KnightHawk TECH NOTES

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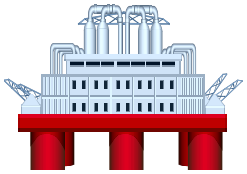
"Fit For Service"

Your production facility is no different than many in the business. Equipment has been running for years and as much as we dislike it, static and rotating equipment experience performance and reliability issues. Many times when problems arise the equipment can still operate, but it is not known how safe and reliable it will be.



When walking down your system you discover vibration has developed in your structure that contains a pump and heat exchangers. It could be a suspected tube leak is causing cavitation conditions in the pump. At this point you don't know what is causing it, it could be tube vibration in the exchanger or an NPSH problem in the pump. It only occurs at the higher loads, but you have run at these loads before without the vibration. Fouling conditions are known to occur in the exchanger which affects the temperature of the process and the pump.

Your buddies and some of the "old timers" say "this happens all the time … we will just deal with it at the next shutdown". However, you know that today's operations are not what they were 20 years ago and there is accountability everywhere to ensure that a facility is safe and environmentally friendly while operating, hopefully profitably.

Process safety management still wins in your mind as you evaluate your next steps. You and your management question if this system is "Fit For Service" (FFS) until the next shutdown and you are charged with answering this question. It is not known whether the issue is a static or rotating equipment problem or even how to approach this situation.

There are guidelines and methodologies to address whether equipment is fit for service for continued operation. API Recommended Practices 579 Fitness For Service are "quantitative engineering evaluations which are performed to demonstrate the structural integrity of an in-service component containing a flaw or damage." This Code is an excellent document for static equipment; however the methodology and approach for rotating equipment is on a case by case basis with the intention to satisfy all applicable Codes and standards. An internet search for "fitness for service" produces an amazing amount of resources for how to do this work, primarily for static equipment, but some are for rotating equipment as well

Two cardinal rules for all the FFS work is to remember:

- ***"No analysis or solution can be more accurate than the input data that goes into it."***
- ***"Nothing beats experience."***

For static equipment, our company considers API 579 a good resource. In a nut shell, the defect or flaw has to be carefully characterized by a qualified professional. You need to know what you have, before you can move forward. Many times individuals charge forward wanting to execute a FFS but have no idea of the details for the flaw or defect. While we are talking about this, it is a good time to clear up a frequently misconstrued point; The FFS is not a "get you by" measure to keep running. It is an engineering evaluation of the current status of the equipment that determines remaining life based on the conditions analyzed. FFS is a methodology to characterize flaws and defects and analyses to meet Code conditions. Yes, that is right; you still have to meet Code for all anticipated operating conditions. Process Safety Management (PSM) is still in effect. FFS is no short cut or alternative.

When a proper FFS is done, the following is frequently but not necessarily the limit of considerations:

1. Process and operations assessment – including steady state, upset, startup, and any transient conditions that the equipment may experience.
2. Condition assessment – Flaws, defects, and conditions are characterized by qualified personnel. This is one of the most important steps. If we don't know the actual conditions, all assessments may be garbage.
3. FFS
   A. Static
      i. Determine what level of analyses are required. As in API 579, it might be as simple as a Level 1 analysis, or all the way to a Level 3 analysis with in service monitoring.
      Ii. See that applicable Code conditions are met
   B. Rotating
      i. Characterize the equipment condition.
      ii. Risk assessment
      iii. Analysis – This might be hand calcs, or highly detailed structural simulations.
4. HAZOP – Include a review of the FFS.
5. Recycle on the above steps
6. Process, Mechanical, Materials, Controls, and Operations sign off.
7. Implementation of a feedback loop on the equipment.

The main aspect of FSS is that it is not a "cookie cutter" approach; each problem should be evaluated for its unique conditions. All FFS work should be directed and approved by a professional engineer qualified to do the work.

KnightHawk Project Update

- Compressor High Vibration – Petrochemical
- Stripper Tower Failure Analysis – Petrochemical
- Liquid Ring Compressor Failure – Petrochemical
- CFD of Compressor Gas Flow – Petrochemical
- Hydrogen Gas Reformer Design – Oil & Gas
- RCF of Corroded Pipe – Oil & Gas
- Air Compressor Failure – Petrochemical
- Critical Pipe Stress – Petrochemical
- Flue Gas Cooler – Petrochemical
- Thermal Oxidizer Mixing Analysis – Petrochemical
- Transient Fluid Dynamics – Petrochemical
- API Tanks FFS – Petrochemical
- Structural Analysis – Petrochemical
- Transfer Line Exchanger – Petrochemical
- Flare Design Analysis – Petrochemical
- Fit for Service Analysis – Petrochemical
- Tensile Testing – Manufacturing
- CFD of PSV Systems – Petrochemical
- Compressor Failure – Petrochemical
- Corrosion Testing – Oil & Gas
- Ultra High Pressure Vessel FFS – Petrochemical
- Reciprocating Compressor Failure – Petrochemical
- Pump Vibration Analysis – Petrochemical
- Corrosion Analysis – Gas Pipeline
- Gasifier Equipment Design – Power
- Gas Plant Fire & Explosion – Oil & Gas

Cliff's Notes: I hope everyone has had a great summer and your kids are off to a good start in School. I know for myself, it was a summer full of interesting projects and most importantly, "great motorcycle riding". The family and I took a motorcycle trip to Tennessee and road the "Dragon's Tail", which I must say was truly beautiful and a blast to ride. Football is back and I look forward to seeing what happens with the college football playoff system. Hopefully LSU will be right in there and the Saints are where they need to be.

KnightHawk is your one stop resource for FFS. We have performed many Level 3 API 579 analysis for static equipment. We also have worked many situations in rotating equipment to keep things running safely. Our staff which is made up of Process, Mechanical, Metallurgical, Instrumentation/Controls many with operations background really make a formidable team for those challenging problems. Because we have fought the battles you have when we worked in the plants, we understand the ball game.

I look forward to see what the final quarter has in store for us, take care and God bless.

Cliff Knight

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