KNIGHTHAWK TECH NOTES

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"Intensive Care and Life Support Systems"

It is Friday evening and you are leaving the plant and wondering about the compressor that is running at high vibration. You can only believe that you will get a call in the middle of your kid's soccer game over the weekend with operations advising you that the compressor has tripped out and off you go to the plant. You have had all the experts in but no one has been able to put their finger on the problem. You need more data because something is just not right.

There are many times we are faced with situations regarding issues with static and rotating equipment where we simply do not have enough data, or as part of a FFS (Fitness for Service) plan, in-service monitoring is required. In these situations it may be necessary to install dynamic pressure transducers, acoustic transducers, temperature compensated strain gauges, and vibration monitoring equipment. Some examples of applications are as follows:

- Liquid ring compressor running a variable molecular weight leading to acoustic vibration.
- A steam let down station causing vibration at different modes due to unforeseen chock flow through the cages.
- A transfer line exchanger with cracking at the tube to tubesheet joint where an FFS requires in service monitoring.
- A large coking furnace with a fluidized bed where pressure pulsation is ripping the piping apart.
- Case vibration in a compressor where acoustics are believed to be the source of the problem.

The examples could go on and on and are nearly endless and apply to both static and rotating equipment. The basic problem is the instrumentation that was supplied with the equipment or installed for the plant is not capable of the high dynamic response required to capture transients that are causing the problems. In most cases, if in service monitoring is required for FFS then the typical plant instrumentation is not capable.

A typical approach may be explained with two examples.

High Compressor Vibration – In this situation the compressor is experiencing high vibration and it is not known what the source is. Is it stall, surge, overload, honeycomb balance piston interaction, case acoustics, etc… Let's assume all the vibration experts have looked at the data and everything has been ruled out and tried and nothing has worked. The vibration is still there and high. The steps to get to the bottom of the problem may be as follows:

- Develop a test protocol for collecting high response data.
- Install dynamic pressure transducers, accelerometers on the case, and tie into the proximity probes on the bearings. It might also be a good idea to install acoustical transducers on the case as well. The dynamic pressure transducers should be installed on the suction, discharge, and balance line. Usually these transducers can be installed in existing ports.
- Tie all instruments in to a high frequency data acquisition system. A multichannel analyzer works best as it has FFT plotting capability.
- Reduce the data – This step is very critical. To most, dynamic data can be confusing and misleading. It can be misinterpreted and/or misunderstood. Vibration experts have become very good at understanding how to relate dynamic data to rotating equipment. However, outside of that relationship the interpretation becomes less recognizable, unless they have experience in acoustics, flow induced vibration, choke flow, stall, surge or other and the types of dynamic response these can induce.
- Have the experts review the data and diagnose the problem.

Fluidized Bed in Coking Furnace – This situation involves high pressure steam lines that pick up heat out of a fluidized bed coming out of a coking furnace. The serpentine coils would fail and cause damage. Many things were tried to solve the problem but the source of the driving force causing the vibration was not known. Steps in solving this problem involved.

- Written test protocol
- The development and implementation of a cooling system for dynamic pressure transducers.
- Vibration monitors
- Multichannel data acquisition system.
- Diagnosis of the problem. As it turned out the pressure pulsations produced by the fluidized bed matched the natural frequency of the coils. Through analytical work and redesign the problem was fixed.

As can be seen putting a life support system on equipment can be a valuable source for data. All work should be reviewed and approved by a professional engineer competent in the problem.

Cliff's Notes: KnightHawk has worked many tough and challenging data acquisition problems around the world. We have designed special "one of a kind" equipment to get the job done. Our company has successfully found problems with static and rotating equipment putting high response instrumentation in place. Used in combination with analytical techniques, KnightHawk has been able to solve complex problems.

On another subject regarding the oil spill in the gulf: Our hearts and prayers go out to all the families that experienced loss and to all those affected by the spill. Our prayers are also with BP as they work to find a long term solution and deal with all the problems.

God Bless you and we look forward to working with you to solve your toughest challenges.

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KnightHawk Project Update

- Coupling Failure – Gas Pipe Line
- Bolting Failure – Automotive
- Turboexpander Failure Analysis - Gas Plant
- Gear Drive Failure Analysis - Petrochemical
- Vessel Failure Analysis – Refinery
- Flare System Analysis – Petrochemical
- Reactor Failure Analysis – Petrochemical
- Oxidizer Redesign – Petrochemical
- Oil Pump Failure Analysis – Petrochemical
- Piping System Thermal Analysis – Petrochemical
- Gasifier Equipment Design – Power
- Pump Vibration Analysis – Petrochemical
- Reverse Engineering – Manufacturing
- High Temperature Molten Salt Tank Design – Green Energy
- Tool Failure Analysis – Offshore
- CFD Ethylene Furnace – Petrochemical
- TLE Fit for Service Analysis - Petrochemical
- Oxidizer Redesign – Petrochemical
- Inlet Cone Design for TLE's - Petrochemical
- Bearing Design – Heavy Manufacturing
- Vaporizer Design – Petrochem
- Mechanical Equipment Design – Off Shore
- Transient Fluid Dynamics – Petrochemical
- Waste Heat Boiler Failure – Petrochemical
- Liquids & Solids Separation Technology Development – Coal
- Waste Heat Boiler FFS – Petrochemical
- Furnace Feed Header Analysis – Petrochemical