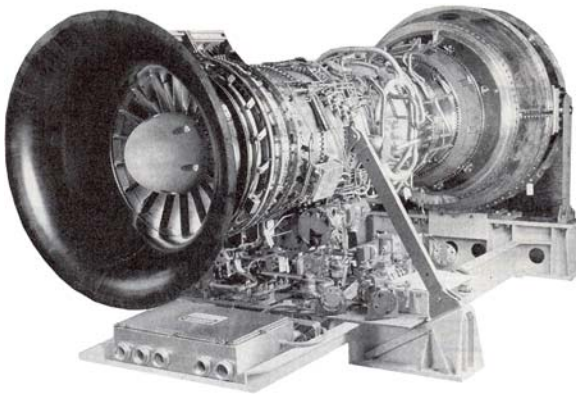
Mechanical Solutions, Inc.
Rotating Machinery Analysis, Test & Troubleshooting

Case History: Aeroderivative Gas Turbine and Gearbox / Genset

MSI was called on behalf of a customer who had seen a large increase in the vibration levels of a particular LM500 Gas Turbine Generator Set being used to supply power to a large pharmaceutical facility. The increase in vibration levels was serious enough to warrant shutdown. This power facility was used to meet much of the electrical power needs of the entire complex and any loss of generating capacity translated straight into increased electrical operating costs because of the need to buy power from the grid at a time of the year where such purchases were particularly expensive. The plant wished to continue operation another 3 months, until there was a planned shutdown.



The OEM had not been able to find the reason for the difficulty. Therefore MSI was called in to help diagnose and fix the excessive vibration. The customer had noticed that the large increase in the overall vibration was particularly troublesome in between the gas turbine and the generator. They suspected that the problem was a torsional natural frequency of the gearbox. MSI performed testing using generator shaft strain gauges and sophisticated radio telemetry. Because of MSI's experience conducting such tests, the generator was shut down for only an hour in order to install the telemetry system.

The testing was to focus on torsional oscillation, but showed that the torsion did not cause the high gear box vibration. MSI continued testing and was able to quantify the vibration levels with increasing load. Based on the shape of the vibration

spectrum, the strength of the vibration appeared to be associated with a natural frequency resonance. However, impulse testing on exposed components detected no strong natural frequencies near 1X or 2x gear mesh. It was also noted that the vibration increase was sensitive to load level. In light of this, the sudden increase in vibration suggested a possible shaft or casing crack that opens up under increasing load. This crack could open up further as the load transmitted through the gear box was increased. Stationary "bump" tests did not indicate this crack but vibration measurements at many locations at various loads made it apparent.

In order to be completely certain that this was the most likely cause, MSI also tested the electrical generator to confirm that the problem was not generator or electrically based. This testing revealed nothing unusual in the phase to phase characteristics of the system and left a crack as the most likely cause of the problem.

On the recommendation of MSI, die penetrant testing of the gear box was conducted. The die penetrant testing revealed that a crack had formed on the foot of the gear box casing. The crack was welded shut and subsequently the vibration of the gearbox was reduced to earlier acceptable levels. This work allowed the end user to continue power generation during a critical portion of production.

In addition to knowledge of the LM500, the staff of Mechanical Solutions, Inc. has background and experience in the analysis and testing of aeroderivative gas turbines, such as the popular FT-4, FT-8, LM2500, LM6000 PC, and Frame 7FA units. One of MSI's principals was one of the design analysis team-members for the original ground-based and marine-based conversions of the FT-4. Generally, problems with these units are installation or system related. MSI's ability to separate and evaluate rotordynamic, casing, and support structure effects allows such problems as well as any warranty issues to be quickly identified, such that responsibilities can be determined, and appropriate fixes can be developed and implemented.

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