Jun 17th, 12:00 AM - Jun 20th, 12:00 AM

International Junior Researcher and Engineer Workshop on Hydraulic Structures Session 4

Gonzalo Duró

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Boris Rodriguez

Fadi Wakim

International Junior Researcher and Engineer Workshop on Hydraulic Structures
6/19/2012, Logan, UT USA

SESSION REPORT

SESSION 4

Chairman: Gonzalo Duró

Rapporteur: Mitch Dabling

Advocatus diaboli: Josh Mortensen

Speakers: Boris Rodriguez, Fadi Wakim

ROUND TABLE

Moderator: Nathan Christensen

Rapporteur: Mitch Dabling

Session Chairman: Gonzalo Duró

Session Speakers: Boris Rodriguez, Fadi Wakim

External Expert: Warren Frizell

1st Presentation

Title: Pumping Problems with Variable Reference Head: the Non-Visualized Problems

Author(s): Boris Rodriguez, Astrid Pérez, José Adriasola

Speaker(s): Boris Rodriguez

Brief description of author(s) approach:

This research investigates the difficulties of designing pumping systems with multiple discharge points and variable reference head. The example given included a metal processing plant and a reservoir. Designing such a system can be difficult because there are multiple cases that need to be considered (e.g. reservoir empty and full). Different TDH's between the full and empty cases resulted in 21% difference in the flow pumped.

Questions and answers:

Q: If needed can you use 4 pumps in parallel and 4 additional pumps in series?
A: You need to be careful to select a pump that has an operation point on the curve. If you have four pumps in parallel and another 4 in series, you maybe have a not efficient system. It might be better to have 6 pumps in parallel.

Q: Did you consider variable speed drives?
A: We considered it as a possible solution, but it was too expensive. Variable frequency drives with a control valve downstream might not be as efficient because the TDH can increase. It seems counterintuitive to add head loss to a system, but you can increase efficiency that way.

Q: You mentioned there are 36 in. lines, what happens if the pump station shuts down? How do you prevent backflow into the pumps?
A: We have not done a transient analysis, but possibly a check valve. Small check valves in parallel will help alleviate the concerns of the large pipe size.

Q: Can you eliminate a pump station?
A: Sure, but the difference in head is 600m. To have only two pump stations with heads of 300 m can be very complicated. 200 m is much more manageable. The power needed to handle a large flow is very high. Also you would need larger pressure pipe.

Q: Is the system ever empty?
A: About 3 months of the year the river is empty. The dam fills the plant but not the other parts of the lines. Then when water is flowing again you fill from the river up to the reservoir.

Q: Would there be any advantages to series pumps? It seems odd to have a parallel pump system with such high head. What if you have a parallel/series pump system?

A: That could be a possibility. You would need to select different pumps.

Rapporteur's appreciation:

As an undergraduate student it was great to learn more about pump system design. One suggestion that was given for both presenters was to explain a bit about the ideas that they discarded before settling on the design. This would help prevent confusion and "why did you not do this?" questions. I thoroughly enjoyed this presentation.

2nd Presentation

Title: Heat Exchanger System Piping Design for a Tube Rupture Event

Author(s): Fadi Wakim, Pinar Kavcar, Sustafa Samad

Speaker(s): Fadi Wakim

Brief description of author(s) approach:

Some of the most damaging events for a pipe network are hydraulic transients. This presentation focused on hydraulic transients caused by a tube rupture in a Liquid Natural Gas system. A guillotine type failure was used for design as it is the most severe type. The author explained how he safely designed a LNG system and provided details on the differences from a standard water pipe system.

Questions and answers:

Q: One of your solutions was to get larger pressure relief valves. How did you know how big was big enough?
A: We experimented using vendor data until the valve was large enough.

Q: Did you have problem with column separation/cavitation?
A: Yes some of the spikes in the system response graph were due to this

Q: What considerations did you have to take into account with LNG as opposed to water?
A: One big difference is that there are different components in LNG. This caused issues with the rejoining of gas bubbles. Because you have different components in LNG, they separate at different vapor pressures. When you have multiple components, after gas begins to rejoin, you can still have other gasses in the line. When you inject air into a line, the gas bubbles in LNG act in much of the same way.

Q: How do you release gas from the pressure relief valves safely?
A: It goes into a burner.

Q: Have you looked into unsteady devices?
A: There are many devices you can use, but the problem is dealing with the manufacturer. When they need to guarantee that the valve will open in 10-15 milliseconds, they usually don't.

Q: How much do you feel the API standards helped guide your analysis?
A: The API standard simply said there was a problem and I needed to design for it, but it did not give any sort of analysis method.

Q: I'm guessing that you are using heavy enough walled pipe you are not worried about pipe collapse?
A: Correct, the tubes are very small, only one inch, so negative pressures are not a concern.

Q: Are ruptures common?
A: No. maybe one in a thousand years. But the effects are catastrophic. Very low probability, very high risk. Pipes can blow out of place.

Q: To start the simulation, did you start a rupture along the pipe?
A: The worst case scenario is that the pipe breaks as a guillotine. There is literature about how this can begin. Most cracks are not a big concern. There is research that shows there is a crack length to tube diameter ratio that the likelihood of a guillotine crack increases.

Q: Do you have any field data?
A: No. That is the challenging part. To create a standard we need data. No one wants to admit they had a failure. There have been field data collected to validate our software using valve closures etc. Our software was very good.

Rapporteur's appreciation:

Having no background in working with hydraulic transients, I found Fadi's presentation very informative. He explained some of the difficulties of working with LNG in the roundtable, and this could be used to help his presentation become clearer. Also explaining some of the design techniques he discarded and why would be helpful.