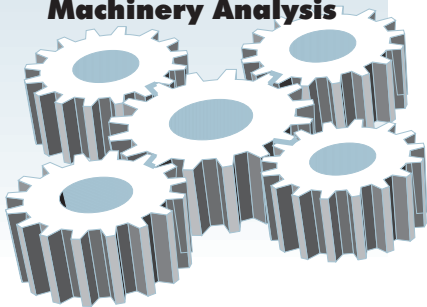


THE BETA BULLETIN

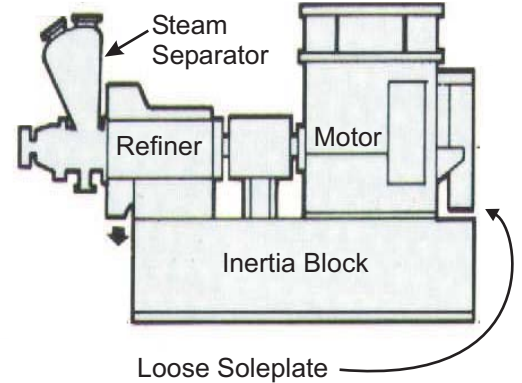
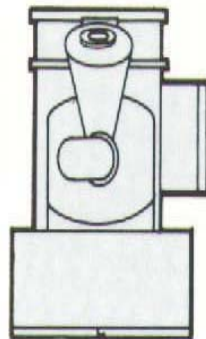


Machinery Analysis



Loose soleplate could have cost \$1 million to replace

Single Disc Overhung Rotor Pulp Refiner
12 Mw Synchronous Motor



One of eight identical 12MW synchronous motors was showing high vibration levels at the motor exciter end occurring at a frequency of 30 Hz (1800 RPM) in the horizontal direction. This particular motor had a history of problems with the insulation in the rotor.

The mill team tried running the motor uncoupled but found it had no effect on reducing the vibration. They called Beta Machinery Analysis Ltd. to help with the diagnosis.

The Beta analyst discovered a loose soleplate at the exciter end and another motor with slightly high vibration readings. All other units had tight soleplates and low vibration.

Since there was no way to eliminate the looseness in the soleplate, the mill proposed to pour a new inertia block adjacent to the TMP hall and replace the old inertia block when the new concrete cured. The total cost of this solution would be in excess of \$1 million and the work would have to take place over the Christmas season.

Beta reviewed the complete set of vibration records since start-up. The result of the review offered an alternate solution. The analyst noticed that the vibration levels were more noticeable in September and increased every week for 2 months before leveling off in November.

He compared the vibration levels to the corresponding operating parameters and discovered that the temperature of the lube oil to motor bearings had dropped by about 5°C during this same time period.

Beta recommended that the oil temperature setpoint be raised gradually. They noticed that for an 8°C increase, the motor vibrations dropped by 60%. Although the vibration level was still rough, it was within allowable limits. They also recommended that the motor be precision balanced whenever it was convenient.

During the summer the soleplate became loose, which decreased the effective stiffness of the motor bearing and reduced the horizontal natural frequency to below run speed. The colder oil in winter raised the natural frequency closer to run speed, making it more sensitive to the loose soleplate. So by increasing the oil temperature setpoint, the mill saved over \$1 million and avoided the hassle of emergency construction during the Christmas season.

INSIDE VOLUME 8 #2

Loose soleplate on refiner motor 1

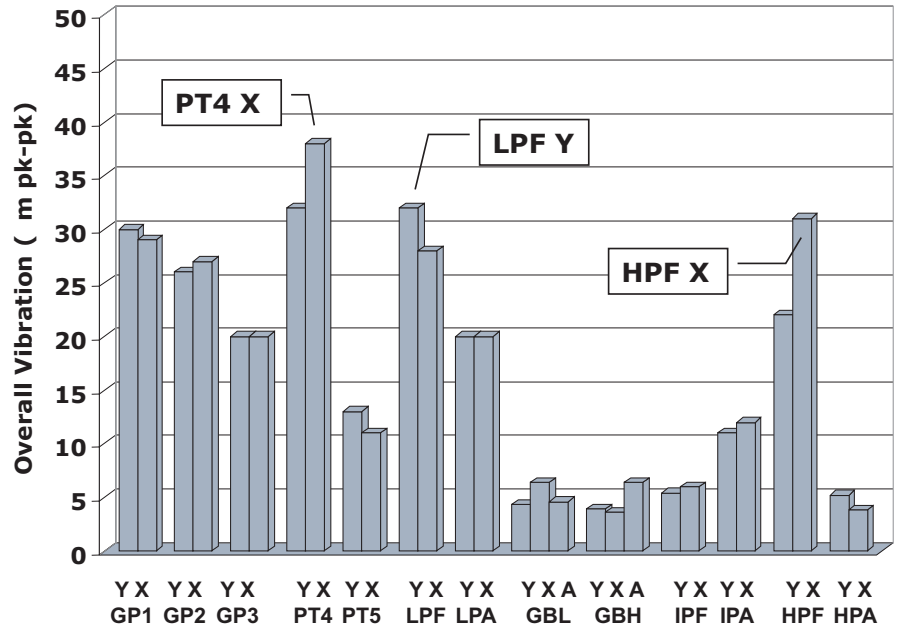
Gas turbines and centrifugal compressors 2

New course and seminar 4

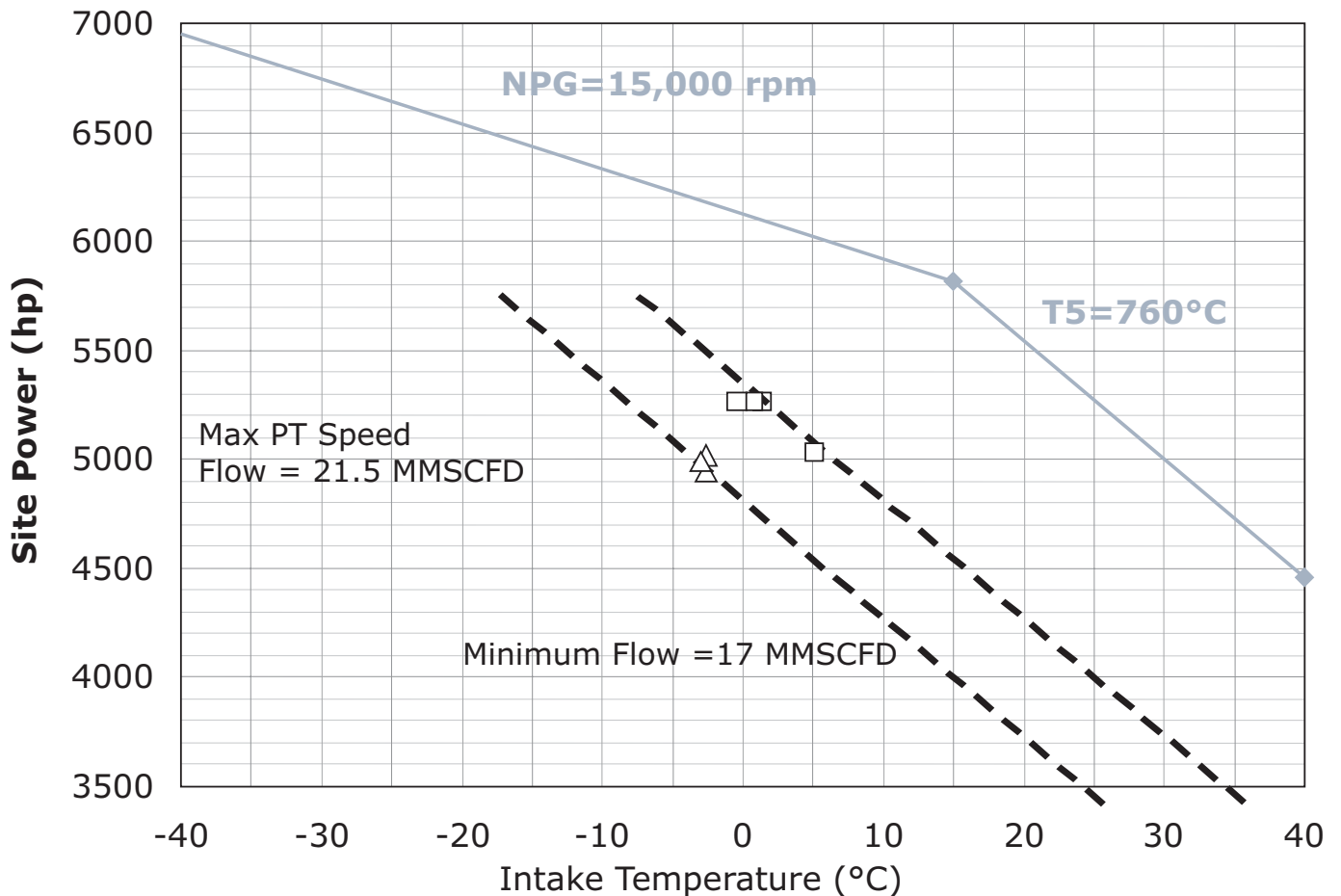
Beta Machinery Analysis recently completed an analysis of a Solar Taurus.

Come to a free half-day seminar to find out what they learned.

What does this overall vibration profile tell us about the unit? ▶



What does this figure tell us about turbine performance? ▼



Monitoring condition and performance of gas turbine/centrifugal compressor units can provide major economic benefits. There are three major aspects: performance monitoring, vibration analysis and physical inspections.

On the facing page, some results from an evaluation are shown. These analyses were undertaken to help decide on whether to make a major investment in a rebuild at this time or to continue to run the equipment.

Vibration Analysis

The power turbine #4 bearing shows high vibrations (46-48 micrometres pk-pk), partic-

ularly on the X probe, marked "PT4 X" in the bar graph. The primary component of the vibration is at run speed, suggesting poor balance. The vibration did not improve after a wash. Trending shows that the vibration has increased over the last 4500 hours.

The HP compressor inboard bearing has higher vibrations than the outboard bearing (31 vs 6 micrometres pk-pk). The primary component is at run speed with a nearly circular orbit, suggesting poor balance.

Performance Analysis

Gas turbine performance is summarized in the graph of power versus intake temperature. The solid line at the top represents the design

operating limit for the turbine. Above 15 deg C ambient, power is limited by T5, that is, by turbine temperature. At lower ambient temperatures, power is limited by gas producer speed. Any deterioration in the gas path tends to raise T5 for a given power level; T5 limit line moves down and to the left, parallel to the original. The lower dashed line represents the actual limit for this unit "as-found". Notice the major reduction in available power across the entire ambient temperature range. After the compressor was washed, some of this lost power and reduced efficiency was recovered, as shown by the higher dashed line.

What's new for old turbines?

An article appearing in the February edition of Mechanical Engineering brings hope to many aging turbines. In it, Michael Valenti, Associate Editor, discusses how operators, utilities and manufacturers are retrofitting their aging turbines with modern instruments and controls in an effort to extend their operating life and to enhance their performance. Turbines fitted with such controls are operating with increased reliability and operators have a more accurate picture of the overall health of the equipment. Plant assets are better managed through regular inspections and maintenance planning.

Valenti also gives many examples of how control technology is being used in industry and some insight into emerging technologies. A new blade

tip clearance measurement technology is currently being tested by GE Power Systems and is intended to reduce turbine losses and improve efficiency. Another interesting tool, Creep-FatiguePro developed by Structural Integrity Associates, collects temperature, pressure and flow rate data to predict creep damage in turbines, boiler components and piping.

Reference

Valenti Michael, *Upgrading the Old Turbine*, Mech. Eng., Vol 121, number 2, pp. 44.

Seminar -- Gas Turbines and Centrifugal Compressors

Want to learn more about condition monitoring for gas turbines and centrifugal compressors? Beta Machinery Analysis Ltd. would like to invite you to a free half-day seminar about gas turbine and centrifugal compressor monitoring. This introductory session will discuss the principles of operation, maintenance considerations, and performance and condition monitoring for a turbine and centrifugal compressor.

About Beta

Beta Machinery Analysis is a world leader in the analysis and trouble-shooting of machinery. Our mission is to provide engineering services that ensure and enhance the economic performance of industrial machinery. We have experts in acoustical and mechanical design, performance and condition monitoring, and field trouble-shooting.

Beta has over three decades of experience serving machinery intensive industries, and meets the needs of its customers in three fundamental areas:

- ▶ ensuring that the entire system is designed for minimum problems and maximum life and performance
- ▶ monitoring both the condition and performance of equipment during operation, to identify and solve issues before they become problems
- ▶ in existing units, solving problems of excessive vibration, premature failure, and unsatisfactory performance.

New courses and seminars

This spring we are pleased to offer two new courses to our customers.

To register please complete the form enclosed and fax it to Beta, or call our Calgary office.

Vibration and performance testing for gas turbines and centrifugal compressors

In this half-day seminar, Bill Eckert discusses the operation and methods of performance mapping for gas turbines and centrifugal compressors.

He reviews the vibration and performance results of a Solar unit that he recently analyzed.

Improving the reliability and performance of reciprocating compressors

If you are responsible for the efficient design, operation and maintenance of compressor systems, you can benefit from this valuable course. Reliability engineers, project engineers and maintenance supervisors will find this course essential to their career development. For APEGGA members, this course counts as a 2 day "Formal Activity".

e-mail: info@betamachinery.com

www.betamachinery.com

Check out the bulletin board.

Beta Machinery Analysis

Ste. 300, 1615 - 10th Avenue SW
Calgary, AB, Canada, T3C 0J7
Phone 403-245-5666
Fax 403-245-3257
800-561-2382

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