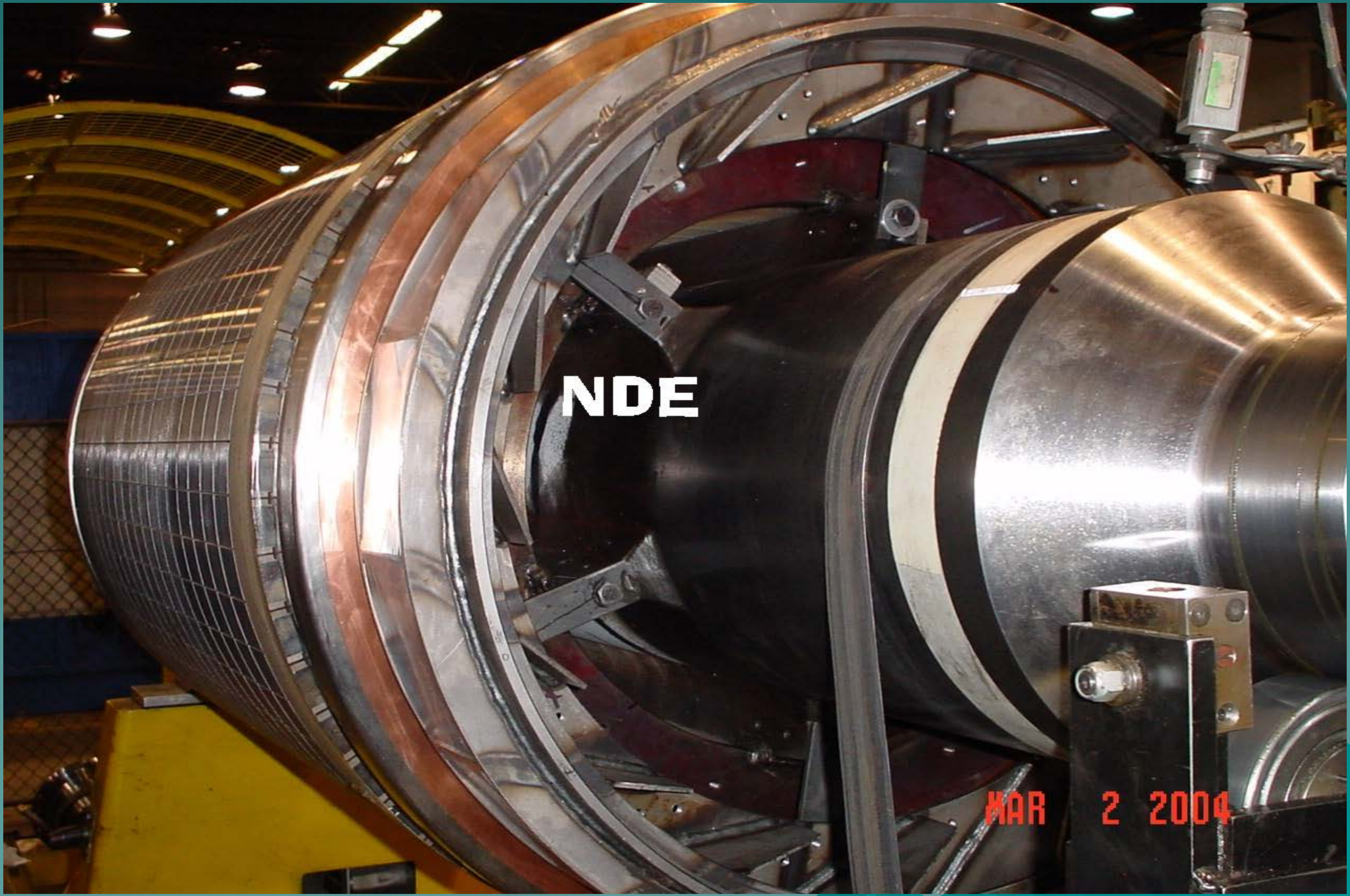
Vibration after startup



Parallel path was to obtain a new motor with low inrush current design

- Repair method had not been used before
- Failure rate of the repair was unknown
- Timing for new motor was in sinc TAR

New Motor Rotor



New Motor

- New Motor rejected on test stand
- Test stand startup current too high
- Developed list of solutions

Options

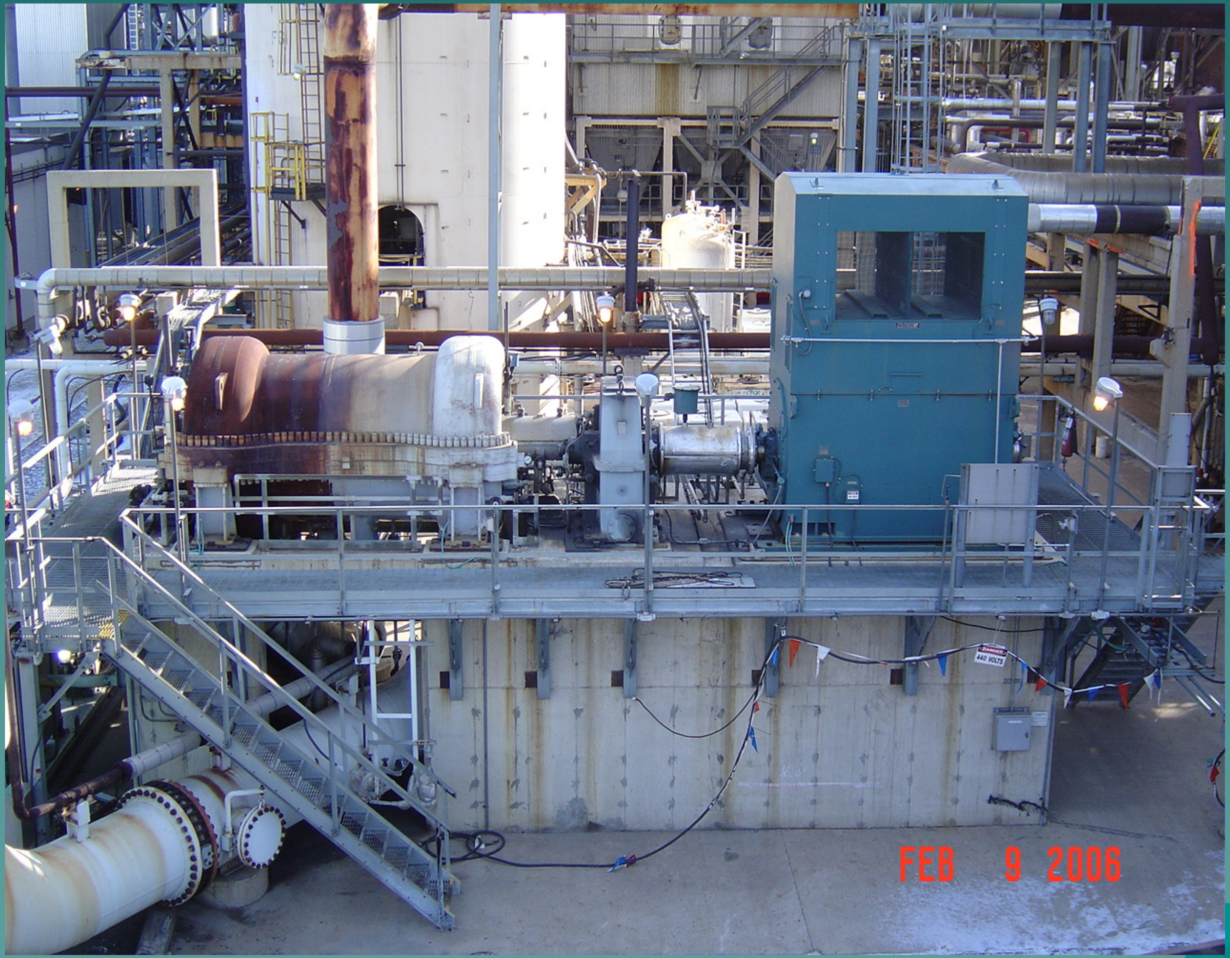
- Rebuild new motor – 5 months minimum
- Different motor connection to system to minimize inrush current – work could be done during TAR
- Meantime, old motor still in service

New Connection Caused

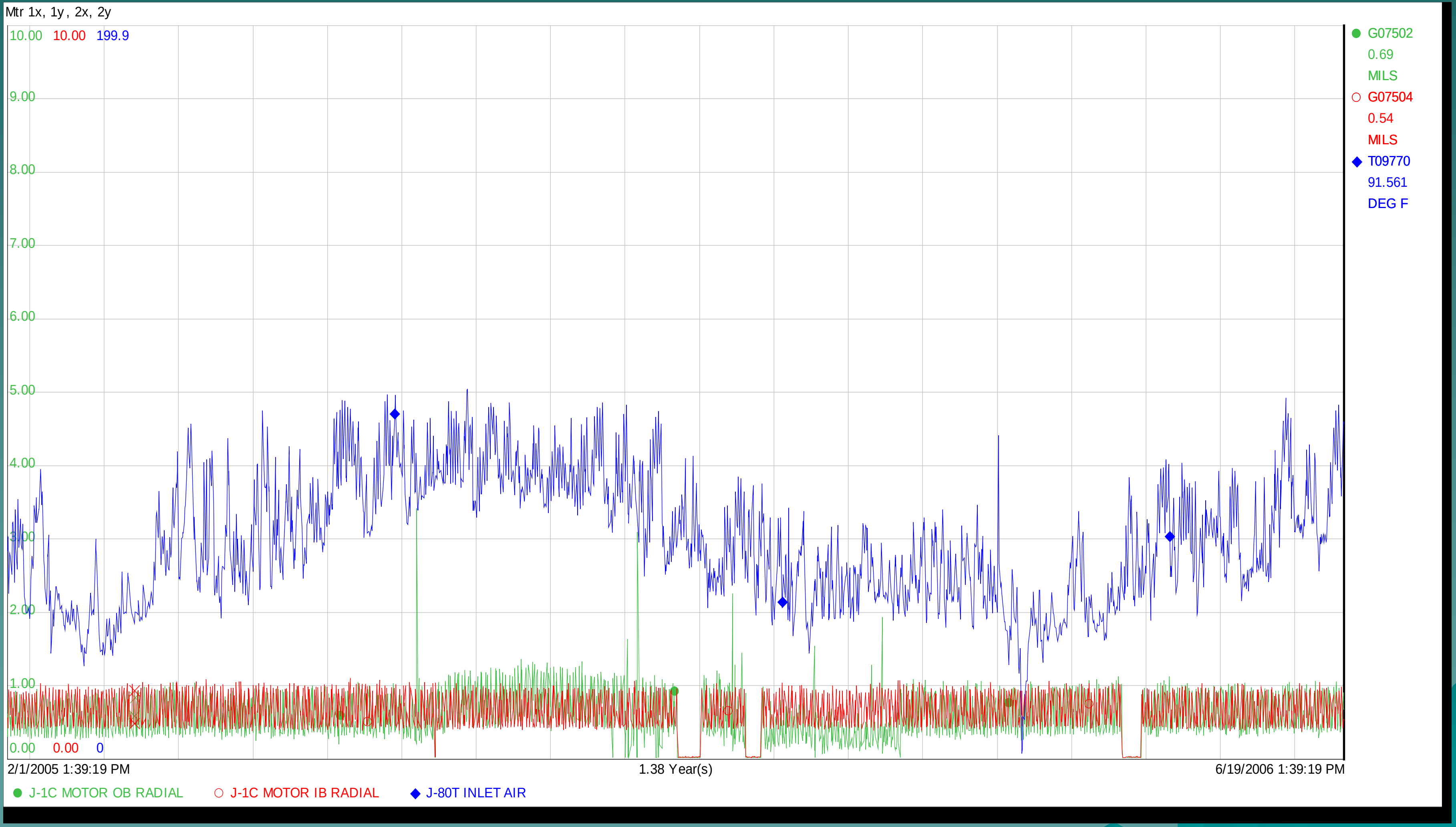
- Different motor torque characteristics when we changed from Wye to Delta

- Review of couplings, gear, and compressor capability – SF ok.

New Motor after Installation



Present Day Vibration



- Thank You
- Questions?