Paper machine: Bearing failure

- The case study presented in this document demonstrates some of the powerful analysis tools available in System Reporter
- High speed paper machine
- System Reporter 200 with software version 5

A paper mill contains a large number of rolls and dryer cylinders that, in case of a bearing failure, can generate severe damage with following production losses.

This application note shows a case study where the central roll in the press section was replaced on August 10, 2000. Already a week later a bearing fault had developed which, if it would not have been discovered, could have led to a serious breakdown with large costs as a result.

System Reporter contains functionality especially designed for use in pulp and paper application. Alarm handling is performed continuously using:

- 10 configurable frequency ranges
- SPADE expert system

in order to facilitate detection and instantaneous display of upcoming problems.

System Reporter also has the ability to perform minute measurement, which is a powerful tool for use when hourly measurements are not applicable, e.g. during plant start/stop or when tuning a system.

SPADE EXPERT SYSTEM

The SPADE expert system is built around a knowledge-based database containing references from a large number of errors originating from 14 different error types.

This study shows how the SPADE expert system works. For the current application the SPADE expert system was configured to filter out all frequencies originating from bearings, e.g. BPFO, BPFI, BSF, FTV, and to summarize these in combination with some 50 overtones into a total bearing error ("Lagerfel" in Figure 1). Figure 1 shows a trend of the SPADE total bearing error on bearing 232/560cak located on the drive side of the central roll in the press section.

CONCLUSIONS

Based on the alarms and analysis results generated by System Reporter, it was decided to stop the paper machine and replace the faulty bearing (see Figure 8). If the error would have been left unattended, a breakdown would most probably have occurred, with associated costs in the range of millions US $.

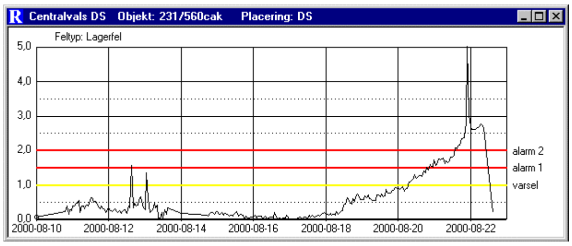

Figure 1. SPADE trend showing that bearing related frequencies increase to reach above high alarm levels above within four days.

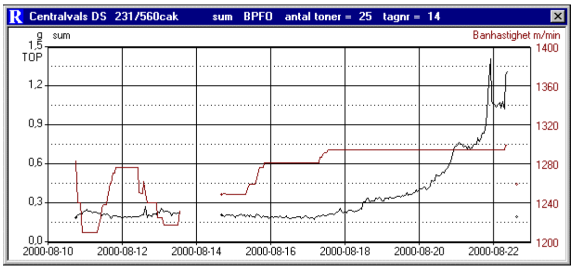

Figure 2. The figure shows an example on how the SPADE error, calculated from the object frequencies, related to BPFO has increased during the time period. Production speed is displayed as red line.

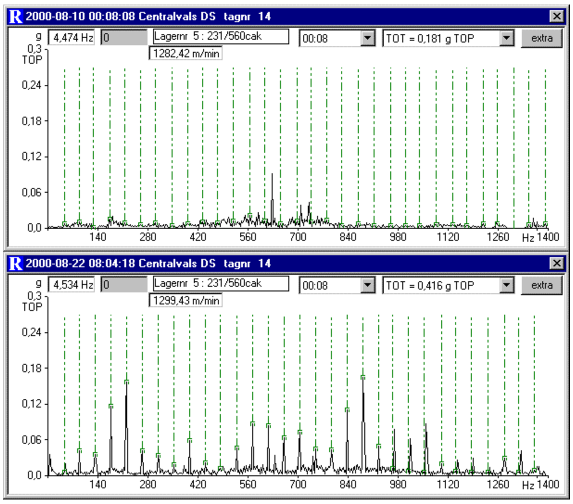

Figure 3. Single spectrum 0 – 1400 Hz after replacement of the central roll on August 10 (top) and on the day (August 22) before the bearing was replaced (bottom). The vertical green lines represent BPFO frequencies.

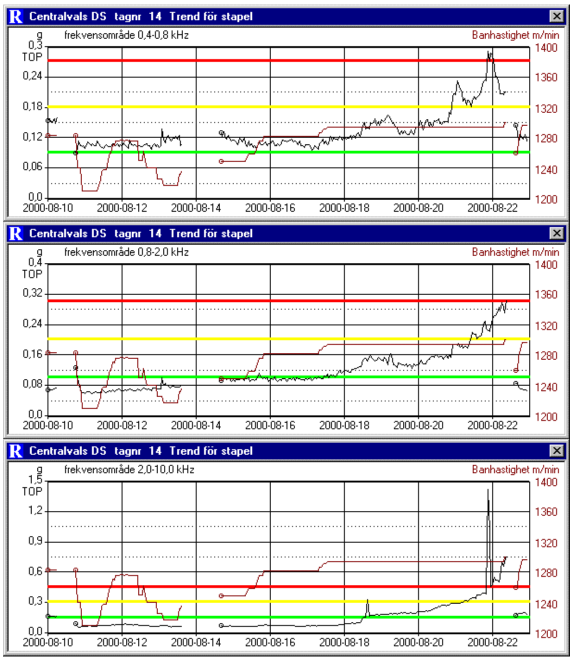

Figure 4. Trends from some of the 10 frequency intervals that has alarms. 0.4 – 0.8 kHz (top), 0.8 - 2 kHz (middle) and 2-10 kHz (bottom). Yellow lines represents alarm level 1 and red lines alarm level 2. Obviously the BPFO error is reflected in both high and low frequencies.

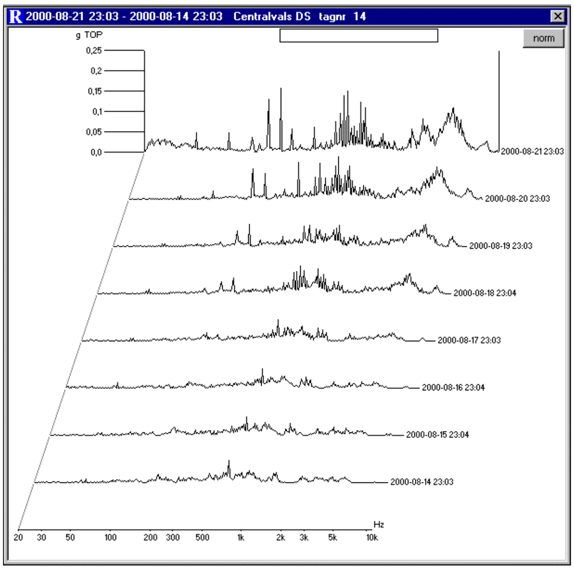

Figure 5. Waterfall spectrum from the central roll from August 14 (bottom) to August 21 (top), showing that the damage to the bearing is increasing.

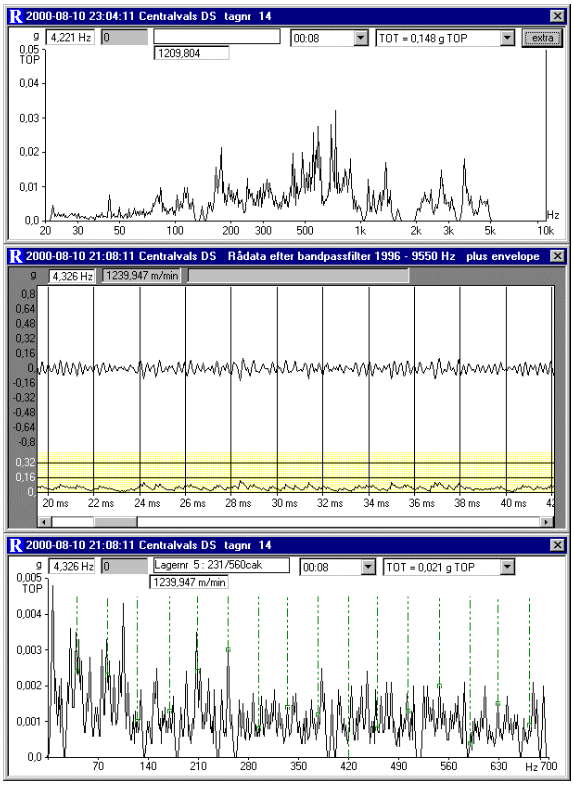

Figure 6. Single spectrum 0 - 10 kHz (top), time domain data (raw data) with a band pass filer 2 – 10 kHz (middle) and envelope spectrum (bottom) from August 10. By using envelope calculations it was possible to show that the bearing was affected already at installation on August 10. The vertical green lines represent BPFO frequencies.

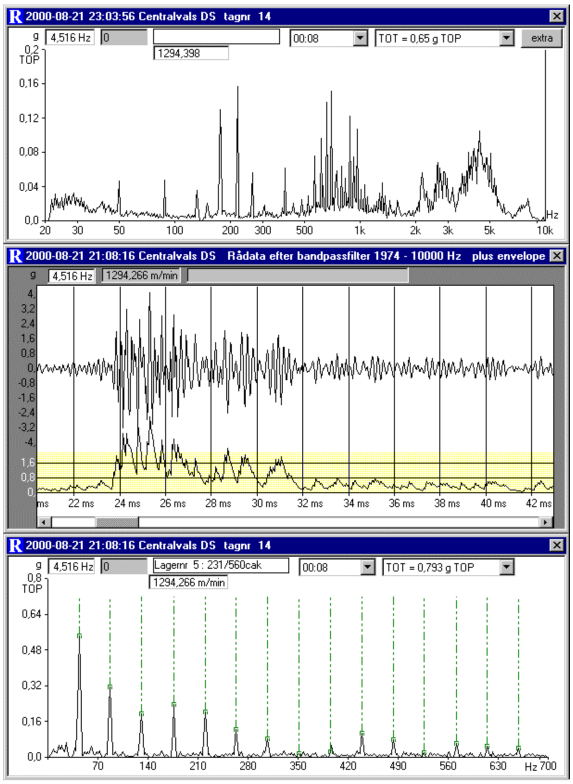

Figure 7. Single spectrum 0 - 10 kHz (top), time domain data (raw data) with a band pass filer 2 – 10 kHz (middle) and envelope spectrum (bottom) from August 21. The vertical green lines represent BPFO frequencies. Note the amplitude in the envelope spectrum.

Figure 8. A damage in the bearing outer ring approximately 120 × 60 mm. Rust damage was present on rolls and on the outer ring, indicating that water has entered the bearing casing.

Figure 9. Zoomed-in view of the damage shown in Figure 8.

LAGGE control ab

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