CMVA 60 ULS SKF Microlog – Drill Platform Anchor Winches

By Dr. Bob Jones • SKF

Background

Drilling for oil in deep water requires some unique equipment to provide the stability needed for the drill platform during operations. Using a combination of cable and anchor chain, four or more anchors are placed by tugboats several thousand feet from the platform. After the anchors are secure, the cable is retracted until taut. Maintaining this tension provides the stability for operations.

The cable and anchor chains weigh approximately 149 kg/m (*100 lbs./ft.*) so that the cable winch is a massive device of over 113 000 kg (*250 000 lbs.*). The cable drum, which is electrically driven through a gearing arrangement, has the support bearings mounted into the inside radius of the drum, resulting in a rotating outer ring for the bearing and a stationary drum shaft.

During normal operations, the drum rotates at 10 r/min on two different bearings, an SKF 23292CA and an SKF 24064CC.

Fig. 1. Drill platform under construction.

Fig. 2. Anchor cable drum.

Once the drilling rig is in place, it will remain in place until there is some requirement to move, possibly many months. Environmentally, the bearings are in trouble from the day the tension is set because they may not rotate again until the platform is moved. As with any bearing, inactivity is hazardous to its health, and when it is in a damp, variable temperature location, condensation will occur and result in damage to the bearing rings. In addition, during storms, salty seawater is blown over the bearings and seeps into the internal parts. Water etching will result, which leads to spalling and an ultimate catastrophic bearing failure.

This is what had happened to a rig in the Gulf of Mexico. The resultant damage from the bearing failure included dropping several thousand feet of the anchor chain, which required a special recovery ship at an expense of over $2,000,000 USD, plus repair and lost production cost. The owners then asked us if we could inspect the winches on a rig under construction at a dry dock in Texas. The winches had been installed early in the construction and had been inactive for over six months.

Data collection

On arrival at the site, the usual unexpected conditions occurred. Primary was that the drive motors were not electrically connected and the units would have to be turned using the output from a welding machine. This limited the rotation speed to 2,3 to 2,4 r/min instead of 10 r/min. In addition, in contrast to the unit in the shop that we had examined, the stationary shaft on the installed units did not all have a "window" to the end of the shaft where we had planned to place the accelerometer. The end of the shaft is a perfect place to collect data, as it is the shortest path to the possible ring damage.

And finally, on some of the units, the cable was installed and a 76 mm (*3 in.*) cable spooling on or off a drum is not a quiet operation, even if the noise is random. The SKF Microlog CMVA 60 ULS is specifically designed to handle this difficult, ultra-low speed (ULS) application.

We began by obtaining the bearing fault frequencies for inner ring rotation from SKF Engineering in Kulpsville, Pennsylvania, and adjusting them for 2,3 to 2,4 r/min. The results were:

	SKF 23292CA	SKF 24064CC
• BPFO:	18,6 CPM	28,7 CPM
• BPFI:	24,5 CPM	34,2 CPM
• BSF:	16,7 CPM	23,9 CPM

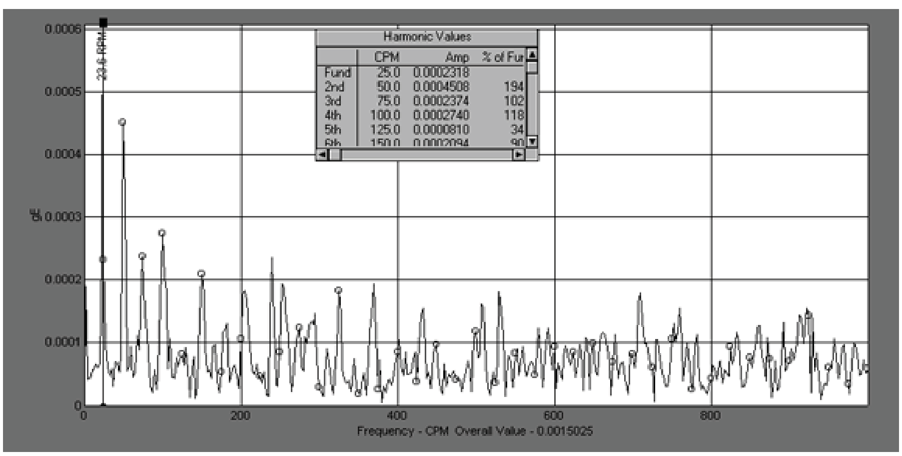

Fig. 3. Frequency spectrum of an SKF 23292CA, inner ring rotation at ~2,4 r/min. Winch number 2.

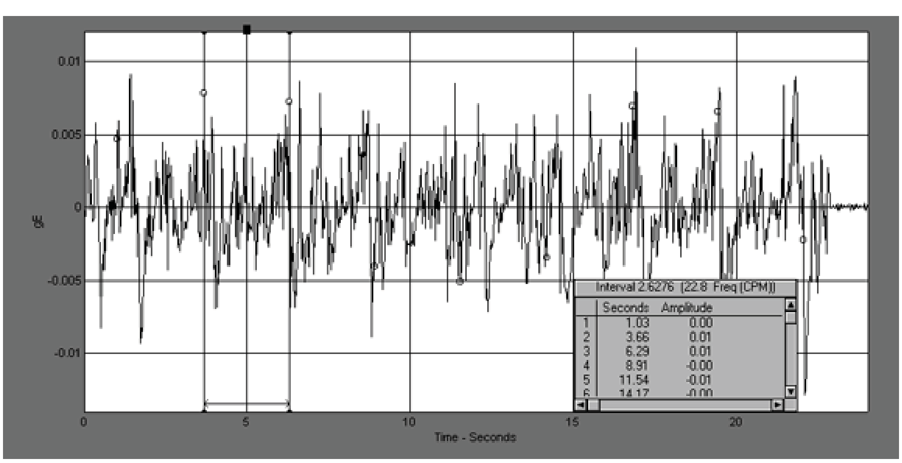

Fig. 4. Time waveform for suspect SKF 23292 inner ring damage. Winch number 2.

After experimenting to determine which envelope filter provided us with the best spectrum, the second filter was chosen, 50 to 1 000 Hz.

Fig. 3, taken on an SKF 23292CA, is one of the spectrums we collected that seemed to indicate a damaged inner ring. The fundamental frequency is marked at 23,6 CPM and it has multiple harmonics. Although the frequency was 0,9 different, the visual evidence was compelling; in addition, the r/min was calculated with a wristwatch.

Although the amplitudes are extremely low, one must remember that enveloped acceleration amplitudes are speed dependent. Laboratory testing has shown that a flaw in a bearing rotating at 50 r/min produces an amplitude of 0,004 gE. This same flaw produces an amplitude of 1,7 gE at 3 600 r/min. In addition, a bearing flaw will generate a truncated sine wave, which when processed with a Fourier Transform, will show the fundamental frequency plus harmonics.

Based on this knowledge, we called this a bad bearing. In addition, we always save the time information. **Fig. 4** is this display showing how the 23,9 CPM energy also appears in the time domain. We attributed slight variations in alignment to the slight variations in the rotation speed.

In **fig. 4**, the flat line for the last 2 to 3 seconds is the results of the welding machine dropping off line stopping the rotation. In comparison, **fig. 5** is data collected on another SKF 23292 where no damage was detected. All point setup parameters remained the same.

There is energy shown above 950 CPM, but this is not attributed to the bearing.

Fig. 6 is the time waveform of the number 3 winch bearing and scales set the same; the differences are readily apparent.

In this case, we were able to obtain photographs of the bearing after it was removed. In the color photo, the water staining is very apparent and although the damage cannot be seen easily, when a fingernail is passed over the area, a slight tick from the water etching can be felt.

Conclusion

In the realm of slow speed bearings, the SKF Microlog CMVA 60 ULS enables the user to evaluate bearing conditions on equipment rotating at speeds that previously would not have produced any usable data.

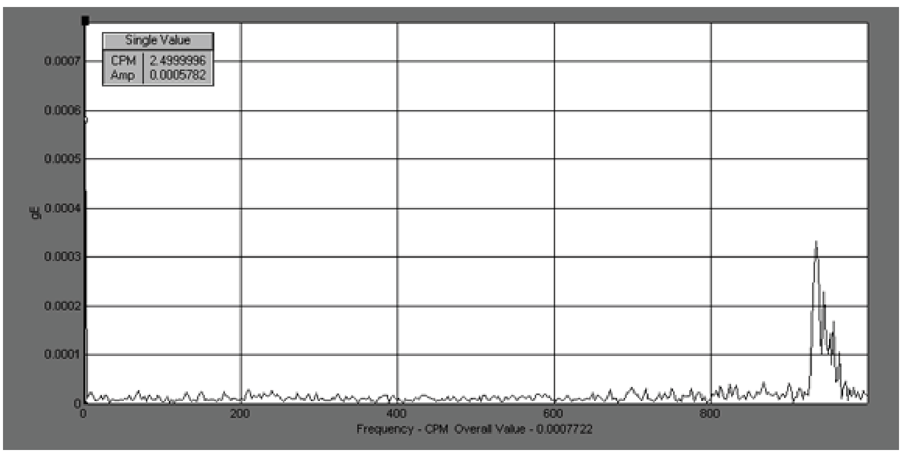

Fig. 5. Frequency spectrum of SKF 23292 on winch number 3.

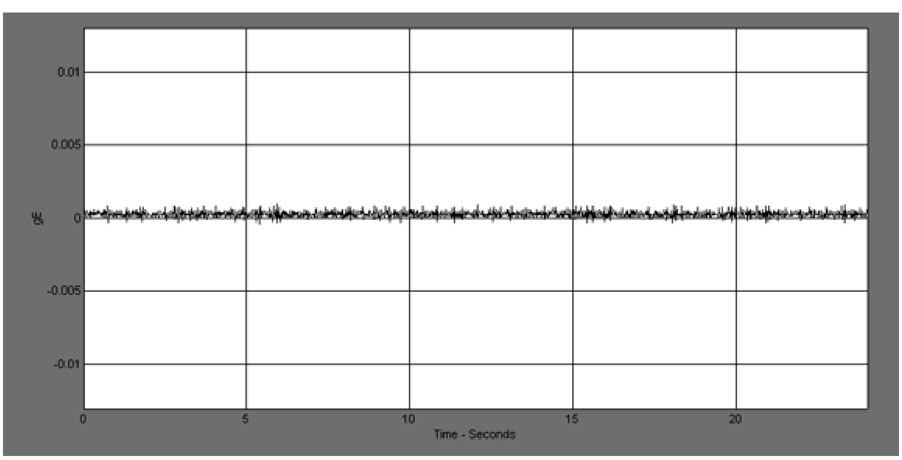

Fig. 6. Time waveform for winch number 3.

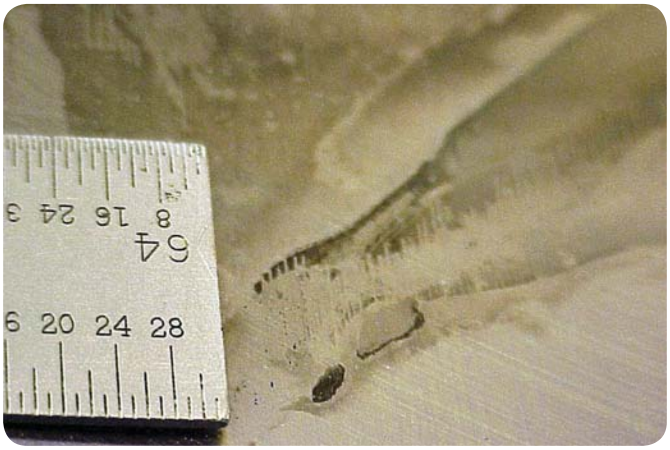

Fig. 7. Bearing ring surface, ruler has 1/32 in. hash marks.

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