Knowledge Partner

Keeping systems steady

Frederik Van De Walle, CTO of Firemiks AB, explores the challenges of managing overflow and optimizing reaction time in suppression systems using dry piping and rotating equipment

Firemiks often receive questions about how to consider the effects of overflow in fire suppression systems with dry piping. These are important questions as the can be critical for ensuring system reliability. In this article, Frederik Van De Walle, CTO of Firemiks AB, explores the impact of overflow on system reaction time, providing key insights and practical solutions to optimize fire suppression performance.

Understanding system hydraulics

In fixed fire suppression systems that contain dry piping, system designers should always consider the possible effects of water hammer and overflow. Water hammer can send pressure waves in the system as high waterflows hit flow limiting components, possibly causing malfunction of pipework or components.
Overflow is an overload condition of equipment that has a set maximum flow rate. In this article I will put this phenomenon in context by using FIREMIKS as an example of rotating equipment in the water flow. While water hammer and overflow are closely related, this article will primarily focus on overflow and its impact on system reaction time.

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When designing a fire suppression system using foam, the system designer will usually calculate the required amount of foam solution needed and design the foam system to provide this required amount. While different components like various valves, dosing system, piping and various discharge devices for foam have their flow ratings, the actual foam solution flow is governed by the complete system properties.

This is, if done well, calculated in a hydraulic calculation using one or several methodologies to calculate the intersection of the pump curve of the water source, with the flow characteristics and resulting pressure drop of the complete system. Where

these two curves intersect, there we have the expected flow of the system.

FIREMIKS is a foam dosing system that uses the extinguishing water flow for power. It uses what we call a water motor that is installed in-line with the extinguishing water, where it uses the energy from water to drive a foam concentrate pump. It is important to understand that such a water motor is an entirely passive system in the sense that it will just follow the actual water flow through the system, it does not power or govern the water flow like a water pump or a valve.

The FIREMIKS water motor also at the same time acts as a de-facto flow meter because it uses a volumetric design. So, it not only drives the foam concentrate pump, it also does so at a speed for the correct amount, making it a dosing system.

Steady state and high flow start-up scenarios

The hydraulic calculations are typically done for the steady-state scenario where the foam is applied at a constant rate. When the complete system is already filled with water, at start-up the flow will simply increase up to the design flow. In this article we consider the scenario when there is piping in the system that is, wholly or in part, empty at start-up. Such empty piping can be a few meters long, but in some case can also be hundreds of meters long.

What is important to realize is that in such an empty pipe scenario, all components in the system that are not wetted and pressurized by the water flow, are not (yet) part of the hydraulic calculation, and thus the system has a different flow characteristic as compared to a filled system at steady-state. With less flow resistance, the initial water flow can be higher, sometimes much higher, than the steady state flow.

Calculating dry pipe start-up flow and reaction time

Potential overflow is calculated by re-doing the hydraulic calculations without the components that are not filled with water. This will give the worst-case start-up flow. With this dry pipe start-up, and knowing the volume of the complete system, one can also calculate the system reaction time. This is the time from when the system is started, until when the foam is actually applied to the hazard.

In my role of helping our customers dimensioning their systems using a FIREMIKS, it is not uncommon to find surprisingly long reaction times in their systems. In such a case, a high start-up flow due to empty piping can be a positive.

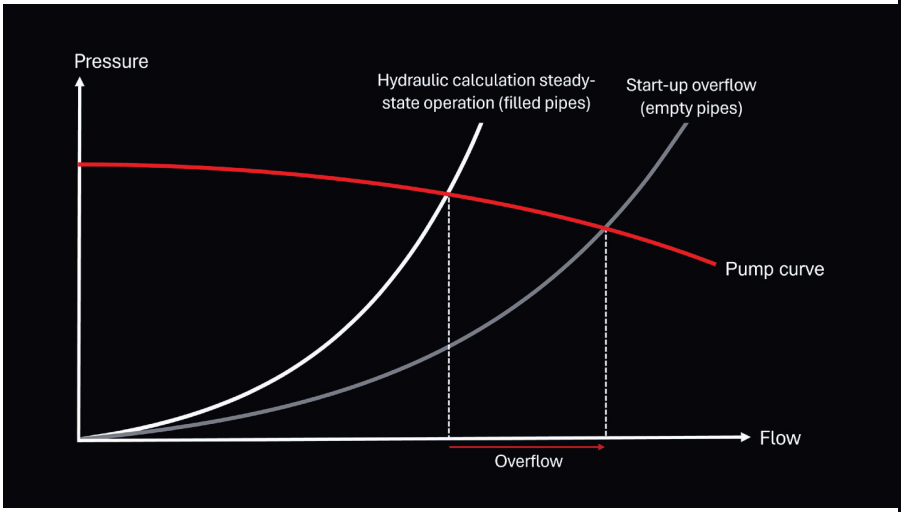
> **"Removing overflow when reaction time is not critical involves controlling the start-up flow to below the allowable maximum flow."**

Overflow and designing for short reaction time

A short reaction time is crucial for limiting damage and having the best chance of extinguishing a growing fire. In case of long dry piping, a high start-up flow can be beneficial to reduce the reaction time as it more quickly fills the piping. This high start-up flow only becomes overflow if the components in the system are rated for lower flows.

In case of the FIREMIKS, overflow will wear and if done repeatedly eventually damage the water motor and can also cause cavitation in the concentrate pump. However, if the system is purposedly designed to deal with a higher start-up flow and also uses correctly dimensioned FIREMIKS, it can instead greatly reduce reaction time.

Calculating the exact high start-up flow with empty piping can be a little tricky, with FIREMIKS there is the possibility to measure the unit rpm with a tachometer during



commissioning to get an idea of this start-up flow, where the max flow rpm is given in the datasheet. If the max flow is exceeded, it is possible to add additional flow resistance by adding an orifice or partly closing an e.g. globe of OS&Y valve upstream of the FIREMIKS, if such methods are acceptable according to local rules.

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Another way of quicky getting foam solution to the discharge devices is to have the foam dosing equipment as close as safely possible to the hazard, so that the solution has a shorter distance and travel time to the hazard. This is usually easier with a FIREMIKS because it strictly speaking does not need electricity, fuel tanks, control valves or instrumentation to function correctly. This and the previous strategy can of course be combined.

Because the FIREMIKS typically accommodates a wide flow range, it can be dimensioned for a high dry pipe start-up flow while still maintaining accurate dosing as the lower steady-state flow begins once the piping is filled. This has of course to be verified in the steady-state hydraulic calculation, in addition to verifying that all other components in the system can actually deal with the initially higher start-up flow.

Removing overflow when reaction time is not important

In case the reaction time is not critical, and the start-up dry pipe flow is calculated to exceed the maximum flow of a FIREMIKS or similar equipment, this becomes an overflow condition that needs to be remedied. This can be done with whatever one, or in some cases also a combination, of the following methods that successfully reduce the start-up flow to below the allowable maximum flow:

- Slowly opening of one deluge valve, or if there are several, not opening them at the same time.
- If the main extinguishing water is delivered by a powered pump, use appropriate methods to ramp up the pump speed and water flow slowly. Or if there are several pumps, start them in a controlled delayed sequence to slowly step up the water flow
- Using a deluge valve with flow control. This kind of valve can use the differential pressure over the FIREMIKS as an indication of flow that should not exceed a threshold value.
- Using a bypass valve that opens up when flow through the FIREMIKS exceeds a threshold value, this can again use differential pressure over the FIREMIKS.
- Using an orifice or partially closed valve to control start-up flow, which is then bypassed by a parallel valve that is opened once it senses there is backpressure in the system.

Of course, we guide our customers in this if they require any assistance.

Also note that, if in case of a sharp emergency, any of the above method fails for some reason, FIREMIKS is designed to survive a *single* overflow event. This criterion was also included in the latest standard of FM Approval, where our FM Approved units are tested for exceeding maximum flow with 10% for 1 hour and 50% for 4 minutes in succession.

We at FIREMIKS hope this article gave useful insights. When considering our systems, we welcome any discussions on how they are best applied to get the most effective fire protection in your applications. ■