ZOOM MC/TM

VIBROSYSTM

CS035

Alternative to Generator Shutdown During Peak Season

Machine Data

Commissioning:	2002	Power Factor:	0.85	Cooling:	Air
Turbine Type:	Combined cycle/Gas & Steam	Speed:	3600 rpm		
Power:	240 MVA	Insulation Type:	Class F Micadur		

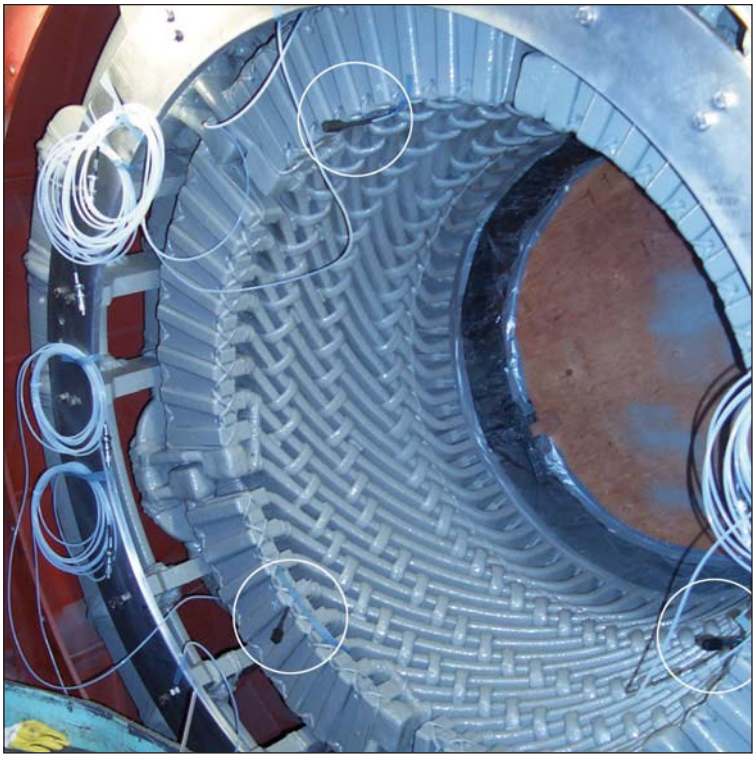

Figure 1: FOA™-100 Sensor locations at 3:30 (105°), 7:30 (225°) and 11:30 (345°) positions during the installation of sensors on the generator.

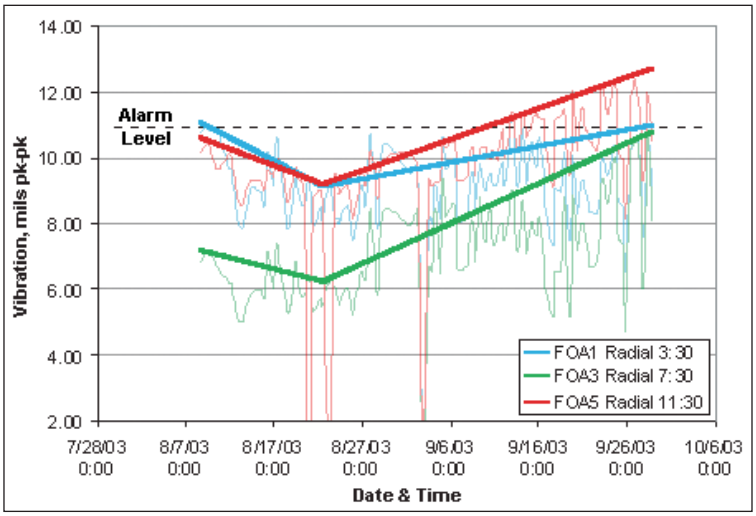

Figure 2: Trends of end-winding vibration on STG #2, from early August to late September 2003, show that vibration levels had reached or exceeded alarm levels.

The following case describes the successful application of end-winding monitoring technology on two newly commissioned steam turbine generators. This action facilitated their operation through the summer peak demand and helped monitor the performance of subsequent Original Equipment Manufacturer (OEM) modifications.

In June 2003, the generator manufacturer notified the utility of a potential serious problem with the phase lug connectors on the collector ring end and advised them to shut down both units immediately and wait until the Fall season to proceed with corrective measures. A four-month forced outage and loss of power generation during the peak summer season was not an acceptable solution for the utility management.

With the generator manufacturer's approval, the utility installed three pairs of Fiber Optic Accelerometers (FOA™-100) on each generator, on the end-windings at the 3:30, 7:30, and 11:30 positions (one radial & one tangential each) as per the manufacturer's instructions (see Figure 1 of FOA™ installation). The manufacturer also indicated vibration alarm levels where, if exceeded, they must be contacted immediately.

Over the summer, a pattern of increasing vibration emerged. STG[1] #2 was of greater concerns. Figure 2 shows that in early August, radial vibration levels were at 254 µm (10 mils) pk-pk and at roughly 203 to 229 µm (8 to 9 mils) pk-pk at the end of the month. By late September, radial vibration at the 11:30 position had exceeded 305 µm (12 mils) pk-pk.

The unit was cycled between full load and half load to meet system requirements. A strong correlation of high vibration at half load was observed. By October, end-winding vibration had increased to a level at which curtailment was

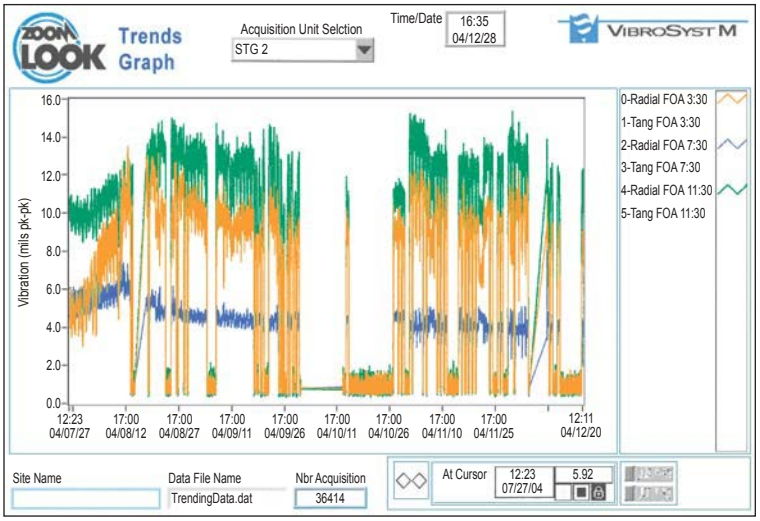

Figure 3: Trends of end-winding vibration from late July to late December of the same year.

imperative. Fortunately, peak demand period was over and both units were removed from service for end-winding structure modifications.

The units were not operated extensively until early June 2004.

Figure 3 displays STG #2 end-winding vibration trends from late July through December 2004 showing a steady increase in radial end-winding vibration. In early June, all three radial FOA™ readings were under 102 µm (4 mils) pk-pk. By late July, radial FOA™s at the 3:30 (yellow) and 11:30 (green) positions read well over 254 µm (10 mils) pk-pk. The 7:30 radial position FOA™ (blue) peaks at over 178 µm (7 mils) pk-pk in early August and then gradually ramps downward towards the end of the year.

However, the vibration at the 11:30 radial position increased to as much as 381 µm (15 mils) pk-pk by mid-August 2004. The manufacturer was contacted and used the data to aid in the development of an end-winding stiffening system in order to mitigate the problem.

End-winding vibration monitoring had proven to be a necessary and effective tool: 1) it confirmed a trend of increasing end-winding vibration on STG #2, 2) it allowed continued operation of the units with high end-winding vibration instead of a forced shutdown and the purchase of replacement energy during peak demand period, and 3) it provided valuable information to develop and implement corrective actions.

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[1] STG = Steam Turbine Generator