KNIGHTHAWK TECH NOTES

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Will "Betsy" Last to the Scheduled Shutdown?

It seems to always happen. The scheduled shutdown is five weeks away and you're most critical piece of equipment starts to malfunction. Of course this equipment is not spared and with it off-line the whole plant must be shutdown. You have checked with your shutdown planners and it is impossible to take an early shutdown as a planned shutdown. The bean counters have also told you that profit margins are high at this time and they do not want any shutdown much less an unscheduled one. The Plant Manager says to keep it safely running if at all possible. You are given the mission to sort through everything, not only the root cause of the problem, but all the risk management issues. You have to run safe and you are in charge of the team that will make recommendations to management.

There are several recommended steps to ensure the greatest opportunity of success to keep running. The first step involves getting the right help to address the problem. If it is critical rotating equipment, this might include a rotating equipment specialist. For a pressure vessel, it might be a vessel engineer. It is important that the help be capable of performing on fit-for-service calculations. "Hip shooters" are not advised, because all decisions need to have a sound basis. Good help early on can reduce the number of "rabbit trails" you chase. Put together a team to assist in your mission. Also, team members should have a long history of dealing with risk management issues and fitness for purpose direction. Team members should also have an objective approach to all the issues. It is easy to get someone that will say "shut it down". The team needs to be consensus minded and work together.

The second step involves the organization of the information and critical data during these times. Gather the design, process and mechanical specifications. This would also include equipment condition reports and inspection reports from the files. Process trending data is also important for assessment.

An investigation of malfunctioning equipment requires high detail. Complete time history data of all parameters measured on the equipment should be put in an excel file for teams members to do their own data reduction. The third step involves planning. Once the data is organized and your team is assembled, a plan must be developed to attack the problem at hand. It might consist of some data acquisitions measurements and/or some on-site engineering evaluations. A written action plan must be put together and agreed to by all team members. The next step is to execute the action plan. After execution of the individual tasks, the team should review the findings in a group environment. A safety and management review should be conducted. An informal or formal HAZOP review is recommended during this step.

Example: One example that involves vibration in rotating equipment lines such as turbine compressor trains could be as follows. In this example the compressor wrecked on multiple occasions in the past and now the vibration was going up.

The first step would be to get a response team consisting of the site maintenance engineer, equipment maintenance specialist, operations specialist, process engineer, rotating equipment expert, management representative and a qualified millwright. The maintenance engineer would be responsible for gathering equipment data and condition evaluation. The millwright will assist in alignment and maintenance issues. The operations specialist will coordinate machine operational conditions and provide history from the control room. The rotating equipment expert will assist in the evaluation of the problem including recommended data acquisitions requirements. The management team member would address risk management issues. A group chairman should be elected and it does not have to be the management representative. Typically, the maintenance engineer fits best to be the response team chairman. The equipment and process specifications, history files, and current process and equipment conditions should be organized for the team. All team members should receive the same data.

A typical action plan to troubleshoot the equipment problem would be as follows:

- Assemble Team.
- Gather all information from the historian.
- Review previous failures to look for correlations to current failure.
- Evaluate metallurgical failure from current failure vs. previous failures.
- Conduct a field study to look at dynamic pressure and vibration.
- Compressor performance assessment.
- Review maintenance and operation history
- Perform numerical FE and CFD studies of the system to determine likely forcing functions.
- Root Cause Analysis

In this particular problem a compressor was run at a higher rpm due to debottlenecking in the plant. Vibration was being picked up on load conditions that were not previously experienced. The plant needs a few more weeks until the problem could be fixed permanently. The solution was simply running the compressor at a lower rpm. The control system was changed, so the machine would not run at that detrimental rpm.

Cliff's Notes:

KnightHawk has led and participated in many investigations involving static and rotating equipment issues. We are a one stop shop for multidiscipline approaches including field services. We also have our own accredited lab to get the job done. Just think, when you call us in, our team is bringing its experience to the table on thousands of failures the company has looked at over the past twenty six years.

KnightHawk has been called upon many times to assist facilities to safely operate until a shutdown. We have changed equipment running conditions or revised the process on a temporary basis to keep production facilities running until a planned outage.

At KnightHawk our prayers and thoughts are with all that suffered during Hurricane Harvey and Irma. KnightHawk was spared from any damage.

Take care and God Bless,

Cliff Knight

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KnightHawk Project Update

- Rotordynamics of a centrifugal compressor
- Fan Performance Failure Analysis
- Steam Turbine Failure Analysis
- Valve Failure Investigation
- Pump Seals Root Cause Analysis
- Check Valve Testing
- TLE Inlet Redesign
- Metallurgical Failure Analysis
- Thermal Oxidizer Feed Mixing CFD
- Heat Exchanger Underperforming RCA
- Reciprocating Compressor Failure RCA
- Coker Furnace Outlet Piping Non-Linear Creep Stress Analysis
- Vessel Code Calculations
- Heat Exchanger Diaphragm Failure
- RCA of I Beam Cracking
- Fan Vibration Analysis
- Heat Exchanger Rerate Analysis
- Reverse Engineering of Pump Body
- PMI and Materials Consulting
- Boiler Tube Failure Analysis
- Tower Fit for Service Analysis
- Brittle Fracture Analysis