KNIGHTHAWK TECH NOTES

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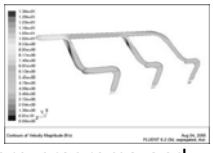
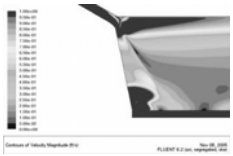
"The Fluid World "

You are at a staff meeting and all the engineers have been asked to provide updates on their projects. One of the looming projects has been a vibration problem on a compressor and then you hear those words. "We need a CFD model run on the inlet piping to determine if there is a flow disturbance at the inlet guide vanes leading us into surge under certain load conditions". You instantly reflect back to the last time a CFD (Computational Fluid Dynamics) model was run on a project. It seemed very complicated and to this day you wonder what you got and whether it was really worth the time and effort. Even so, you reluctantly give the engineer authorization to proceed with a CFD model and you "cringe" as you see a potential heavy budget hit.

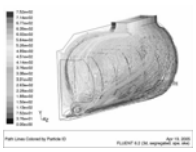


Today there are many software programs and computers are faster than ever. There are many applications for CFD and more and more problems are being addressed using this tool. However, there are a few important points to remember when considering the use of CFD in an application.

1. **Nothing beats experience.** As I said in previous newsletters, having a little grey hair involved with the problem is good. Today engineers are coming out of school very literate in computers and software; however, having someone involved with the problem that is familiar with the "old school" hand calculations is a plus.
2. **Use an Industry Recognized Code:** Major software codes are complex and quite large. All codes have errors and only an experienced user can detect when and how they may occur. Frequently there are user forums for the major codes that can be used to address errors and how to get around them.
3. **Remember the CFD Code is A Tool:** The CFD code is a tool that is used by a competent engineer to assist in a solution of the flow field. Many of the advertisements would suggest a "user friendly world" with bells and whistles that will let you sit and relax as the computer and CFD program "spits out the results" and gets you on the way. That is simply not true. The same CFD code can be given to several engineers on the same problem and the answers can be completely different. The user has to be familiar with the complexity of the problem to get reasonable results. There are all sorts of issues that affect a good solution such as grid design, boundary conditions, the solver used, relaxation factors, choice of fluid property models, etc… There are almost endless settings and tweaking on complex problems and when the user does not know what to do, the "default settings" are used. And oh yes, "pretty plots" and graphs are always produced and has the appearance that it is all correct.
4. **Define CFD Goals and Objectives:** In every problem there are goals and objectives. Perhaps it is to know the local temperature field, or pressure field, or velocities. In any case, it is important to define what the main goal of the project is because the model can be designed to focus on the target goals with higher accuracy. Plus, the assumptions may effect the model.
5. **Scope Meeting:** Have a scope meeting with the engineer who is performing the CFD model to make sure he or she understands the process and the details of what is happening. A good solution is not found in "ivory towers", the engineer must be familiar with what is going on. The goals and objectives are also discussed at this meeting.



6. **CFD Plan:** A project execution plan should be developed to consider the approach, milestones, and client reviews. If there is an existing set of conditions that the client has data on, perhaps this should be modeled to validate the capability of the CFD user and tool.



7. **Results Review:** The CFD is a tool with high complexity and the user's experience is a major factor in results. The client should critique the results in detail to make sure that they make sense and don't accept "intellectual answers" or results that don't make sense. On complex high exposure results, contract with other experts to review the results. A good CFD project has checking, checking, and more checking…

All CFD work should be reviewed by a professional engineer competent to perform CFD work.

Cliff's Notes:

As you can see, CFD is a complex area and many factors and variables are involved with a good solution. KnightHawk has developed a reputation for over 15 years of solving complex problems for industry in DOD, NASA, Petrochemical, Nuclear and Fossil Power, Off Shore, and many others. Not only can we do the CFD, we can do that "old school" hand calc. KHE has an approach with cross checks that I believe is second to none. In house we have over 50 years experience with CFD. That is a lot of problems. KnightHawk has also been used as an expert to evaluate results from others as well as in house work from our clients. Oh, about the CFD Code. We can run all the major codes. Nearly 24 hours a day, seven days a week we are crunching on a major CFD problem in the industry.

On the personal side, I hope each of you has gotten your summer off to a good start and are able to take a vacation and spend time with the family. If you have been at any baseball games, we need to root the ASTROS on as they are having a rough start. In any case, have a great safe summer.

Cliff Knight

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KnightHawk Project Update

- CFD of Pumps - Petrochemical
- Non-Linear FEA – Fossil Power
- CFD Review of Ethylene TLE - Petrochemical
- 3-D CFD model of Polymer Pump – Petrochemical
- Burner Acoustic Field Study - Petrochemical
- CFD of Ethylene Furnace Burner – Petrochemical
- Flange Leak Finite Element – Petrochemical
- Waste Heat Boiler Failure Analysis – Petrochemical
- Aerodynamic Study of Inlet of TLE – Petrochemical
- Level 3 Waste Heat Boiler Fit For Service – Petrochemical
- Rotordynamics – Motor Compressor Train – Refinery
- Polymer Gear Pump Failure Analysis – Petrochemical
- Polymer Heat Exchanger – Petrochemical
- Residual Weld Stress – Non-linear Plastic Analysis - Petrochemical
- Waste Heat Boiler Failure Analysis and Redesign - 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
- Special Process Reactor Design – FEA, CFD - Defense
- High Pressure Flange Design Riser – FEA – Off Shore
- Structural Vibration – Petrochemical
- Process flow problems – CFD - Petrochemical
- Nonlinear Membrane Bladder – Nonlinear FEA – Equipment Mfg
- Compressor Vibration Study - Petrochemical
- Non Linear FEA - Petrochemical