Imbalance in an Induced Draft Fan

CASE HISTORY

This case highlights the benefit of spectral measurements and a knowledge of where fault frequencies will appear. It also shows that condition monitoring will only work if the CM team has the full cooperation of the production and maintenance departments, and that it is not only necessary to diagnose the result of a problem but also the cause.

An induced draft fan for a 500 MW steam turbine was being monitored with vibration spectra. It was noted that the running speed peak, at 10 Hz, was increasing. The problem was diagnosed as growing imbalance. Unfortunately, the accelerometer, which is permanently mounted inside the fan, failed under the extreme temperatures (>130 degrees C). Naturally, when this happened, it was difficult to tell exactly what condition the fan was in. Two days later, it failed, and cost the company $589,400 in lost generation and labor.

In a relatively short period (three months), the vibration levels were approaching the same levels as that before the failure. This time, it was possible to plan the shutdown. At the least expensive operating time, the fan was shut down and 40 kg of dust was removed from the impeller housing. It was obvious at that stage that there must have been a leak, however, there was no time to look for and repair it.

When the fan was returned to service, the levels again were low. But again, after another five months, the vibration levels had increased to the alarm level. The problem was detected and acted upon. Another 40 kg of dust was removed from the impeller. A thorough examination of the unit was made and it was found that there was a significant leak, allowing the flue gasses to get inside the hub of the impeller. This leak was repaired and the fan has operated successfully ever since.

The plot in figure 1 is a waterfall plot showing all the spectra that have been collected, 23 in all. The high running peak speed without harmonics is indicative of imbalance.

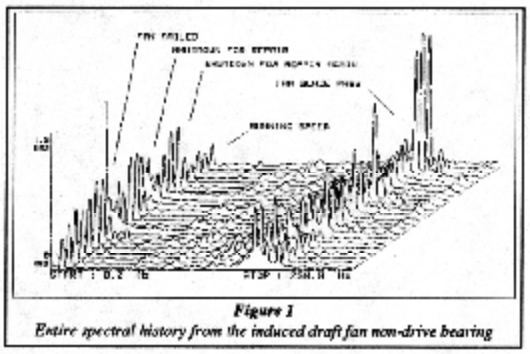

Figure 1
Entire spectral history from the induced draft fan non-drive bearing

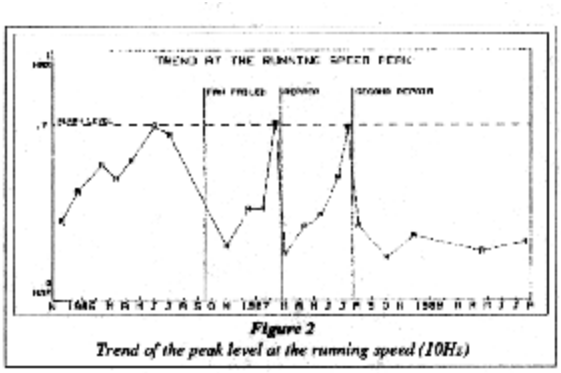

Figure 2
Trend of the peak level at the running speed (10Hz)

Figure 2 is a trend plot of the running speed peak, that is, it is a graph of the height of each peak in the waterfall plot at 10 Hz, versus time. Using the reporting functions and the history file, it is possible to add notes and completely rearrange the page layout. This format is also useful when attempting to predict when the levels will reach the alarm values.

This function would have been very useful in January and June, in order to predict when the data would reach the level of the previous failure.

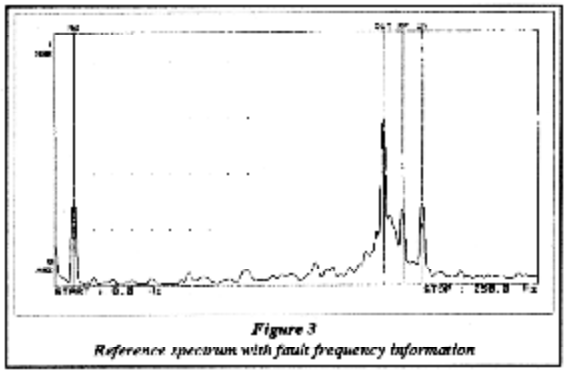

Figure 3
Reference spectrum with fault frequency information

Figure 3 is a simple plot of the reference spectrum, along with the fault frequencies of interest. The first peak is the running speed peak (RS). The peaks at 17, 18 & 19 times running speed are the blade passing frequencies. There are inlet (IN) and outlet (OUT) guide vanes and rotating blades (BP). Given that the pitch of the inlet guide vanes is adjustable, and the angle was not controlled during the tests, the alarm mask, used to automatically detect changes in vibration levels and report on the nature of the problem, would be designed so that these frequencies would not trip the alarm, because in this case they are meaningless. It should also be noted that an accelerometer was used to collect this vibration data. If a velocity probe was used, the blade pass peaks would appear lower as they are at a higher frequency.

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