KNIGHTHAWK TECH NOTES

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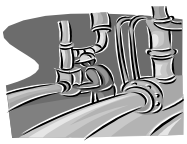
"Rock and Roll "

At the Monday morning meeting, the shift supervisor, yet again, brings up the problem with the South Structure "Rock and Roll". The night shift reports shaking that does not seem right. You inquire at the meeting, get all the facts and the next morning you arrive early to talk to the night shift about the events. This has happened for the third or fourth time over the last few months and it is getting worse. But the problem is, every time you go up to the structure, it is smooth. It is your job to fix a problem that you have not personally witnessed, yet you trust those that say it is there. It just so happens that the South Structure is the largest structure and has the most equipment on it. It contains a turbine deck, reactor, waste heat boiler, pumps and so forth. You have your data acquisition equipment ready to go, but you have no data to collect. The following week, things get a little worse as some secondary structural members come apart and the turbine trips. Now the Plant Manager has you on the hot seat to figure out what is wrong and to solve it.



You ask yourself what is next as you crack open the vibration hand books and start thinking about the problem. The question is—what type of vibration could be driving the problem. You have identified the following possibilities:

1. Load changes on the turbine – but they are all smooth.
2. Pump vibration – Maintenance has said at times the vibration is high, but you do not believe the pumps could be the driver at the lower frequencies that you guess is the culprit.
3. The rest is just process equipment and they are all steady state with no upsets.

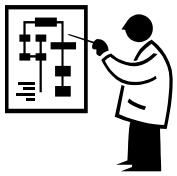
You are thinking that the problem must be transient in nature and that it must be a low frequency problem. What could be the driver? You see nothing. Now it is time to hit the DCS and look at all the equipment pressures, flows, and temperatures. Sure enough, there is nothing remarkable there. Then you remember that all the data is time averaged over 10 minutes and it is not likely that it could be picked up. At this point, you talk to the operators in detail about the events at the time of the shaking in the structure. Then you realize that at the time the structure "rock and rolls," the waste heat boiler is being blown down with a new automatic system. That is all you know. High speed data acquisition is installed to pick up pressure and vibration.

You found the problem — the blow down was programmed too long and the pressure dropped enough in the waste heat boiler to cause flashing and in effect, "burping" the boiler caused a pressure wave large enough to make the boiler jump. The resulting jolt essentially rang the structure causing it to vibrate.

As you can see, vibration in a structure can be complex. The problem above is a good troubleshooting example of the steps one can take. For a structural problem, one may consider the following steps.

1. Identify all the equipment in the structure.
2. Discuss with Process Engineering the process layout and the dynamics of the equipment
3. Make a judgment whether the event is a transient forced response or a harmonic tuning in.
4. Perform high speed data acquisition tests. Make sure the test is tied into rotating equipment and process flow meters where applicable.
5. Reduce the data and study it.
6. Once you have identified the possibility, test it and confirm that your answer is safe and feasible.
7. Detune the structure using finite element methods or eliminate the process driver.

Many of the process structural dynamics problems are complex and sometimes a quick fix can make it worse or better. Make sure all work is reviewed and approved by a professional engineer competent in the diagnosis and analysis of process driven structural problems.



Cliff's Notes:

I want to thank all of our clients for their business. 2005 is going to be an exciting year for KnightHawk as we expand our horizons into other areas. Our team at KnightHawk has years of experiencing in diagnosing and fixing problems as described above. Since we have a crew with process, mechanical, control, and materials experience, we can attack most all the possibilities of a problem.

Well the Rockets lost, but they fought hard. Let's see what happens with the Astros. As for KnightHawk - Chet Stroh, who is an expert in Rotating Equipment, has joined our company as Group Leader. He has a BS and MS in Mechanical Engineering with 30+ years of success. He has been there and done that in the field. Chet also serves on the Texas A&M TurboMachinery Symposium Advisory Committee. Chet will lead our effort to expand this area as our business continues to grow.

We also added Jim Salter to our staff in January. Jim is our Business Development Manger and has 30 years experience in industry. Jim's e-mail is jsalter@knighthawk.com. Drop him a line and he can visit with you and tell you what we do and how we do it.

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KnightHawk Project Update

- Surface Condenser CFD - Petrochemical
- Waste Heat Boiler Failure Analysis and Redesign - Petrochemical
- Emergency Hot Tap – Level III Analysis - Petrochemical
- Earthquake Seismic Analysis - Nuclear
- Valve Design Troubleshooting – Off Shore
- Level Control Problems – Nuclear
- Waste Heat Boiler Failure Analysis – Petrochemical
- Gas Turbine Ducting and Damper Exhaust Failure Analysis – Off Shore
- Process Transients Field Data Acquisition – Petrochemical
- Reactor Design Optimization – FEA - Petrochemical
- Steam line fluid dynamics – CFD – Nuclear
- Steam line condensate level troubleshooting – CFD – Nuclear
- Special Process Reactor Design – FEA, CFD - Defense
- High Pressure Flange Design Riser – FEA – Off Shore
- 10,000 psi Oxygen Valve CFD – NASA
- Ethylene Crack Gas Cooler – Fit For Service – Petrochemical
- Heat Exchanger Vibration – Petrochemical
- Structural Vibration – Petrochemical
- Low process problems – CFD - Petrochemical
- 100 MW Gas Turbine Failure – Power
- 150 MW Gas Turbine Failure – Power
- Compressor Vibration Study - Petrochemical
- Gasifier Reactor Redesign – Petrochemicals
- Boiler Failure - Petrochemical
- Boiler Failure analysis – Petrochemical
- Non Linear FEA - Petrochemical
- Inlet Cone Design for TLE's – Petrochemical
- Aerodynamic Study of Inlet of TLE – Petrochemical