Beta Machinery Newsletter Volume 21-1

Beta Bulletin

June, 2012

In This Issue

Torsional Vibration Analysis – new technical training video

Now available on the Beta Machinery channel on YouTube, (www.youtube.com, search Beta Machinery channel) and on our web site, www.betamachinery.com/training-videos.aspx, see the newest video in our Training Tools series.

Module 3 Torsional Vibration Analysis for Compressors and Pumps runs just over 5 minutes. It introduces key concepts about torsional vibration problems on compressors and pumps, and how to address torsional vibration and its effects to get better compressor and pump designs.

Some situations where a torsional vibration analysis is required include new driver and compressor configurations and if there is a change in operating conditions.

In the News

Reciprocating Pumps

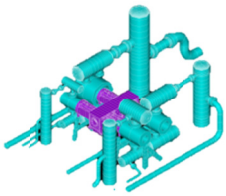
BETA's Jordan Grose, Manager, Pump Systems, has a series of case studies running in CompressorTech2 (www.compressortech2.com) magazine's new bi-monthly section called PumpTech. In the April issue, Jordan wrote about how poor design considerations for a noncritical pump can severely limit operations. In this case study, a reciprocating diaphragm metering pump installation was held to 25% of rated capacity. In the June issue, Jordan relates lessons learned after design flaws in a small reciprocating pump

Jordan Grose

system shut down operations for an entire oil platform. If you experience problems with these links, the articles are also available on our website, www.BetaMachinery.com. BETA is providing customized training on pump vibration issues. We plan to offer an open pump course in Calgary and Houston in the fall 2012. Stay tuned.

Performance Training for Reciprocating Compressors

A new 2.5 day course is available in September for rotating engineers or other specialists involved with evaluating performance on reciprocating compressors. This in-depth course will utilize a series of case studies, and hands-on class participation to evaluate compressor performance, troubleshoot potential problems and predict future performance issues. To learn more see www.BetaMachinery.com/Seminars.aspx.



GMRC Research Project on Compressor Vibration

Phase 2 of the Gas Machinery Research Council (GMRC) project on compressor vibration is now in full swing. BETA was awarded the contract to lead this project and along with a number of owners, OEMs and packagers, are investigating solutions to reduce vibration on suction bottles, scrubbers, and discharge bottles. These vessels are often resonant, creating severe vibration issues. For more information, see www.gmrc.org/projects.

Ask the Expert

Q: *Many owners are working with BETA to take proactive steps to reduce small bore piping (SBP) problems. One question often comes up:*

Is it important to evaluate transient operating conditions on small bore piping?

A. Small bore piping (SBP) failures continue to be the number one failure we see on many machinery packages - both liquid pumps and gas compressors. SBP refers to tubing, drain piping, sight glasses, and small appurtenances attached to main process lines - typically two inches or less in diameter. A gas or liquid release at a facility will generate untold losses due to staff safety consequences, environmental remediation, public exposure, increased regulatory costs, and of course, downtime.

Vibration Audit on Small Bore Piping

In our definition, a transient condition includes the start-up and ramp up of a pump station, shutdown including ESD events, throttling of a pressure control valve during a temporary condition, or other seldom run conditions.

Why worry about transient conditions?

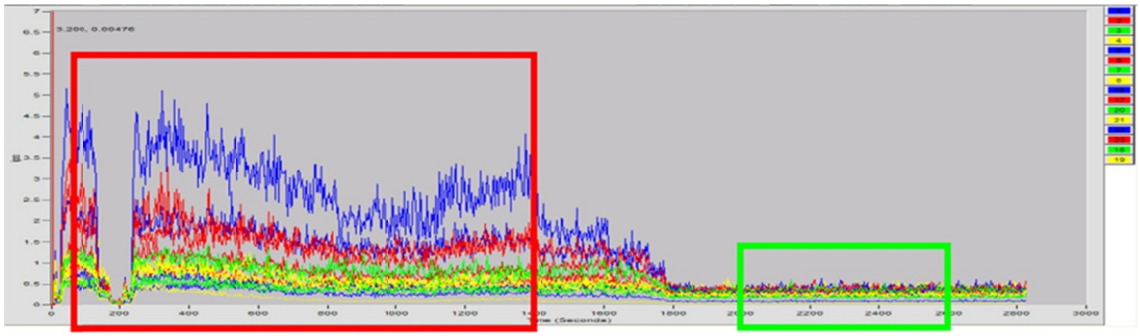
There are a couple reasons.

- First, many operators often do a vibration check on rotating machines and the piping system. These checks are typical during steady state operations and do not include testing during a transient event. This means the operator is not aware of vibration risks during these events.
- Second, the design of SBP is hit and miss. In many situations, the design of SBP is left up to the installers in the shop or field. The result can be an inconsistent approach to SBP design standards. In other cases, the design team may evaluate the SBP design, but the design may be based on steady state conditions, and may not evaluate the range of transient conditions.

High Transient Vibrations

Here is an example that illustrates the risk. During a field inspection for a pumping facility, Beta measured vibration across steady state and transient conditions. A multi-channel analyzer is used to assess SBP vibration at key locations. The data is captured across a long time period and specialized software is then used to process and analyze the results.

The chart below illustrates just one of many results from different customer locations. The vertical scale is overall vibration amplitude (inches per second). The horizontal scale is time (seconds). The vibration screening guideline is also shown as a black horizontal line. Each color represents a different test point in the station. For simplicity, only 16 of the 56 channels of data captured are shown.



The green box illustrates testing during normal "steady state" operating conditions. Vibration is well below Beta's screening guideline.

The red box illustrates high vibration measured while testing different transient events. The vibration levels significantly exceed the guideline. In this case the transient events measured will occur several times per month, thus increasing the risk of failure over time.

Is this a Reliability Risk?

Transient vibrations may be tolerated if they seldom occur. However, if the transient event happens on a regular basis, then the risk of fatigue failure should be considered. Depending on the frequency of the vibration and stress levels during the transient event, it may only take a few hours for the SBP to achieve enough cycles to cause a crack.

This example illustrates how transient conditions can be a culprit in SBP failures. Beta's baseline assessment is a good way to identify SBP vibration risks, and can include testing during transient operations. For a background on SBP problems, see CompressorTech2 magazine, April 2012 issue, Small-Bore Piping Failures on the Rise.

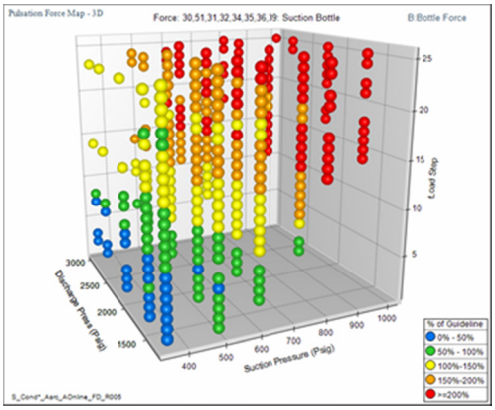
Software Updates Enhance Vibration Studies

BETA's in-house team of developers has made a number of enhancements to our pulsation and vibration analysis software.

- Upgraded pulsation solver to 64 bit processor. This allows us to process larger and more complicated compressor station models much faster. For example, BETA is analyzing a complex station operation with over 15 different compressors running in parallel and having different piping configurations and operation

scenarios. These projects utilize our Time Domain solver and ensure more accurate predictions compared to the simplified Frequency Domain solver utilized by commercial software. The faster 64 bit processor benefits our customers with more accurate and timely results.

- Improved visualization of predicted pulsations and shaking forces in reciprocating compressor and pump systems is enhanced with BETA's unique DataMining tools. Customers can now see which conditions pose a problem and then make informed decisions to mitigate vibration risks. Packagers, consultants and owners all benefit from improved understanding of the vibration risks. DataMiner allows easy customization and interpretation of pulsations, forces and other key data. The tool's flexibility is valuable for more complicated applications involving different load steps and operating conditions. On the chart shown here, each dot represents a unique condition. This allows the customer to view one chart instead of checking hundreds of pages of plots - the standard approach used in many competitors' reports.



- 3D acoustic modeling of gas passages is available in cases where customers want an extra level of precision. While not needed on most projects, this feature may be required for some high spec applications.

BETA pioneered the use of digital pulsation analysis software in early 1980s. Since then, we have continued to revolutionize the industry with advancements in Time Domain modeling, performance analysis, torsional, mechanical and a variety of other field tested features. It is estimated that BETA's software tool is used by the majority of pulsation jobs (globally).

End Winding Resonance Testing

Turbine end of generator stator

BETA was contracted by a leading UK electrical engineering company to perform "end winding resonance" testing on several high kW generators. This analysis was used as part of the major overhaul activities of the generator stator for power plants in Malaysia and a large pulp and paper company in Indonesia.

Electromagnetic forces cause vibration of stator end-windings. End winding resonance testing evaluates the mechanical natural frequencies (MNFs) of the generator stator end windings, and is normally performed before and after any consolidation work is carried out at the stator end winding area.

When resonance problems are found, some simple fixes can be surprisingly effective. For example, fitting a fiberglass block between the windings is one way to shift the MNFs of specific windings. The block is wrapped with fiberglass tape to keep it in place and then sprayed with epoxy paint.

If end winding MNFs are left at generator electrical frequencies, they will become resonant with electromagnetic forces while the generator is in operation. Resonant end windings will degrade more quickly over time than planned maintenance practice intends. The unwanted motion from resonance can create erosion of coil insulation leading to ground faults, cracking in windings and brazed joints leading to overheating, and even melting of epoxy insulation within winding end caps. Measuring and correcting these resonant issues will greatly increase the life of the stator, and reduce the number of unexpected costly repairs required in future planned overhauls.

Testing effectiveness of temporary winding supports

SE Asia Update

Mike Cyca

For seven days in April, Mike Cyca, BETA's SE Asia Development Manager, led a team of instructors, including Kelly Eberle from BETA and, at different times, Bryan Fofonoff from BETA and Derek Kane from Ariel Corp., to venues in Kuala Lumpur and Singapore. Customized training courses were given to staff at a large Engineering Contractor and also at an End User; and the team also conducted one-day open courses on Compressor and Vibration Control. Participants from Indonesia, Thailand, Singapore and Malaysia participated in a blend of lecture, animations, case studies and hands-on demonstrations.

Due to the interest from the participants in the demos and case studies, next time we offer these courses we plan to extend the one-day open courses to two days to give us more time to dig deeper into the case studies and to offer one or two more modules.

Thanks to all those who attended the sessions. We look forward to conducting more training in SE Asia next year. If you are interested in attending training in SE Asia next year, send an email to us, info@BetaMachinery.com and let us know.

Upcoming Events

Visit us at the **41st Turbomachinery and 28th International Pump Users Symposia, Booth 810**
September 24-27, 2012 in Houston, TX. Information about vibration issues will be at our booth.

See us at the International Rotating Equipment Conference (**EFRC** and **Pump Users International Forum**), **Booth B34**, September 27-28, 2012 in Düsseldorf, Germany. Presenting papers at the conference.

We'll be at the **GMRC 2012 Gas Machinery Conference and Expo (GMC) Booth 407**
Sep 30-Oct 3, 2012 in Austin, TX. Presenting papers and short course at the conference.

Courses

To check out upcoming courses, view a list of our standard seminars, or to organize a customized seminar at your office, see the Seminars page on our website, www.BetaMachinery.com/Seminars.aspx.

If there's a topic you'd like to see addressed in the Beta Bulletin, please send an email to Jackie Walters, jwalters@BetaMachinery.com.