KNIGHTHAWK TECH NOTES

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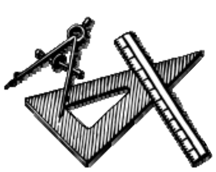
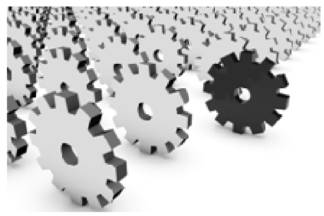
"Frequency Response – Detecting Complex Structural Defects "

Once again there is a crack found in the inlet tubesheet in your high pressure high temperature heat exchanger. As head of the maintenance engineering effort, you know the plant management will ask you if it can run safely and reliably until the next scheduled shutdown. In the daily production meeting the issue comes up and you recommend that a fitness for service (FFS) be performed. Non-destructive techniques are reviewed and there is uncertainty over the characterization of the crack. Without the proper characterization of the crack it is unlikely that a reliable FFS could be performed and if so, the unit would have to be shutdown and repaired during a non scheduled outage. This situation described is not uncommon. Every facility has a goal to run safely and reliably.

In the back of your mind you remember a frequency response test performed on compressor blades to assess the effects of microcracks that were difficult to characterize in depth due to location in the fur tree style blade attachment. Every structure has a natural frequency and mode shape for every frequency. A baseline was first determined using on a good blade. The blades were statically tested in the machine for the best and most realistic response. Most of the blades had the same frequency response and mode shape of the good blade and along with all the other non-destructive tests, these blades could be used. Several of the blades, however, had a very distinct and different response which made them suspect and not usable.



For the situation involving the heat exchanger inlet tubesheet, the situation is more complex. Someone would need a "cluster" of accelerometers tied into a data acquisition system to evaluate the response around each tube section. In such a system one is looking for the variance from the established norm for that situation. For both of the situations described it is best to also have acoustic sensors attached to the equipment as well to assist in the overall evaluation.



For the issue involving the heat exchanger inlet tubesheet, the problem can be more complex. A "cluster" of accelerometers tied into a data acquisition system will be needed to evaluate the response around each tube section. In such a system, one is looking for the variance from an established norm. For both of the situations described, it is best to also have acoustic sensors attached to the equipment as well to assist in the overall evaluation.

A general methodology that would apply to both static and rotating equipment is as follows:

1. Exhaust all standard non-destructive techniques (NDT) and follow standard applicable Code procedures. If a positive conclusion cannot be reached with standard NDT then the following may be considered as applicable.
2. Develop a test protocol for the testing. This will typically consist of both acoustic sensors and accelerometers.
3. Instrument a "good" specimen or area that is known to have no structural defects.
4. Establish frequencies and mode shapes for the "good"specimen.
5. Cross check the data with analytical calculations.
6. Perform the same procedure for the equipment believed to be defective.
7. Review the data and establish a norm that compares to the baseline.
8. Develop acceptance criteria based on the above.

In general this testing is highly specialized and requires technicians and engineers familiar with the ball game. In no case should the results of this testing replace or supersede any standard NDT work governed by applicable Codes and Standards. The test should only be conducted in addition to or when other methods simply will not work as anticipated. All work should be directed and supervised by a professional engineer that is qualified for this type work.

Cliff's Notes: KnightHawk has pioneered and implemented frequency response testing on both static and rotating equipment. This technique has been used in the aerospace and defense industries for years with high success. KnightHawk has implemented such tests in complex situations where traditional NDT methods would not meet expectation. Call our team and we can show you how we can help solve some of your most complex challenges regarding defects.

I hope everyone had a great summer and your football team is winning. I am happy because LSU beat Florida and Alabama, but most of all my son's football team went undefeated in Intermediate school. I want to wish all of you a very Happy Thanksgiving Holiday and may God Bless you and your family.

Cliff Knight

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KnightHawk Project Update

- Gas Pipeline Coupling Failure – Oil & Gas
- Water Pump Failure Analysis – Nuclear
- Weldability Testing – Fabrication
- Bearing Pedestal Monitoring – Petrochemical
- Bolting Failure – Automotive
- Centrifugal Compressor Failure Analysis – Petrochemical
- Jacketed Reactor Vessel Design – Petrochemical
- Oil System Contamination Investigation – Petrochemical
- Vessel Destructive Testing – Oil & Gas
- Cryogenic Tank FFS – Petrochemical
- Corrosion Analysis – Gas Pipeline
- Flare System Analysis – Petrochemical
- Reactor Failure Analysis – Petrochemical
- Riser Flange Analysis – Off Shore
- Oxidizer Redesign & Reconstruction – Petrochemical
- Creep Tensile Testing – Communications
- Gasifier Equipment Design – Power
- Pump Vibration Analysis – Petrochemical
- High Temperature Molten Salt Tank Design – Green Energy
- CFD Ethylene Furnace – Petrochemical
- Inlet Cone Design for TLE's – Petrochemical
- Bearing Design – Heavy Manufacturing
- Vaporizer Design – Petrochemical
- Transient Fluid Dynamics – Petrochemical
- Waste Heat Boiler Failure – Petrochemical
- Liquids & Solids Separation Technology Development – Coal