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Knowing What's Ahead™

# Wind Farm Remote Monitoring

Tom Francisco

# Condition Monitoring is not new

- Many industries have used various condition monitoring techniques for DECADES.

# Rotating equipment

- Vibration monitoring is very effective
  - Used in nearly every industry
  - More than 40 years of history

# Lubricated systems

- Oil monitoring is a LEADING indicator
  - Particle count rises before significant damage occurs

# Wind Turbine monitoring

- Combination of vibration and oil
- Usually ~10 vibration sensors
- A tachometer
- Oil particle counter

# A little twist

- Wind doesn’t blow at a constant speed
- Tachometer is key

- Oversample and process using tach signal for very clean vibration spectrum

# Mechanical systems

- Some are more complicated than others
  - 3 stage gearbox
  - Planetary gears
  - 1 or more generators

# Setup

- Exact  ratios and element counts are programmed for monitoring
- Levels are compared to baseline
- Changes are detected and inspected for match with fault templates

# The Story

- Jan 26 – change in vibration is attributed to possible early stage bearing wear. No action required other than continued monitoring.

- Feb 10 – Demod data indicates bearing tones.  Early stages

# The Story - continued

- Feb 17 – Gear mesh frequency with intermediate shaft sidebands are detected.
- This localizes the fault to a bearing on that shaft.

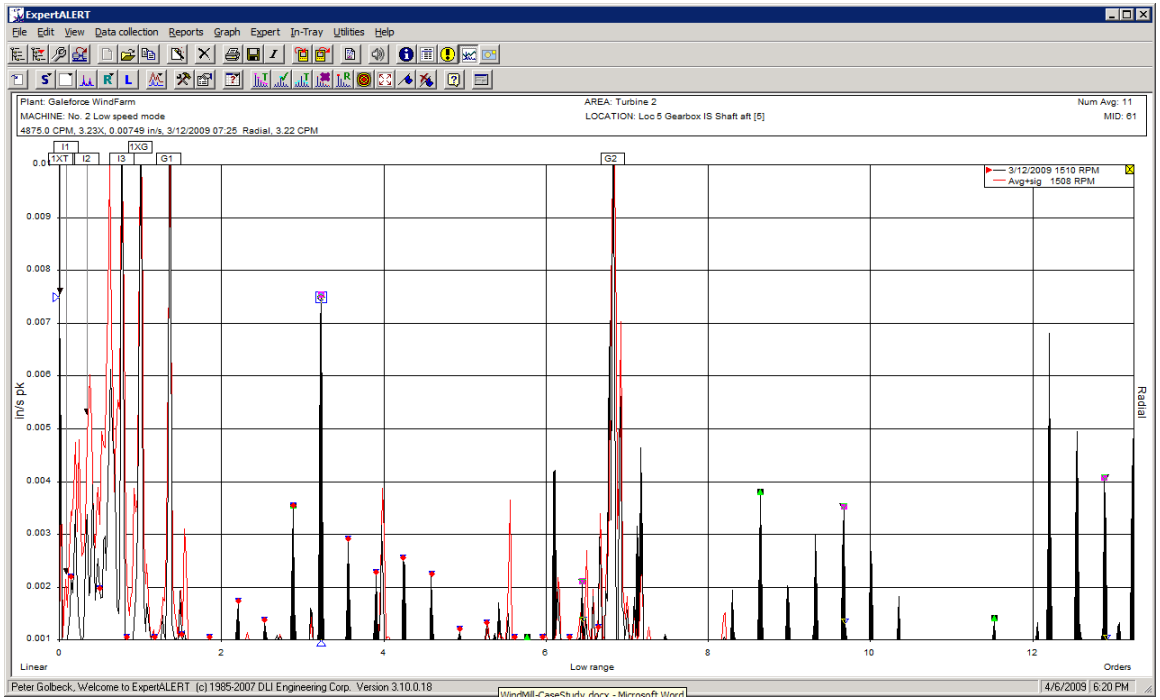
- Feb 23 – Increase in sideband level stabilizes.

# The Story - continued

- Feb 27 – Bearing tones and sideband levels indicate the problem could deteriorate at any time.
  It is recommended that the machine be secur ed for repair.
- Mar 6 – Diagnosis re-confirmed.

# The Story - continued

- Mar 13 – Alarm level reached.  Client secures unit.

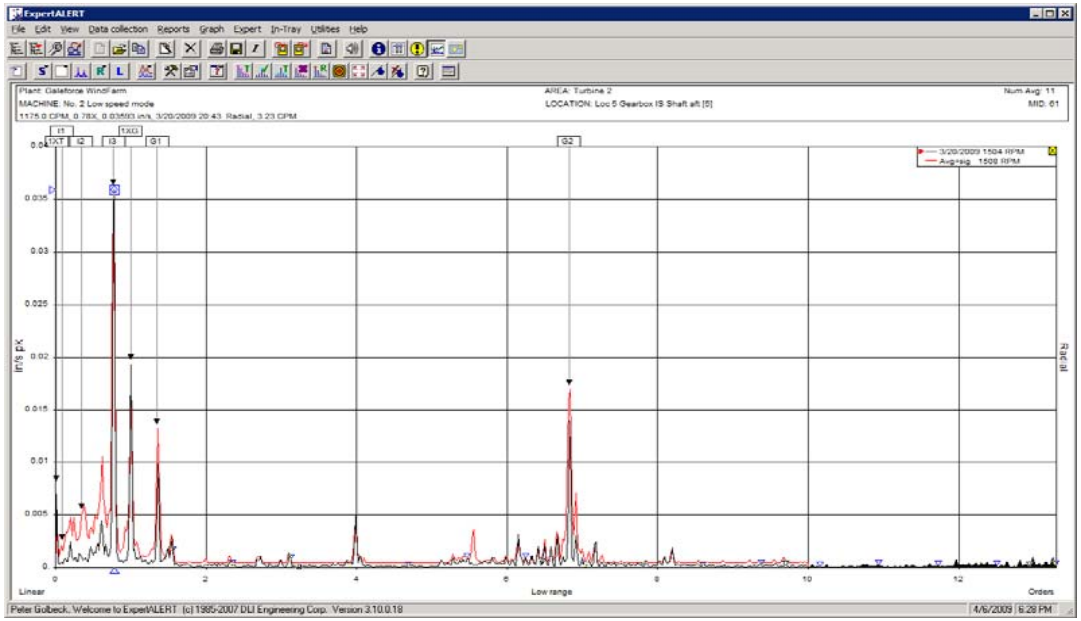


# The Story - continued

- In less than 7 weeks from inception, the fault has reached alarm levels.

# The Outcome

- Bearing was replaced and the gearbox returned to service.
- Vibration data confirms a successful repair.



# The Bearing

# The Moral of the Story

- Mechanical system wear and fail
- They give repeatable and recognizable indications.

- The Internet allows remote analysis of these faults by dedicated professionals.

# Win – Win situation

- The CM system worked.

- Operator was able to avoid considerable expense and lost revenue
- Repair facility saved considerable “warranty” liability.

# The Bearing

- Failed 28 weeks after installation
- In the repairs shop's report:

"The root cause of this type of failure is almost impossible to ascertain. However, there is no doubt that the readings from the condition monitoring prevented what could have been a catastrophic failure with this gearbox."

# Estimated Return on Investment

- Better than 10 to 1

# Thank you for your time and attention

- Questions?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