

Machinery diagnosis



Sulzer is your global partner with reliable and sustainable solutions for your key operations. We offer repair and maintenance services for turbines, compressors, pumps, generators and motors. We also offer OEM and aftermarket parts. With one of the largest service networks in the industry, we are close to our customers with over 180 production facilities and service centers worldwide. Our cutting-edge engineering services provide unique and innovative solutions customized to your equipment needs.

This 1943 vintage steam turbine consists of a multistage, tandem compound double flow turbine exhausting to a surface condenser. Over the years, this unit experienced a myriad of vibration problems and thrust failures. In December of 2000, Sulzer was commissioned to rebuild and modernize this machinery train. The work scope included a rotordynamic analysis, updated lube oil system, new control and vibration monitoring system, plus hardware improvements such as squeeze film damper at the #1 bearing. In addition, optical alignment measurements and field balancing were performed, and this extensive work was completed in March of 2002. Under this configuration, the train ran successfully at rated capacity for the next four generating seasons.

During the winter outage of 2005-06, the generator rotor was removed, rewind, high speed balanced, and reinstalled. The turbine rotor was likewise removed from the casing, various problems were repaired, and the married HP-LP rotors were high speed balanced. Following reassembly of the machinery train, the initial startup to full speed occurred on March of 2006. Unfortunately, vibration at the #1 bearing was load sensitive. At generator loads above 32 megawatts the shaft vibration increased at an alarming rate, and sustained operation at desirable loads of 44 to 46 megawatts was not possible during the 2006 generating season.

- Troubleshoot vibration and mechanical issues
- A clear route to reliable equipment



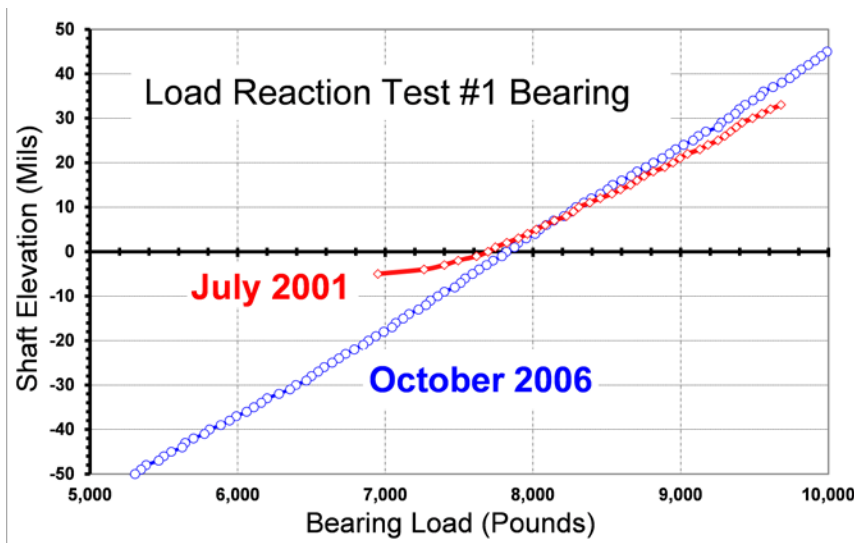
In close cooperation with the customer, Sulzer developed an extensive test plan for investigating the mechanism(s) responsible for the high vibration and associated power generation restrictions. During the outage of 2006-07 it was discovered that the bottom half of the #1 bearing was wiped and obviously overloaded. In order to verify bearing loads, a load reaction test was performed as shown in the adjacent photo. This test consisted of removing the bearing and measuring static load with a digital scale versus journal elevation with a dial indicator.

The results from this test are presented in the next graph. It is clear that elevation versus load was identical between the initial measurements from July of 2001 and October of 2006. Since the loading was identical, and the #1 bearing bottom half was wiped, it was necessary to reshoot the train optically. These vertical bearing position measurements revealed that the #1 bearing was sitting 30 mils higher than necessary, and the effective loading was substantially increased.

In the final evaluation, previous shaft vibration at 30 megawatts was 4.9 Mils,pp in March of 2006. Removing 30 mils of shims from the front standard allowed the train to run at desired output rate of 44 megawatts with only 1.5 Mils,pp of shaft vibration at the #1 bearing.

Engineering services capabilities/service offering:

- Alignment tracking
- Machinery diagnosis
- Field balancing
- Performance rerates
- Technical upgrades (blade design improvements)
- Root cause failure analysis
- Rotordynamic analysis
- Turbomachinery engineering seminar series



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