

## Bearing upgrade project completed

The project involved upgrading the journal bearings on a Westinghouse 251 B gas turbine. The gas turbine operates at 4,894 RPM and drives a 2-pole (3,600 RPM) generator through a gear box. The turbine is located at an electric utility power plant in the Midwest.

This particular unit has had a history of high amplitude subsynchronous vibration. The user decided to check the stability characteristics of the original sleeve journal bearings and planned to change to tilt pad designs, if feasible. TCE was called in at this point because of their excellent engineering reputation and for their superior ball and socket bearing pivot designs. The reason for choosing a tilting pad journal bearing over a fixed geometry bearing is the greater dynamic stability of the tilt pad design.

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***“TCE was called in at this point because of their reputation for superior ball and socket designs”***

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In early winter of 1998, the turbine ingested large chunks of ice. Several rows of blades were damaged requiring an unscheduled extended outage. This meant there was not sufficient time to work on the bearings.

The gas turbine rotor was sent to a turbine repair company in north Houston. About the same time, TCE was asked to review the available design information on the unit and establish that the original equipment fixed geometry journal bearings could, in fact, be replaced with tilting pad bearings using ball and socket pad supports. Figure 2 is a photograph of the OEM bearing. These bearings were shipped to the turbine repair shop with the rotor and eventually reshipped to our factory.

In the meantime, we initiated a search through our job and engineering files and verified that we had indeed reworked several sets of OEM tilting pad journal bearings from other Westinghouse 251 gas turbines. Thus, we were quite confident that we could supply tilt pad bearings for this unit that would be similar to the designs supplied by Westinghouse except for having our upgraded ball and socket pad supports.

All that remained at this point was to perform a bearing analysis of the original bearings and a design study of the tilt pad bearings to verify the various parameters such as stiffness, damping, power loss, oil flow, and temperature rise would be satisfactory.

In early 1999, TCE received an order to manufacture a set of two 9” tilting pad bearings of the four pad design. Delivery was required in a short five weeks. The bearings were delivered during the first week in March and the shipment coordinated with the repaired rotor leaving the repair shop at the same time. The bearings are shown in Figure 1.



**FIGURE 1, above, shows the tilting pad bearings delivered five weeks after the order. Figure 2, below, shows the OEM bearing.**

The unit was fired up about the 15th of April and brought up to 15 MW at synchronous speed. Vibrations were very low compared to previous readings. Previously vibrations exceeded 6 to 10 mils at 5 to 10 MW of load. Reports indicate that in May



1997, the unit was so rough it could not be run safely on a continuous basis. With the upgraded bearing design maximum vibration reached 2.0 mils peak to peak at the first critical and less than 1.0 mil at 15 MW. The journal bearing babbitt metal temperatures are now satisfactory, running well below 200F.

TCE/Turbo Components & Engineering is proud to have been involved in this successful fast turnaround project. This was a

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## TCE announces management changes

Paul Dodson, President of TCE, has stepped down to pursue a life-long dream of working in the great outdoors. Paul's new customers will change from rotating equipment and maintenance engineers to tourists. Paul has held the title of President since the founding of TCE in January of 1991. His leadership skills and determination to provide quality service to our customers has given TCE a strong foundation to continue building from. Paul will continue to serve TCE and our customers in a consulting roll, but will certainly be missed

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## Upgrade

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very cooperative and professional effort involving our customer's engineers, the turbine repair facility, TCE suppliers and TCE personnel.

This case history, and another describing the #1 and #2 bearing upgrades to optimized tilting pad journals bearings on a 220 MW turbine generator set, were presented at an advanced turbine generator maintenance seminar in Florida in June of 1999. Copies of the handouts on these two case histories are available if you are interested. Just give us a call, drop us a note, or send us an email.

## Solutions for hot-running thrust bearings

This quarter our feature paper is "Thrust Bearing Analysis, Optimization and Case Histories". This paper was authored by TCE's Manager of Engineering, John Whalen and originally presented at the 25th Texas A&M Turbomachinery Symposium. Have you ever wondered if you could lower your thrust bearing temperature by changing pad backing material? What would happen if you offset the pivot on a thrust pad or used a directed lube bearing instead of a flooded bearing? This paper can help answer these and other questions related to hot running thrust bearings. Most critical rotating equipment in the refining, chemical, and petrochemical industries contain thrust bearings to counteract internal axial loads generated by pressure differentials in the machine. The paper's coverage is limited to babbitted oil film thrust bearings as they are most commonly found in critical turbines and compressors. Thrust bearing types, terminology, and operating limits are discussed. An analysis tool called THRUST is then introduced. Application of the program is used to illustrate various design options and two case histories follow. Please give us a call or send us an e-mail if you would like a copy of this paper.

## Reach us on the Web at tce1.com

TCE's new web page is up and running. From this page you can view past newsletters, request technical papers and brochures, or send us E-Mails if you have questions regarding babbitted bearings or seals.

For reference our email addresses are as follows:

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## Management

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on a day-to-day basis by those left to carry on. All of the employees wish Paul the very best and if anyone wants to experience the great fishing in Alaska, they might want to get in touch with him.

John Whalen, who has been Vice President of TCE since the founding in 1991, has become President. John built the quality into TCE's products through sound engineering and control processes. Prior to the start up of TCE, John held engineering positions with Dresser-Rand (Turbodyne Division), Centritch and IMO Industries (now TurboCare). John is well known throughout the machinery industry and our customers can certainly rest assured TCE will continue providing the expected quality and service under John's leadership.

Larry Fisher, who has been on TCE's Board of Directors since 1991, has assumed the roll of Vice President reporting to John Whalen. Larry brings 25 years of rotating equipment experience to TCE from both the user and OEM prospective. His previous employment was with International Minerals & Chemicals, IMO Industries (now TurboCare) and Flowserve (previously BW/IP and Durco International). Positions held with these corporations included mechanical project engineer for plant construction, mechanical reliability superintendent, manager of new business development, Alaska service center general manager and, most recently, regional sales and operations manager for five service centers in the Gulf Coast. If you know Larry and/or have worked with him in the past you may want to give him a call (or drop him an email at larry@tce1.com) to catch up.



*Larry Fisher*



*John Whalen*

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