

Courtesy of Alstom

CASE STUDY

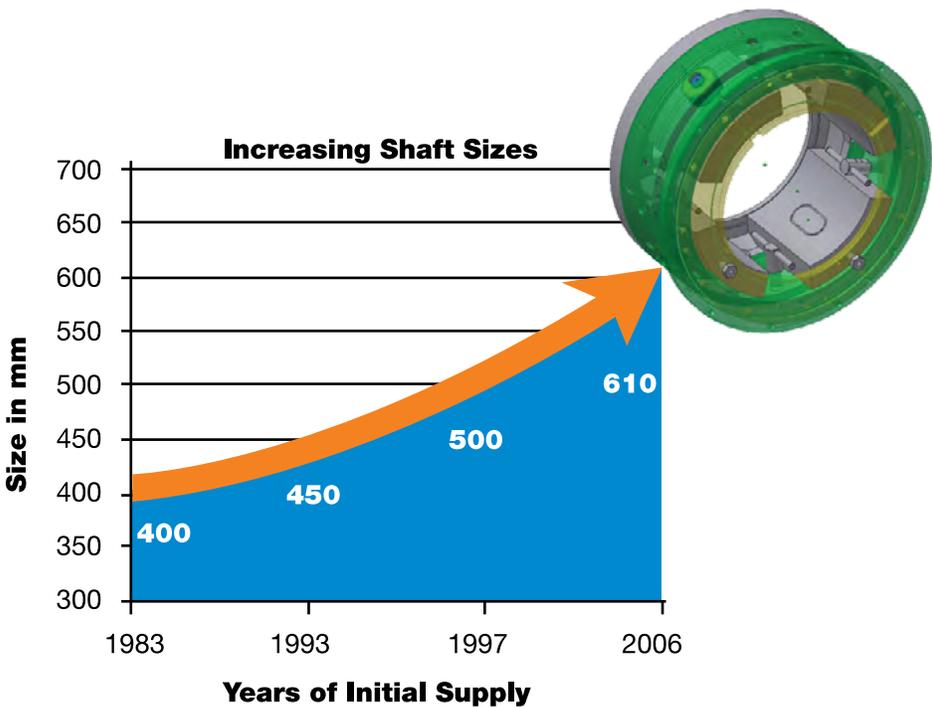
Maxalign® Bearings Reduce Spiral Vibration on Alstom Power Turbo-generators

PROJECT OVERVIEW

With over 100 years of experience, Alstom Power is a leading provider in the power generation industry. Close to 25% of the world's power production capacity depends on Alstom technology or services. With the industry trending toward improved efficiency, in both new and existing equipment, higher demands are placed on the equipment and the bearings.

When Alstom identified a phenomenon of spiral vibration close to the trip level on one of their 450 MVA hydrogen-cooled generators, Waukesha Bearings' (WB) proprietary predictive tools and extensive industry experience on equipment of this size made them the clear choice to design and manufacture a drop-in bearing replacement.

More than 13 generator sets have been commissioned since the initial phenomenon was detected in 2003. In total, the Maxalign bearings have seen 600,000 cumulative operating hours with these particular Alstom generators.



AT A GLANCE

Industry: Power Generation

Application:

- 60 Hz turbo-generator
- Radial load 22 tons
- Shaft speed – 3600 rpm
- Lubrication – ISO VG46 at 45°C/115°F inlet

Product Solution:

- 400 mm (15.75 in) Maxalign journal bearing
- Special features included electrical discharge prevention

Benefits:

- Phenomenon of spiral vibration eliminated
- Critical speeds shifted to well above the rated speed
- Drop-in bearing replacement for fixed geometry bearing without pedestal modifications
- 'Directed Lubrication' controlled oil usage and power loss and achieved acceptable temperatures
- Ball and socket design provides superior stiffness, dynamic alignment capability, and eliminates pivot wear
- Proven design with over 30 years experience, over 150 unique designs and more than 2,000 applications

SOLVING THE CHALLENGE

Spiral vibration, also known as the Newkirk effect, can be observed on various types of turbomachinery and is caused by a vibration induced hot spot on the shaft surface generated by friction. The relative shaft vibration at the generator non-driven end bearing was measured to be close to trip level and therefore a root cause analysis was initiated by Alstom to solve the problem.

Alstom sought WB's expertise to design and manufacture new bearings to resolve the spiral vibration and fit within an existing radial space to provide a drop-in replacement without modifications to the pedestal. In terms of performance, the new bearings were required to have maximized stiffness coefficients, in particular in the direct coupled horizontal plane. Within the space constraints of the original fixed geometry bearings, the new design would need to produce acceptable load support and oil inlet flow velocity, with double insulation to prevent grounding of shaft currents via the bearings.

WB's Maxalign journal bearing with a 400mm (15.75 in) inside diameter was engineered to solve the challenges on this turbo-generator. Using proprietary predictive tools coupled with 30 years of field experience, testing, and development, WB was able to confidently predict bearing performance. This included optimization of pad geometry, lubrication method and taking advantage of the superior stiffness qualities of WB's patented ball and socket pivot design. The installation successfully eliminated the vibration and shifted critical speeds to well above the rated speed, just as the performance testing predicted.

ADDED BENEFITS

Maxalign offers many added features which yield additional benefits to OEMs and end users alike. The ball and socket pivot design is highly adaptable to shaft misalignment caused by mechanical loading or thermal effects in large rotating equipment. The ball and socket pivot design eliminates pivot wear commonly associated with traditional pivot designs, thus providing a zero maintenance bearing. Utilizing WB's 'Directed Lubrication' method reduces the amount of oil needed, power loss, and keeps operating temperatures within the acceptance range.



Hydrostatic jacking grooves in the lower pads not only reduce friction during start up but increase safety margins and machine reliability. The bearing also includes a provision for instrumentation to match original equipment fittings as well as the ability to directly measure electric resistance of each insulating layer when assembled.

Overall, the benefits all point to an increase in availability and reliability in the field.

VERSATILITY

WB's experience dates back to 1983 when the first Maxalign bearing was installed in a 130MW turbo-generator application to overcome a new misalignment condition. Since then, WB has provided more than 150 different Maxalign designs in over 2,000 applications for turbo-generator, gas turbine, steam turbine, and synchronous clutch OEMs. Maxalign is a proven, versatile design available from 300mm (11.8 in) upwards and in combination with thrust bearings, giving customers the benefit of a complete machine set.

