Application Bulletin
PIPENET® Transient Module Case Study

HOW TO REDUCE PRESSURE SURGE IN DRY DELUGE SYSTEM

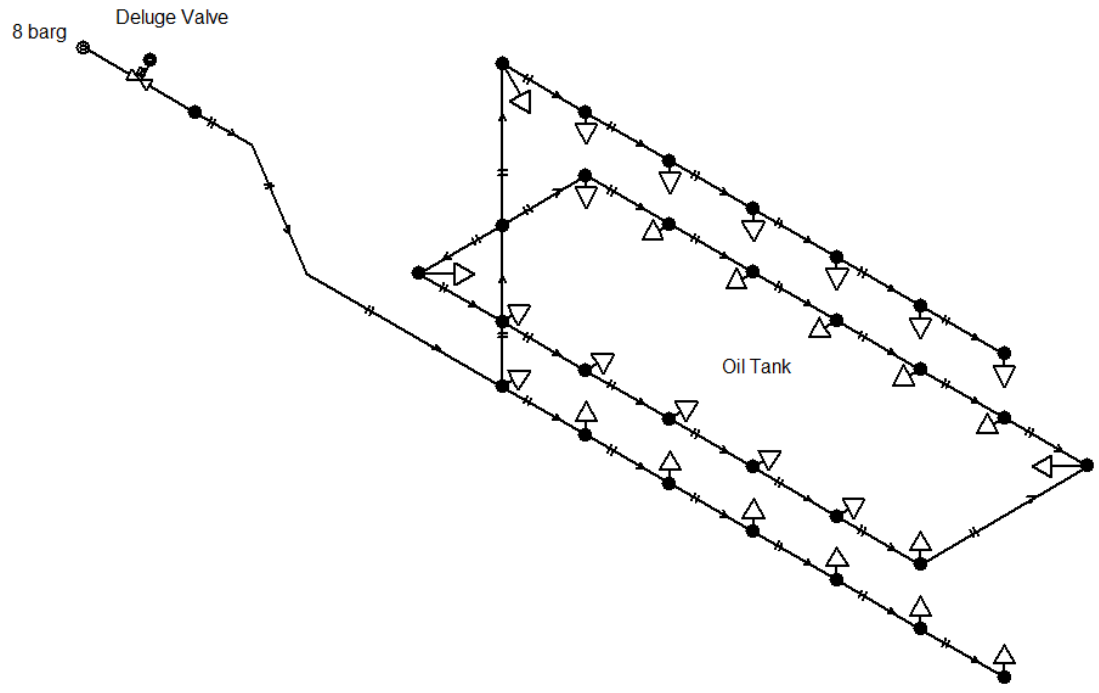
INTRODUCTION

Pressure surge is a common phenomenon when a dry deluge system is primed. In the worst case the maximum pressure can reach high values when the remote nozzle is primed. This is because the flow resistance increases and the flow rate decreases instantly when the fluid in the nozzle changes from air to water. The following network has pressure surge problem based on the simulation results. In this document two cost-effective ways are discussed to solve the difficulties.

1 – using a short dry pipe near the most remote nozzle for creating a cushion effect

2 – decreasing pipe size to limit the flow rate when the network is primed

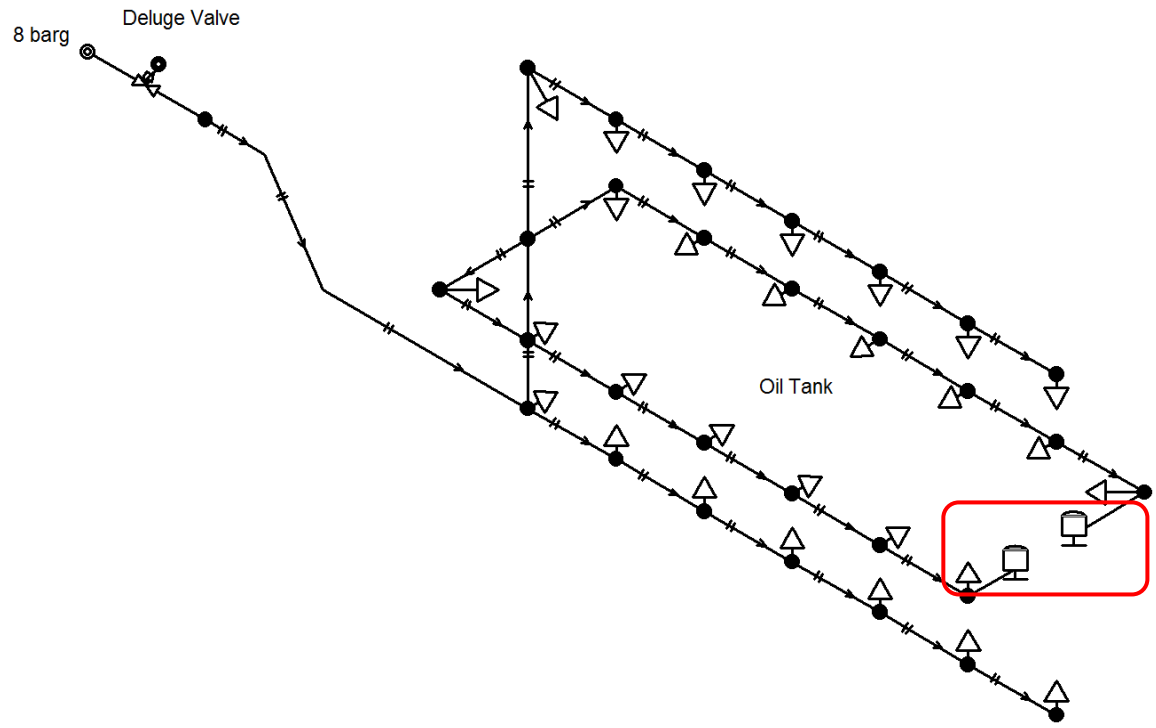
THE NETWORK



Inlet pressure:	8 barg (assume to be constant during simulation)
Deluge valve closure time:	5 seconds
Main pipe size:	Dn100
Riser size:	Dn80
Branch pipe size:	Dn50

BASE CASE

The air trapped in the pipe at the far end of the loop has the same effect as an accumulator when the remote nozzles are primed. Therefore, the above network can be simulated in PIPENET by modelling the mentioned pipe with the help of two accumulators. They are not real but 'virtual' accumulators representing the behaviour of the air trapped inside the pipe.



The dimensions of the virtual accumulators are the same as the modelled pipe. See the figure below.

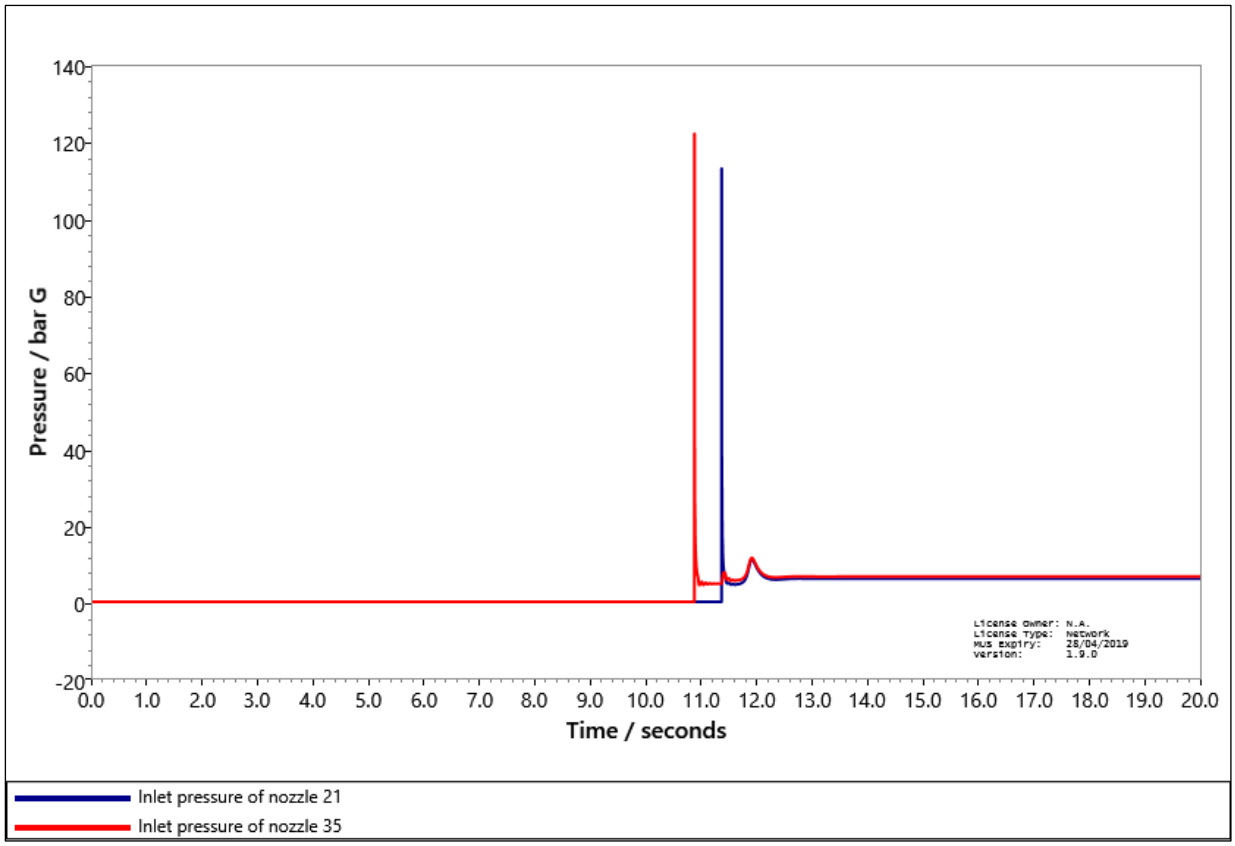
Label	2	
Input node	210	
Type	Horizontal c...	
Diameter	50	mm
Length	2	m
Reference Fluid D...	1	mm
Reference gas	Diatomic gas	
Heat capacity ratio	1.4	
Reference Gas Te...	21	°C
Reference Gas Pr...	0	Bar G
Results selected?	NO	

The calculated maximum pressure occurs at the remote nozzle of the lower and upper branches when the nozzles are primed. See the summary and figure below:

Maximum pressure is 122.052 bar G

on pipe 163 at the outlet

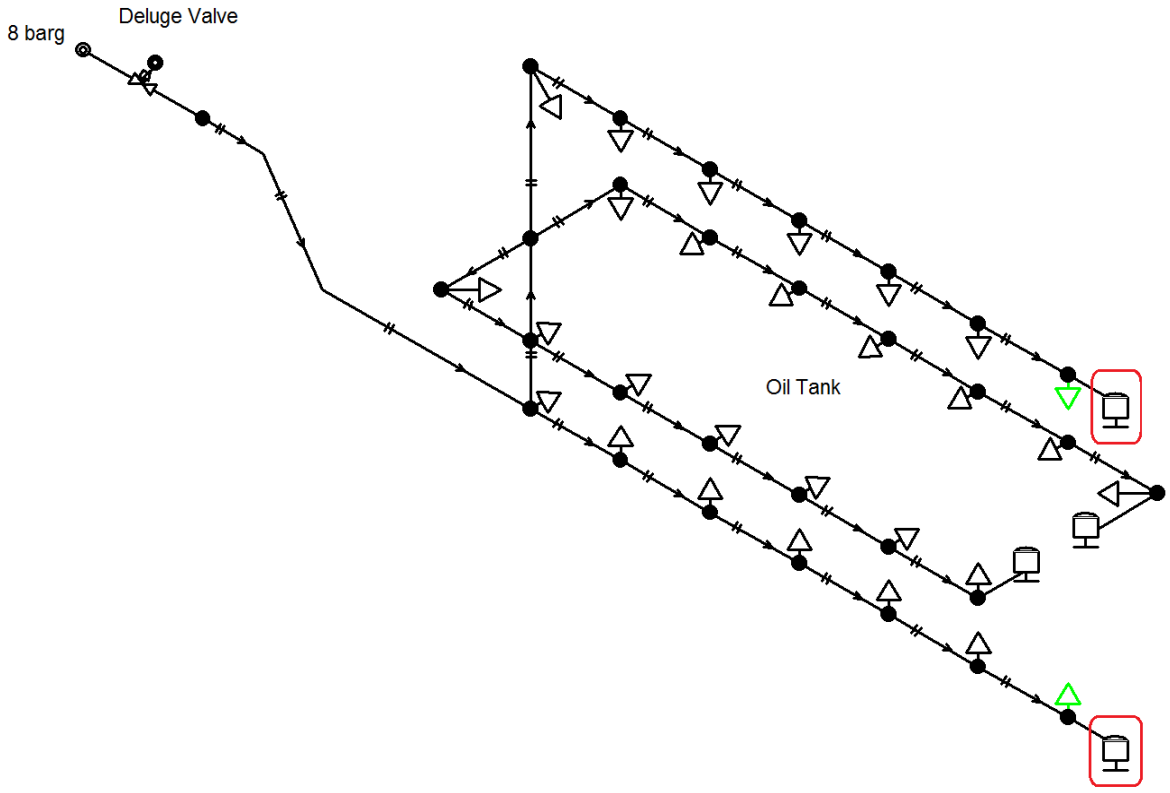
at time 10.88200 seconds



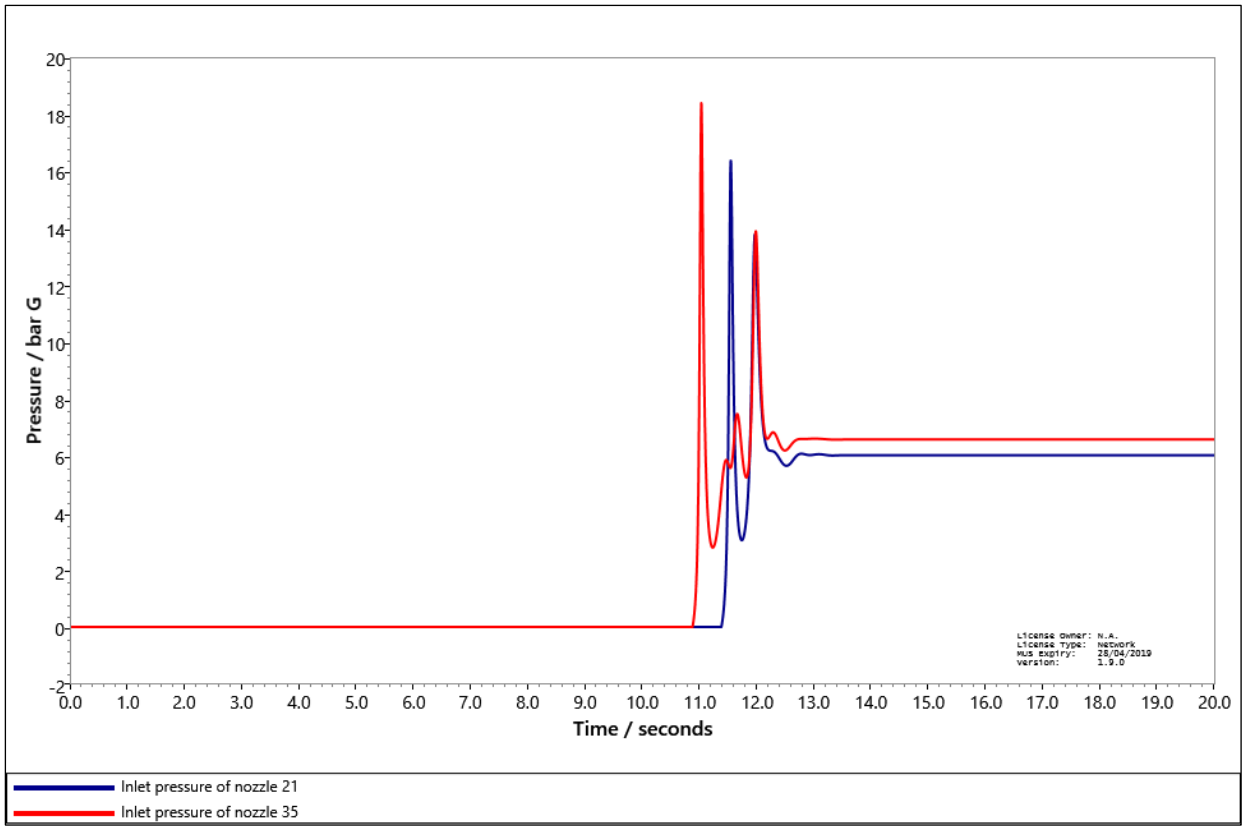
Solution 1 – extend pipes near the remote nozzle

This is the same as the base model, except that the lower and upper branches are extended 1 m for creating the cushion effect when the remote nozzles are primed. These pipe extensions are modelled in PIPENET as accumulators for convenience, although they do not represent real accumulators. They work as cushions to absorb the pressure surge from the nozzle priming.

Label	3	
Input node	7	
Type	Horizontal c...	
Diameter	50	mm
Length	1	m
Reference Fluid D...	1	mm
Reference gas	Diatomic gas	
Heat capacity ratio	1.4	
Reference Gas Te...	21	°C
Reference Gas Pr...	0	Bar G
Results selected?	NO	



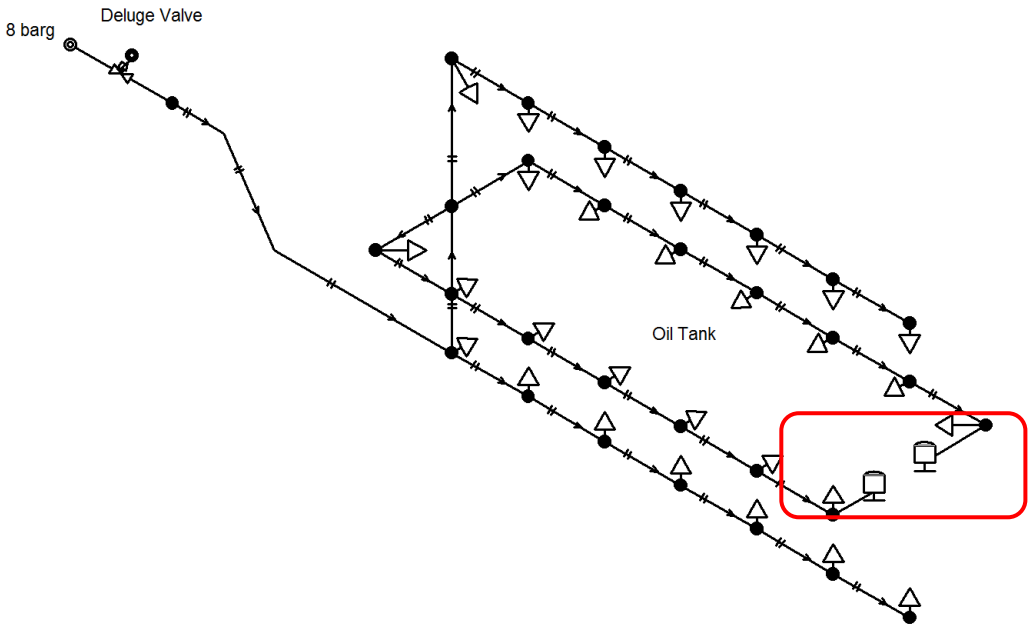
The maximum pressure drops to 18.4 barg. See the figure below:



Solution 2 – use smaller pipes to reduce the flow rate when the system is primed

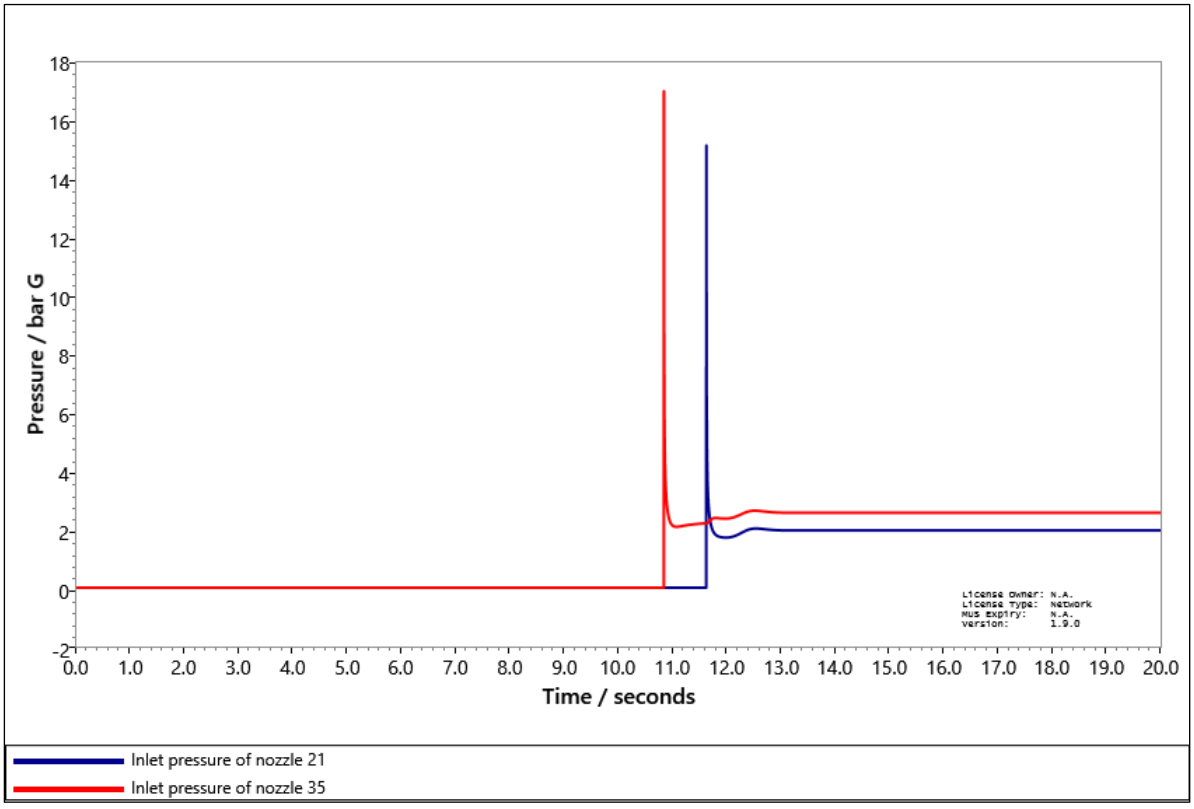
This is the same as the base model, except that the pipe size is decreased in order to create an additional pressure drop. As a result, the pressure loss of the pipes increases significantly and the flow rate when the system is primed decreases. This significantly reduces the pressure surge. However, the flow velocity in the pipes and the pressure at the nozzle inlet must be checked carefully to satisfy the project requirements. In this scenario, the pipe sizes are changed as follows:

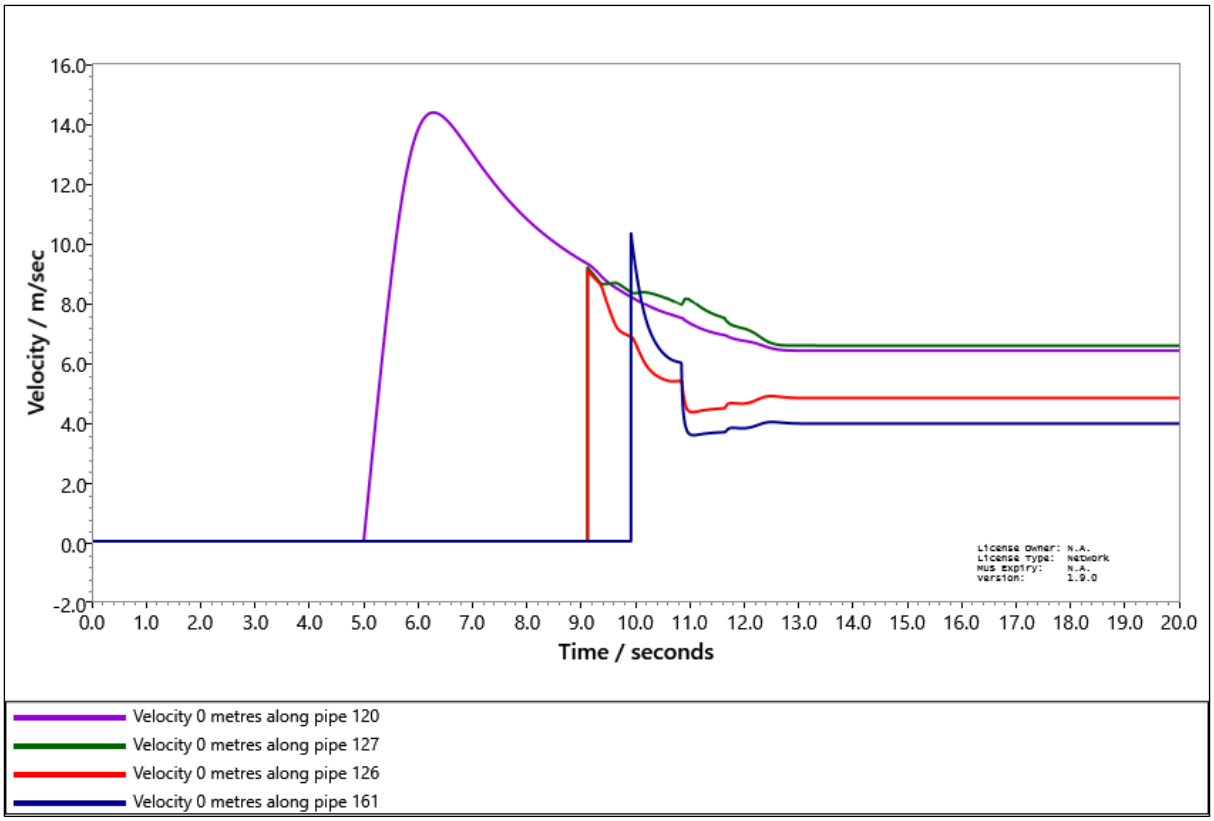
Main pipe size:	Dn65
Riser size:	Dn50
Branch pipe size:	Dn32/Dn25



The maximum pressure drops to 17.0 barg in this scenario. The minimum pressure at the nozzle inlet is 1.95 barg and the maximum flow velocities in the pipes are between 3.9 to 6.5 m/s after the system is primed. See the summary and figures below:

Maximum pressure is 16.9769 bar G
on pipe 163 at the outlet
at time 10.84400 seconds





CONCLUSION

Dry deluge system and the caused problems are discussed in this article. Both pipe extension near the most remote nozzle and smaller pipe are the effective methods to reduce the pressure surge when the system is primed. The size of pipe extensions and pipes can also be optimized based on the simulation results.

If you have any questions about this case study, or any other of PIPENET's capabilities, please email us at Pipenet@sunrise-sys.com.