KNIGHTHAWK TECH NOTES

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"You Can't Afford to Fail at Failure Analysis! - It's Costly…."

Over the years many of us have heard the term, "failure analysis". When you read technical magazines, literature, or solicitations, you see the words "failure analysis" used often. When something breaks, your boss might say, "We need to perform a "failure analysis" to see what happened." To many individuals "failure analysis" has a broad meaning, while to others it has a narrow precise meaning. The word "failure" according to Webster's means, "The condition or fact of not achieving the desired end or ends," "A cessation of proper functioning". "Analysis" means, "Separation of an intellectual or a substantial whole into it constituent parts for individual study". So what does this have to do with engineering? Well it can mean a lot, because depending on what your belief of and your understanding of "failure analysis" is, it can impact your company's bottom line.

"Failure analysis" can be used in a broad sense and it should not be limited to any one area or discipline. It can, in fact, encompass many things. "Root Cause Failure Analysis" narrows the focus for the precise viewpoints of failure analysis.

The other day I was in the hospital emergency room with a family member. While there, I observed the orders the doctors were giving. All aspects of the problem were being considered and nothing was being left out. Blood work, EKG, MRI, X-ray, and so on were being conducted and discussed. The doctors wanted the best available information to decide how to proceed. They did all the necessary testing to assure that they had encircled the problem. In industry, we need to do the same when it comes to "real" or root cause failure analysis.

As I was writing this article the following example came to mind. A piece of equipment uses the very viscous process material to lubricate the bearings The equipment failed at the bearing and the shaft broke. Production personnel called in "experts" from various departments to determine the cause of the failure. The metallurgical group performed a "failure analysis" and determined that the bearing material was wrong. The mechanical group performed a "failure analysis" and determined the shaft was overstressed and needed to be revised. The process group performed a review of the process and concluded everything was as it should be, so it must be an equipment malfunction. Therefore, better materials were put into the bearing and the shaft was made stronger. The plant started up and, not surprisingly, the pump failed again and the plant was once more shutdown.

First of all, not one group performed a true failure analysis. The metallurgical group performed a metallurgical analysis. The mechanical design group performed a mechanical analysis and the process group performed a process analysis. Finally, the group I was in came and evaluated the entire system including the process history, mechanical, instrumentation, control, and metallurgical. The group evaluated the work already done and put all the pieces together to determine something was not adding up. The true root cause was faulty instrumentation. A low level in a feed vessel to the pump indicated a higher level some of the time. The pump was cavitating and the product lubrication of the bearings was failing at intermittent intervals. The last group performed a true or correct complete failure analysis and the problem was solved.

So what is a proper failure analysis? "Failure analysis" should be used as the term for a complete multi-discipline engineering assessment to find the "root cause" of a failure of something that is not performing to expectations.

I believe the best approach to failure analysis involves a multidiscipline approach to identify all the physics involved with the problem. A team will typically include but is not limited to:

1. Process Engineering
2. Mechanical Engineering
3. Electrical/Controls Engineering
4. Metallurgical and Materials Engineering

It is not necessary for each engineer to be fully engaged with the project. It is however, important that they be in communication and understand what is going on. For example, on another root cause failure analysis a draft metallurgical report that evaluated a microstructure failure of a mechanical component concluded that failure was caused by "corrosion fatigue". The metallurgist recommended a coating to reduce the corrosion.

The problem however, was that the reverse loading (with or without corrosion assistance) leading to the fatigue should never have been experienced in the first place. Any reverse loading leading to fatigue was too high.

While this was being debated, the device was rebuilt and a coating applied. It failed again even quicker this time and because of the coating there was no corrosion. The root cause of the problem was a destructive harmonic that was not supposed to be there. The lack of consideration of this point, cost the plant millions.

In the end, to achieve a good "root cause failure analysis" all aspects of a problem have to be reviewed. Don't let the details bite you. Don't let the lack of a multidiscipline approach let details escape consideration. Make sure a competent professional engineer is involved in the failure analysis that is experienced in coordinating a multidiscipline effort.

Cliff's Notes:

KnightHawk utilizes a failure methodology we call the "Integrated Systems Approach" that has proven to be highly effective in failure analysis over the 18 year history of KnightHawk. We have mechanical, metallurgical/materials, process, and electrical/controls engineers on staff. We are your one stop shop on failure analysis complete with shop, lab, field services, and full specialty engineering capability.

Times are challenging and KnightHawk is prepared to meet these challenges. We know many of our clients are cash strapped, some have shut down, and others are struggling very hard. We can and are prepared to work with you to get the job done. Call us and we will tell you how we can help.

Cliff Knight

KnightHawk Project Update

- Mechanical equipment design – Off Shore
- Valve Failure – Offshore
- Vessel Nozzle FFS – Power
- Structural Dynamics – Petrochemical
- Ring Header Failure Analysis & Redesign - Petrochemical
- Gasifier Process Analysis – Petrochemical
- Reactor Fit for Service – Petrochemical
- Furnace Failures – Petrochemical
- Waste Heat Boiler Failure – Petrochemical
- Casting Failure High Temp Application – Petrochemical
- Compressor Reverse Engineering & Analysis – Offshore
- Rotordynamics Analysis – Offshore
- Surge Drum Vibration Analysis – Petrochemical
- Clinker Grinder Design Assessment – Petrochemical
- Ignition System Redesign – Petrochemical
- Compress wreck – Offshore
- Syngas Heat Exchanger Design Assessment – Petrochemical
- Specialized Pump Skid Design – Offshore
- Pump Impeller Reverse Engineering – Manufacturing
- Fire Tube Boiler FFS – FFS -1/ API 579
- Titanium Tower FFS – 1 / API 579 Analysis – Petrochemical
- Pump Impeller Metallurgical Failure Analysis – Manufacturing
- Flange Leak Analysis – Off Shore
- Fitness for Service Waste Heat Boiler – Petrochemical
- Thermosyphon Analysis - Petrochemical
- Pump Metallurgical Assessment – Off shore - Africa
- Waste Heat Boiler Audit – Petrochemical – Middle East
- Refinery Settling Vessel - Petrochemical
- Vessel Fluid Dynamics – Petrochemical
- Gasifier Failure Analysis – Petrochemical
- CFD of Exchanger - Petrochemical
- Integrally Geared Compressor Redesign – Petrochemical