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Tuesday, 01 April 2003 09:17

Last article of a four-part series covering alignment fundamentals and thermal growth, and highlighting the importance of field measurements through two case studies.

The previous article in this series, “Determining Accurate Alignment Targets” (MT 2/03, pg. 45), presented an example of thermal growth and its affect on equipment alignment at a wastewater treatment plant in Cleveland that needed realistic cold alignment targets for a 3600 rpm compressor. Another example is a project that involved performing off-line-to-running examinations on two identical machines at a cogeneration facility in Virginia.

The machines are gas turbine generator units that experienced high vibration issues at particular times along their operating cycles. These units were considered identical in terms of manufacturer, size, containment structure, load rating, installation, rpm, etc. A laser-based monitoring system was set up on both units and the setup dimensions were programmed into the computers. Data collection was started and the machines were placed into their startup modes at approximately the same time.

Dramatic difference seen

While the trended changes in the alignment had the same basic shape to the graph, one of the units showed a dramatically different change in the vertical offset alignment. Both machines are supposed to operate at the same temperature and both machines were set to the OEM-recommended cold alignment targets.

Unit No. 5 showed approximately a +20 mil maximum change in the vertical offset and settled around +10 mils at normal operating conditions.

Unit No. 6 showed approximately a +30 mil maximum change in the vertical offset and settled around +20 mils at normal operating conditions.

The OEM technical documentation states that the generator will grow 20 mils evenly front to back and the clutch will grow 22 mils evenly front to back. That results in a +2 mil change in the alignment from off-line-to-running at normal operating conditions. As noted, this value is not accurate and does not reflect the actual operating condition of either machine.

Compared to the recommended tolerances for the 3600 rpm machine, ±2 mils vertical offset misalignment, Unit No. 5 is operating with a vertical offset of +8 mils and Unit No. 6 is operating with a vertical offset of +18 mils. These particular machines have been operating under these conditions since their installation more than a year prior and have a history of high vibration readings and premature clutch failures since their first day of operation. The test on both units required less than one day to complete.

Consider dynamic movements

The cost of a precision alignment is typically small when compared with the loss of production should a critical piece of equipment fail. Even with the introduction of portable vibration monitoring equipment and easy-to-use laser alignment systems, alignment still ranks as one of the leading contributors to premature rotating machinery failure and lost production. One reason is the neglect or miscalculation of machinery dynamic movements. It has been shown that besides cold alignments, the actual dynamic movements of machinery need to be considered when aligning.

The problem of ignoring dynamic changes in the shaft alignment of two machines from off-line-to-running condition needs more attention. There is mounting evidence that long-standing assumptions are leading to machine reliability problems—assumptions such as believing identical machines have identical dynamic movements, relying solely on OEM recommendations, ignoring the possibility of horizontal movement, assuming growth will be symmetrical, and accounting only for thermal effects. These assumptions need to be challenged and behaviors changed.

The options available on the market today until very recently have not been enticing. Optical methods, mechanical methods, and laser-based monitoring systems all require some special skills and expertise to obtain good results. It may be prudent to contract these services for critical equipment rather than attempting to develop the skills in-house since the learning curves can be steep. A Swedish manufacturer has introduced a device that greatly facilitates in-house measurement of machinery dynamic movement.

Regardless of the approach, coupled machines need to be set to cold alignment targets that will reflect the actual changes in the shaft alignment. This will lead to lower vibration levels, increased mean time between failures, decreased maintenance expenditures, and increased production. Much like the philosophical change from aligning shafts with dial indicators to aligning shafts with laser-based systems, these types of measurements will take some time to be generally accepted and routinely practiced. While some of the current technology may be relatively expensive, a simple cost/benefit analysis will help with the right decision, which can

yield a significant increase in machine availability and profit. **MT**

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