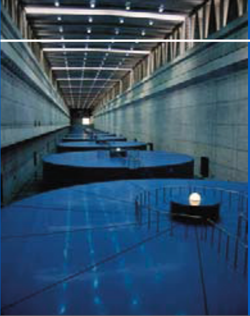

CS017

Short Comings of Conventional Vibration Monitoring

Machine Data

Commissioning:	1999	Nominal Air Gap:	11 mm/0.433 in.	Turbine Type:	Bulb / Kaplan	Bearing Layout:	Generator Guide
Power:	42 MW	Stator Bore Dia.:	6.45 m/253.94 in.	Nbr Blades:	4		Turbine Guide
Speed:	112.5 rpm						

This case, related to *Case Study CS016*[1], demonstrates how vibration monitoring alone can fail to fully protect a machine and why the information it provides can even be misleading. It shows that vibration monitoring did not provide any early indication to permit preventive action.

In *Case Study CS016*, it was clearly demonstrated that the rotor rim severely deteriorated in just nine days. A section of the rotor rim had become loose and was protruding when rotating toward the bottom of the horizontal bulb unit. This rotor rim flexing was creating a cyclic imbalance that overstressed the rotor rim-to-spider interface. At this rate, it was obvious that a failure would occur within days.

Comparison of vibration results for the same period showed that no significant change had yet been measured. Pole measurement graphs in Figure 1 indicate that the overall shape of each sensor curve remained similar while the amplitude slightly increased. Peak-to-peak vibration levels for all probes were still within or slightly above normal assembly tolerances[2]. Further analysis of FFT and orbit graphs (Figures 2 and 3) did not show significant variations over the same period.

Although the air gap clearly indicated a critical situation was emerging, the vibration instrumentation had yet to detect, let alone warn of, any significant change in the vibration behavior. Given the rate at which the rotor rim was deteriorating and the lack of any indication from the vibration instrumentation, it is believed that the situation would have gone unnoticed until a catastrophic failure occurred.

(continued on overleaf)

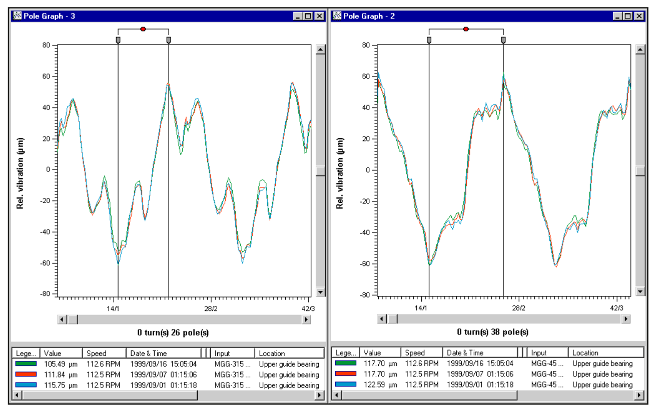

Figure 1: Comparison of shaft displacement measurements at Generator Guide Bearing (left: Y / 315°, right: X / 45°) taken on September 16th, nine days earlier, and two weeks before. Note how little the curves have changed: X varied from 105 to 115 µm and Y varied from 117 to 122 µm.

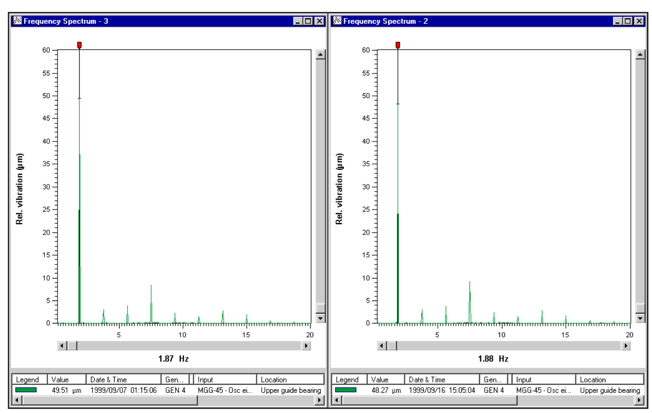

Figure 2: Frequency Spectrum graphs comparing FFT results of X (45°) axis probe at Generator Guide Bearing between September 16th (right) and nine days earlier (left). Again, the spectrums are very similar in amplitude and frequency.

Notes on back of page

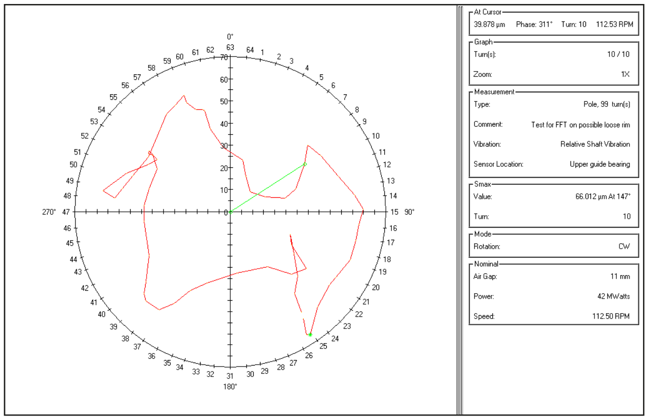

Figure 3: Typical shaft orbit at Generator Guide Bearing on September 16th. The cursor indicates the position of the shaft when pole #39 (most critical) faces air gap sensor at 225°.

This supports VibroSystM's theory, for large and slow rotating machines such as hydrogenerators and large motors, that vibration typically measures the effects of a problem, not the problem itself. Meanwhile, air gap often measures the anomaly, either directly or indirectly, indicating the exact cause of a problem. Although both parameters are complementary, cases after cases have proven that air gap monitoring is frequently more valuable than vibration monitoring for diagnostic purposes on these machines. Their nature is such that, due to their size and weight, most mechanical problems that can occur will be filtered out and will go unnoticed by the vibration instrumentation usually located at the guide bearings.

1 *See Case Study CS016: "Detecting & Diagnosing a Rotor Design Weakness on New Hydrogenerators".*

2 *See Application Note AN001: "VibroSystM's Mechanical Tolerances Guidelines for Hydroelectric Generators". Shaft vibration: assembly < 102 µm / 4.0 mils.*

3 *1 mm ≈ 39.4 mils / 1 mil ≈ 0.0254 mm or 25.4 µm*

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