5 Issues **Automated Network Sizing** Will Solve for the Time-Deficient Engineer

Applied Flow Technology

It is no secret engineers are pressed for time. Regardless if you're designing a system for a facility you work for, or are working within billable hours, every design project needs to be completed on-time and on-budget. Most importantly, the design must be properly sized to account for worst case scenarios. Even in today's world of advanced technology, there always seems to be time restraints. So much so, often engineers must balance more than one project at a time. When this happens, sure, a system will meet its design requirements - but what if there are hidden opportunities to reduce cost you have not had time to consider?

With automated sizing, not only will a design meet its requirements, but each design becomes part of the process to extend the norms of network sizing approaches.

By using your existing steady-state flow models and allowing the piping system to be automatically sized through numerical methods, you let a computer do the tedious iterations for you.

Here are five issues commonly found during the system design process that automated network sizing helps to solve:

Excessive oversizing implies excessive overpayment

Every day, engineers are forced to make critical decisions with limited information. Whether this uncertainty is sourced from unknown system requirements, or even worse, human error, engineers must account for this uncertainty to design reliable systems. Often this uncertainty is mitigated in the form of design factors, ensuring a system can operate as well on day one as in year 5 with its degrading pump and scaled pipes. While automated sizing is in no way a replacement to design factors, sizing a wider range of 'what-if' and 'worse-case' scenarios can help inform the limits for these design factors. Design factors are essential for creating a safe and dependable system, however an excessive design factor can come at a price: the cost of oversizing.

This oversizing cost includes additional weight, volume, and most often higher monetary costs. For our purposes, a *system cost* will describe anything that an engineer would wish to minimize. Using automated sizing software, engineers can easily establish a design objective to minimize a system cost while maintaining their design requirements. A design objective can be set to minimize system costs, minimize initial investment amounts, or minimize the life cycle cost of an operation provided an initial budget limit. With automated sizing, a system's design requirements can be adapted in conjunction with your existing design factors to size the system accordingly, automatically.

Testing alternative designs takes time

There is often a degree of uncertainty associated with a final design. "If this pipe was slightly smaller, how would it impact operation and the bottom line? What if it were slightly larger?" These are questions engineers could easily answer, however the increased time it takes to explore each option yields diminishing returns.

Applied Flow Technology's Automated Network Sizing (ANS) Add-on Module intelligently manages your design iterations for you. The ANS module utilizes IntelliFlow® technology which perturbs pipe sizes and determines the next logical iteration. This enables the module to determine which options to evaluate among millions, or billions, of alternatives. Among these options, the solver determines the cost minimum for the system while maintaining user-specified design requirements. These design requirements can range from flowrates to pressure specifications throughout the system.

Automated sizing enables an engineer to avoid any deadline driven compromise when they know a better design is out there. An automated sizing tool should be available for both compressible and incompressible systems.

3 Pumps and Pipes are often sized independently

While other tools, such as sensitivity analysis, have enabled engineers to compare design alternatives; the potential for comparisons is limited. While sensitivity will easily indicate the minimum for a single variable, it rarely considers interaction between variables on a macro scale. Another issue with sensitivity is that the resulting number of runs is exponentially proportional to concurrently tested variables.

An automated sizing solution to this issue is to size the network holistically. By applying numerical methods to determine a cost minimizing solution, the software avoids the excessive simulations associated with multi-variable sensitivity. Instead, it allows the slope of the system cost curve to inform the next perturbation. Engineers can link pipe sizes to reduce the number of independent variables to further improve simulation times and better reflect the final system. Automated sizing software can also provide insight during the design process by comparing the system costs associated with Variable Drive Pumps and Flow Controlling Valves. It is important to consider this comparison for the entire system rather than in isolation.

4 Systems don't always operate at a single condition

Designing for a single steady-state operation is much easier than attempting to account for all possible operation deviations. However, an engineer must check their system against their set of operating conditions to ensure a safe and properly operating system. While the time-sink associated with properly sizing a system for steady state operation has been established, it is even more time-intensive to size a multi-condition system.

With AFT's automated sizing tools, one established system can be sized to meet multiple operating conditions, each with their own set of design requirements. These different operating cases are represented with Dependent Design Cases (DDCs) and can account for different pressure and flow requirements, bringing pumps online, varying a valve closure, or even adding pipes to account for a planned future expansion.

Additionally, you can get an accurate system cost representation by weighing variable operating costs. This could be applied for pumps which are selectively used during high demand periods for example.

5 Costs change over time

One of the biggest design questions is whether long-term operating savings is worthy of hefty upfront investments. This decision takes many factors into account, including the time value of money, potentially limited capital, and the opportunity costs of alternatives. Designing a system to minimize either life-cycle costs or initial capital investment can result in very different systems, both of which must meet the established design requirements as their number one priority.

A quality automated sizing tool should include the capability to consider the time value of money, as well as incorporate scale tables to represent increasing maintenance costs over the life of the equipment. By considering life-cycle and energy expenses, designs can be sized for both initial and life-cycle cost minimization for comparison. Alternatively, life-cycle cost minimization can be implemented with an initial investment limit to reflect real-world budgetary restrictions. In addition to automatic sizing and costing for new system designs, a good software tool should have the ability to compare the cost effectiveness of replacements for existing systems.

Learning to take advantage of a proven automated sizing technology is a smart solution to help any time-deficient engineer regardless if:

- A project is a brand new system or new piping in a system expansion
- The goal is to reduce your initial investment or reduce your carbon footprint
- A design operates at one or one-hundred operating conditions

Automated sizing enables engineers to maximize their benefit while managing their time spent.

This article is based on is the AFT Automated Network Sizing Add-on Module. The ANS add-on module is available for both compressible and incompressible systems. AFT designed the tool to integrate IntelliFlow® technology into any existing AFT Arrow™ or AFT Fathom™ designs.