CURTISS WRIGHT Flow Control Company SCIENTECH

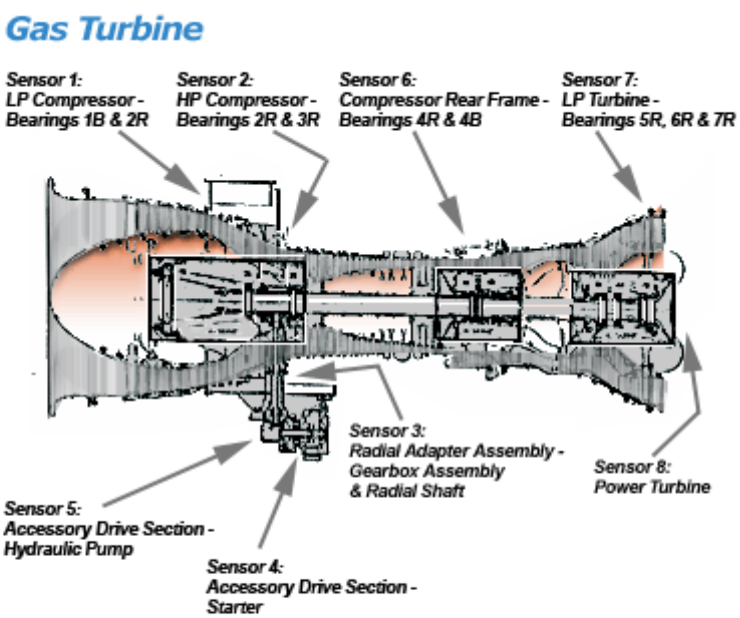
Gas Turbines

Preventing costly and troublesome outages

A GE LM5000 aero-derivative gas turbine engine-power generator was monitored using a Stress Wave Analysis (SWAN™) System for 6 months prior to a scheduled 50,000-hour overhaul. At the onset of the test, Stress Wave Energy (SWE) readings from all sensor locations were very consistent and linear in nature. Within a few months, SWE from the low-pressure turbine section began trending upward in an erratic fashion. Spectral Analysis yielded no significant spectral lines that could be correlated to any of the bearing passing frequencies. Seal damage was suspected as causing the erratic trending. The tear down and inspection confirmed labyrinth seal damage. Given SWAN's ability to detect and clearly display damage as minor as seal wear, it is an ideal tool for detecting the much higher energy events associated with bearing and gear damage.

SWAN technology prevent catastrophic failure and secondary damage-along with the associated downtime and high repair costs-in gas turbine applications.

Bearing failures are some of the most costly and troublesome forms of unplanned outages for gas turbine engines. A failed bearing causes extended down time and very high repair costs when secondary damage occurs in the engine. Ironically, the most common method of preventing such expenditures by routinely overhauling the engine is an extremely costly and difficult time in itself. The time between overhauls is typically set conservatively such that some critical components have as much as two to three times more useful life than the overhaul interval would suggest.

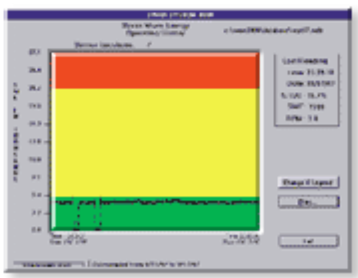


Stress Wave Analysis is not only an ideal tool for identifying bearing damage because of its extreme sensitivity, but also is ideal at showing the absence of damage from critical components as the following case suggests.

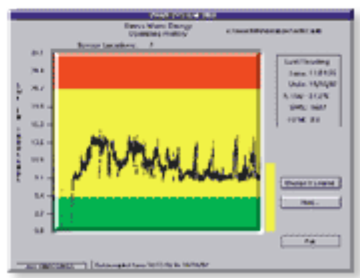
A large aero-derivative gas turbine engine-power generator was outfitted with eight stress wave sensors (see Figure 1) and monitored for a period of six months prior to a scheduled 50,000 hour overhaul. The purpose of the survey was to determine the necessity of the scheduled overhaul, realizing that the costs associated with such an activity is well into seven figures. A prolonging of operation before overhaul would prove to be a considerable cost savings to the operator.

At the onset of the test, Stress Wave Energy readings from all sensor locations were very consistent and linear in nature; thus green, yellow, and red color zones were established using standard SWAN criteria (see Figure 2).

Within a few months, SWE from Sensor 7 began trending upward in an erratic fashion (see Figure 3). Noting that several bearings are in the proximity of Sensor 7, an effort was made to determine the source of the SWE increase. A SWAN Spectral Analysis yielded no significant lines that could be correlated to any of the roller element passing frequencies from bearings. This information, coupled with the absence of aperiodic shock events associated with skidding or particulate debris contamination, led to the conclusion that seal damage was the likely culprit.



Healthy Data



Damage Data

The tear down and inspection process of the overhaul did verify the presence of labyrinth seal damage in the Low Pressure Turbine section. More importantly, no bearing wear or damage was evident from any of the bearings raising the question of whether or not the overhaul was warranted at that time.

Given SWAN has the ability to detect and clearly display damage as minor as seal wear, it is an ideal tool for detecting the much higher energy events associated with the early stages of bearing and gear damage. With this degree of clarity, SWAN not only allows you to extend the useful life of your machinery, but to do so with confidence. The ability to identify bearing damage from its onset provides the operator with tremendous latitude in planning maintenance activities to both optimize

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