

Wind Turbine Gearbox Failure Avoided

Remote Monitoring Service Prevents Gearbox Intermediate Shaft Bearing Failure

This case study demonstrates how Azima DLI's remote monitoring services saved a wind turbine gearbox from catastrophic failure. The following are excerpts from email conversations between Azima DLI's engineers: (Steve Stivers and Bill Watts), the wind turbine operator: ("Dan") and a local engineering company that had recently overhauled the gearbox which was still under warranty. The wind farm is located in Europe and the Azima DLI remote monitoring team is located near Seattle, WA USA. Data is collected on each of the turbines automatically using 16 channel Web enabled SpriteMAX systems. The client has local access to diagnostic reports via a mimic display. Azima DLI engineers access the system via a web portal where data is manually reviewed. The client is notified of any changes in machine condition.

This case study demonstrates the benefits of remote monitoring services and the responsiveness of Azima DLI's engineers. It also demonstrates the rapidity in which a wind turbine can progress from minor indications of faults to near catastrophic failure. Comments about other wind turbines being monitored by Azima DLI were removed from these email conversations, otherwise they are unedited. "UNIT-2" is the wind turbine in question. "I2" refers to the second intermediate gearbox shaft.



Early Warning - No Action Necessary

Mon. Jan 26: Steve Stivers of Azima DLI writes: UNIT-2 has the faults detected: generator bearing noise (the indications are present but are seen only rarely, similar to other turbines) and gear mesh wear (the indications are present only in the low-frequency tests). I don't believe there are currently any concerns for UNIT-2 based on those explanations.

Tues. Feb 10: Steve Stivers of Azima DLI writes: The other turbines are okay. There are varying indications of gear mesh wear and ball bearing amplitude demodulation (very early indications of bearing wear), but nothing that is approaching a serious severity.

Something Is Happening

Tues. Feb 17: Steve Stivers writes: I also noted that UNIT-2 is showing more consistent symptoms of first gear mesh problems. Until now, the symptoms (high amplitudes at the first gear mesh frequency) were present in only the low-frequency tests. Now the symptoms are present in both the low-freq tests and in the high-freq tests. There are also prominent sidebands spaced at the second intermediate shaft rotation rate in the low-freq tests. This may be related to the gear problem.

Mon. Feb 23: Steve Stivers writes: UNIT-2 is still showing prominent side bands spaced at I2 rotation rate. These symptoms appear to have stabilized.

Making the Call

Fri. Feb 27: Steve writes: UNIT-2 intermediate shaft bearing wear and first gear mesh problems have been relatively stable and don't appear to be worsening yet. However, the bearing problem could worsen suddenly. On the other hand, sometimes bearing problems will appear and remain at a serious but stable severity for months. If it were up to me, I would strongly consider securing UNIT-2 until repairs are made.

The First Stage of Grief is: Denial

Fri. Feb 27: Dan, the wind farm operator writes: The company that rebuilt the UNIT-2 gearbox six months ago is not convinced that there is an emerging problem in the gearbox. Is there a way to prove that the gearbox is degenerating or is it expected that the faults will become audible prior to failure?

March 6: Steve writes: For the past couple weeks, the bearing tone side bands we see most prominently at locations 2, 4, and 7 of UNIT-2 have been stable. There is often, but not always, the ability to watch the spectra change as a bearing problem worsens. We can watch this turbine, but as you know, a bearing can degrade from serious to failure rather abruptly. I am not sure what other proof they would need; there are prominent side bands spaced at the I2 rotation rate, which is a definite indication of bearing wear.

The Final Indications and a Decision is Made

Fri Mar 13: Bill Watts of Azima DLI writes: I just checked the data and the gearbox condition has clearly worsened considerably over the past few days. There is great deal more higher frequency bearing tones and random noise. I recommend immediate shutdown and repair. Again, the I2 (intermediate) shaft appears to be primarily at fault, although the damage may have become more widespread.

Fri Mar 13: Dan replies: Thanks Bill, I will get our local engineering company to inspect UNIT-2 gearbox ASAP

Fri Mar 20: Steve Stivers of Azima DLI writes: Your turbine status is the same: I2 bearing problems in UNIT-2 (described by Bill W. last week). It will be interesting to see what you find out about UNIT-2.

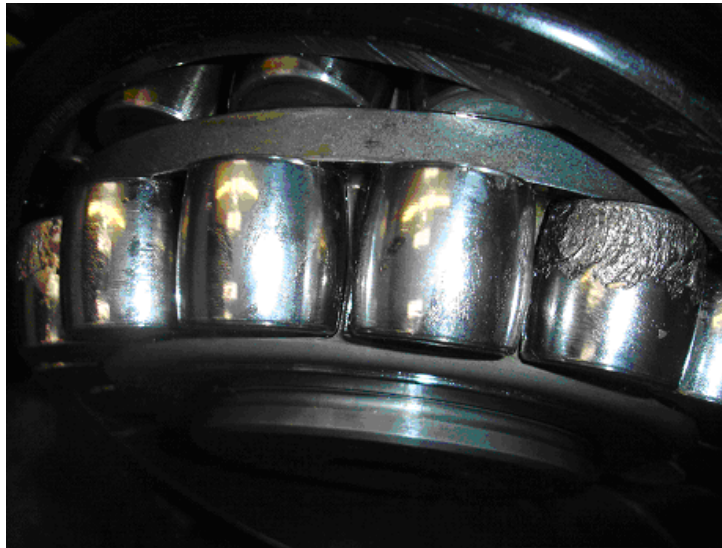
Thanks for a Job Well Done

Sat. Mar 21: Dan writes: Gentlemen, Apologies for not getting back to you sooner but I was working on UNIT-2 gearbox Thursday and Friday of this week. The gearbox rebuild company arrived on site Thursday and we found the bearing on the intermediate shaft was severely damaged. It is very similar to what was discovered when the gearbox was rebuilt in July 2008. We were able to replace that bearing and UNIT-2 went back online at 18.00 on the 20th. It will be interesting to see if the gearbox will return to normal levels or if there is further damage in there. The gearbox rebuild company is preparing a report and will send the damaged bearing to its manufacturer for analysis. The gearbox rebuild company also asked me to pass on their appreciation to you for detecting the bearing failure at an early stage.

The Post Mortem

Monday March 23: Steve writes: UNIT-2 looks like a brand-new turbine again, so that is good. Do you think that we could get some pieces of the degraded bearing for our own analysis and case study report?

Monday March 23: Dan writes: Most of the damaged bearing is being sent to the manufacturer for investigation. I do have three of the damaged rollers out of the bearing if these are of any use to you?



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