KNIGHTHAWK TECH NOTES

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My Turbine has run for years…. Why did it fail now?

There are steam turbines in most every major industrial facility. Many of these turbines have run for years and have been very stable. Typically, after a period of time, the equipment is shut down for maintenance during a planned outage. It is more common than not that the turbine will experience problems after the shutdown and perhaps even failure or high vibration will occur. Now on the surface, this does not make any sense because the turbine ran fine for years and now right after the shutdown there are problems in bringing the machine up.

KnightHawk has observed these problems over the years. There are a number of reasons but are not limited to the following as possible explanations for the startup challenges.

1. The first reason is that the turbine is just difficult to align and set up to prepare for running. We have seen in many instances where the "old timers" knew just how to setup the machine to run but they are gone and a new crew is addressing the challenges. The experienced crew that worked on the turbines in the past really had their own mental manual for procedural conditions that best fit the actual field conditions. In other words the OEM procedures were not detailed enough for addressing all the issues.
2. Pipe stress loadings can be a problem. For example, during the first run, the pipe stress loads "settle out" and relax. During the shutdown the piping does not return to its original cold condition so the nozzle loadings are high. There are other issues as well. For example some of the older turbines still utilize supports under inlet valves that are rigid and must be adjusted in both the hot and cold condition. These supports are no longer used in modern installations and are normally replaced by spring supports.

3. Another might be steam conditions on startup. A typical facility uses process waste heat to generate their own steam and it is possible that during startup the steam conditions from off site or other sources within the plant have either too little or too much superheat. These conditions can affect the rotor in a number of ways. First the loading on the balance piston can change and there might be more or less thrust load on startup. The other point is the damping in any labyrinth seal may change. Another issue with a startup, is steam conditions can affect the stage aerodynamics that could lead to stage stalling? In other words you may get some vibration on startup that will settle out with time.
4. Process load changes are also another culprit. In some applications the turbine may be tied into a common header and the startup sequencing may lead to unwanted interaction between equipment.
5. OEM upgrades are a common problem. It is common to install OEM upgrades in a system during a turnaround. Sometimes these upgrades can change the rotordynamic behavior at your facility, based on your conditions.
6. Another culprit could be controls upgrades which can take many forms, including both hardware and software.
7. Maintenance procedures could also be the problem. At many facilities there have been changes in turnover of personnel that are not as experienced with the equipment and don't know all the details the previous guys knew well.

So what is a good approach to mitigate all these issues? This situation can be very frustrating for management. A typical approach is to keep fighting the "dragons" until the thing starts up. A good approach is to treat it as a new problem and forget the past. You have what you have now and it should be investigated forensically in all aspects to find out what the problem is and what the solution should be.

As any of these cases may be unique, they should be evaluated under the direction of a professional engineer competent in rotating equipment.

Cliff's Notes: KnightHawk is your one stop shop when it comes to the diagnosis and troubleshooting of steam turbine problems. One of the unique aspects of our company is we can look at the process performance including stage conditions, aerodynamics, rotordynamics, and metallurgical. KnightHawk has even been asked on occasion to observe rebuilds around the clock looking at all aspects where we were the owner's "second set of eyes".

We hope everyone had a wonderful Memorial day holiday. I remember when my son was younger a few years back and he asked what this was all about. I said I will show you. We brought dozens of roses and went to the Houston National Cemetery. There were many family members there, who had lost loved ones. He talked to them and gave them roses. It changed his life and he knew what it was all about.

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KnightHawk Project Update

- Combustion CFD Analysis – Power
- Equipment Hydrotesting – Oil & Gas
- Clamping Connector Analysis – Petrochemical
- Critical Fan Vibration – Nuclear Power
- 3 Phase Separator CFD – Oil & Gas
- Critical Pipe Stress – Petrochemical
- Vertical Cast Transporter Failure – Nuclear Power
- Transient Fluid Dynamics – Petrochemical
- Pipe Coupling Redesign – Pipeline
- Valve Reverse Engineering – Oil & Gas
- Transfer Line Exchanger – Petrochemical
- Brittle Fracture Analysis – Petrochemical
- Fit for Service Analysis – Petrochemical
- Pipeline Hydro Testing – Oil & Gas
- Well Bore Flow Analysis – Oil & Gas
- Tensile Testing – Manufacturing
- Pump Vibration Analysis – Petrochemical
- Riser Stack Analysis – Offshore
- Gas Pipeline Coupling Failure – Oil & Gas
- Reciprocating Compressor Re-Design – Petrochemical
- Compressor Skid Pipe Stress – Petrochemical
- Pump Vibration Analysis – Petrochemical
- Vessel Destructive Testing – Oil & Gas
- Corrosion Analysis – Gas Pipeline
- Gasifier Equipment Design – Power
- High Temperature Molten Salt Tank Design – Green Energy