PIPENET® NEWS

SPRING 2018

LEADING THE WAY IN FLUID FLOW ANALYSIS

IN THIS ISSUE...

Meet us at OTC-2018 in Houston, USA,
30 April – 03 May 2018.
Sunrise Systems Limited is participating again in the biggest annual oil&gas event – Offshore Technology Conference - 2018 in Houston. Meet us at NRG Arena **Booth #7320.** We will be happy to demonstrate PIPENET to you.

WELCOME TO **PIPENET®** VISION 1.9.0!

Recently, Sunrise Systems Limited presented the latest evolution of PIPENET® – **PIPENET Vision 1.9.0**. The new release has more than 100 enhancements including templates, an improved graph viewer and a streamlined user interface. There are many significant improvements that will revolutionise the PIPENET experience.

Read the summary of the new features on *Page 2*. For further information, please refer to the Help and PDF manuals.

We are sure you will enjoy the outstanding capabilities of **PIPENET Vision 1.9.0**!

PIPENET Vision 1.9.0 has been sent to all customers with active PIPENET Maintenance, Updates and Support. We hope you are already enjoying using it. If you would like a copy of PIPENET Vision 1.9.0, please contact pipenet@sunrise-sys.com.

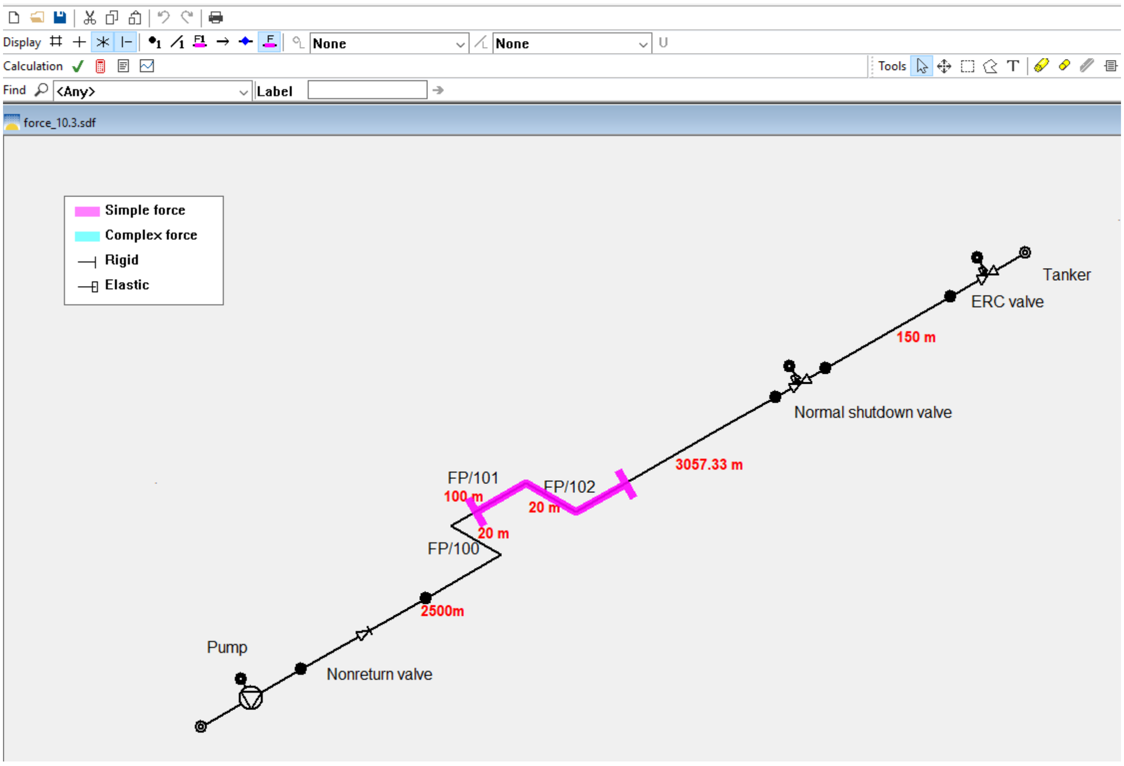
PIPENET® Vision 1.9.0 – New Features

PIPENET Vision 1.9.0 has more than 100 enhancements including templates, an improved graph viewer and a streamlined user interface. There are many significant improvements that will revolutionise the PIPENET experience. Here is a summary of the new features.

PIPENET Vision 1.9.0 Transient Module enhancements include…

- Reference elevation is available.
- Pressure and head envelope can be plotted in Excel spreadsheet.
- Graph smart output is improved to reduce the recorded data.
- Calculation dialog redesigned.
- Improved Graph Viewer.
    - New quick and easy to use colour picker.
    - Improved tool-tips.
    - Improved speed.
    - User editable zoom boxes.
    - Ribbon reorganised into “Home”, “Graph” and “Tools” tabs.
    - “Remove All Graphs” and “Hide Grid Lines”
    - Dynamic change of decimal places on x-axis.
- Added ability to reverse multiple pipes simultaneously.
- Recent files now grouped into a submenu.
- New templates functionality.
- New look user interface.
- Added component description to properties window.

Picture 1. New force display feature

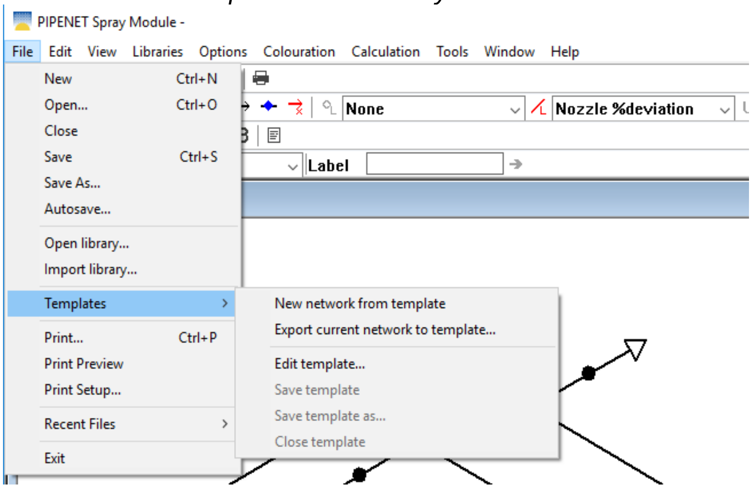


PIPENET Vision 1.9.0 Spray/Sprinkler Module enhancements include…

- An increased maximum number of pipe types and pipe schedules.
- An increased maximum number of all components.

- Pressure at orifice calculation added.
- Added ability to reverse multiple pipes simultaneously.
- Recent files now grouped into a submenu.
- New templates functionality.
- Improved pipe sizing calculation.
- New look user interface.
- Added component description to properties window.

Picture 2. New templates functionality



PIPENET Vision 1.9.0 Standard Module enhancements include…

- Pressure at orifice calculation added.
- Ambient pressure correction calculation improved.
- An increased maximum number of pipe types and pipe schedules.
- An increased maximum number of all components.
- Added ability to reverse multiple pipes simultaneously.
- Recent files now grouped into a submenu.
- New templates functionality.
- Improved pipe sizing calculation.
- New look user interface.
- Added component description to properties window.

Picture 3. Increased maximum number of all components

Component	Number used	Maximum allowed
Analysis spec.	0	1000
Deluge valve	0	600
Design spec.	0	1000
Elastomeric v...	0	600
Equipment it...	0	10000
Filter	0	350
General press...	0	1000
Node	0	20000
Non-return v...	0	600
Nozzle	0	5000
Orifice plate	0	500
Overboard d...	0	600
Pipe	0	10000
Pump/fan	0	350
Text	0	1000

There are many user interface enhancements in all modules. Please see our User and Training Manuals for further information.

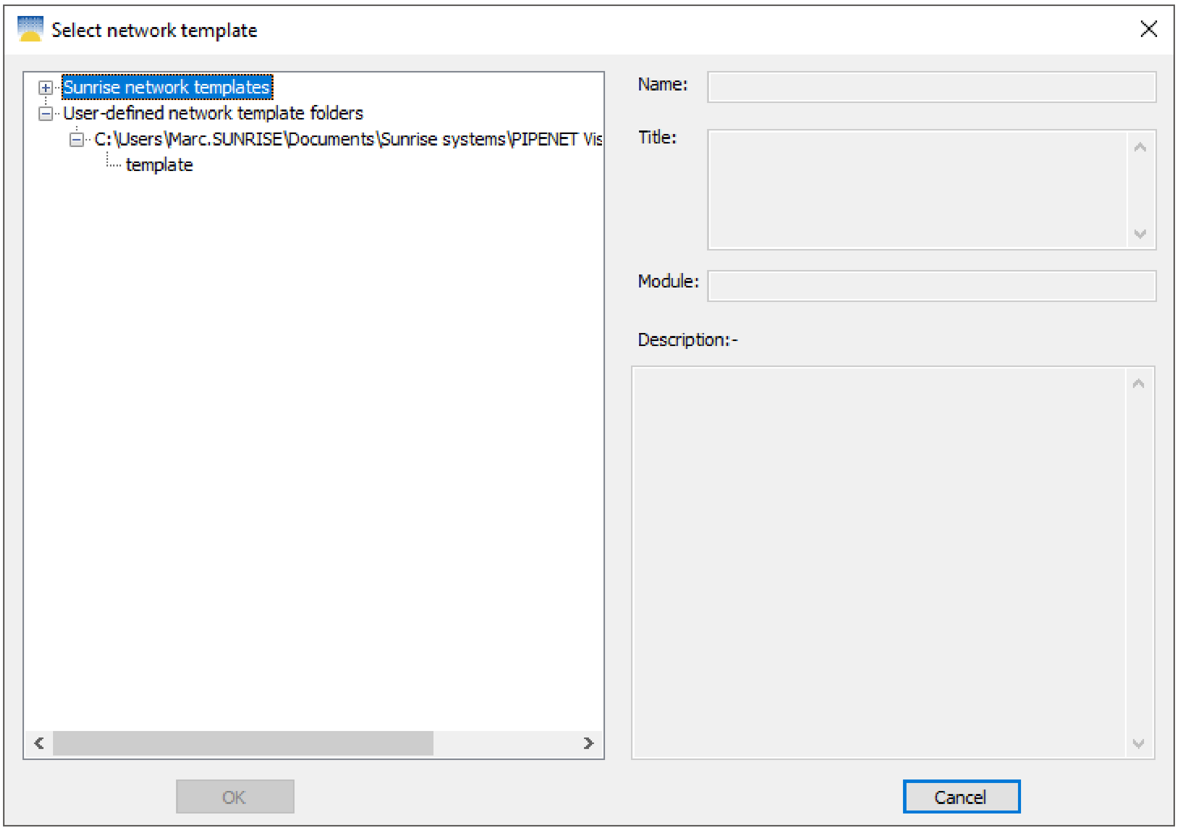
Network Templates in PIPENET® Vision 1.9.0.

The latest release of PIPENET® - PIPENET® Vision 1.9.0 features a new valuable capability – network templates. This function would be especially useful to engineers who tend to create networks with similar basic characteristics, or that follow a similar pattern. If an engineer repeatedly creates networks which have similar basic layout and features, they do not need to start from scratch any more: they can create their own template and save it in PIPENET to be used in the future. Also, this feature would be extremely helpful to those who return to PIPENET calculations after a long break. They do not need to recall what is what and familiarise themselves with PIPENET again. They can simply open a basic template and go ahead with their work!

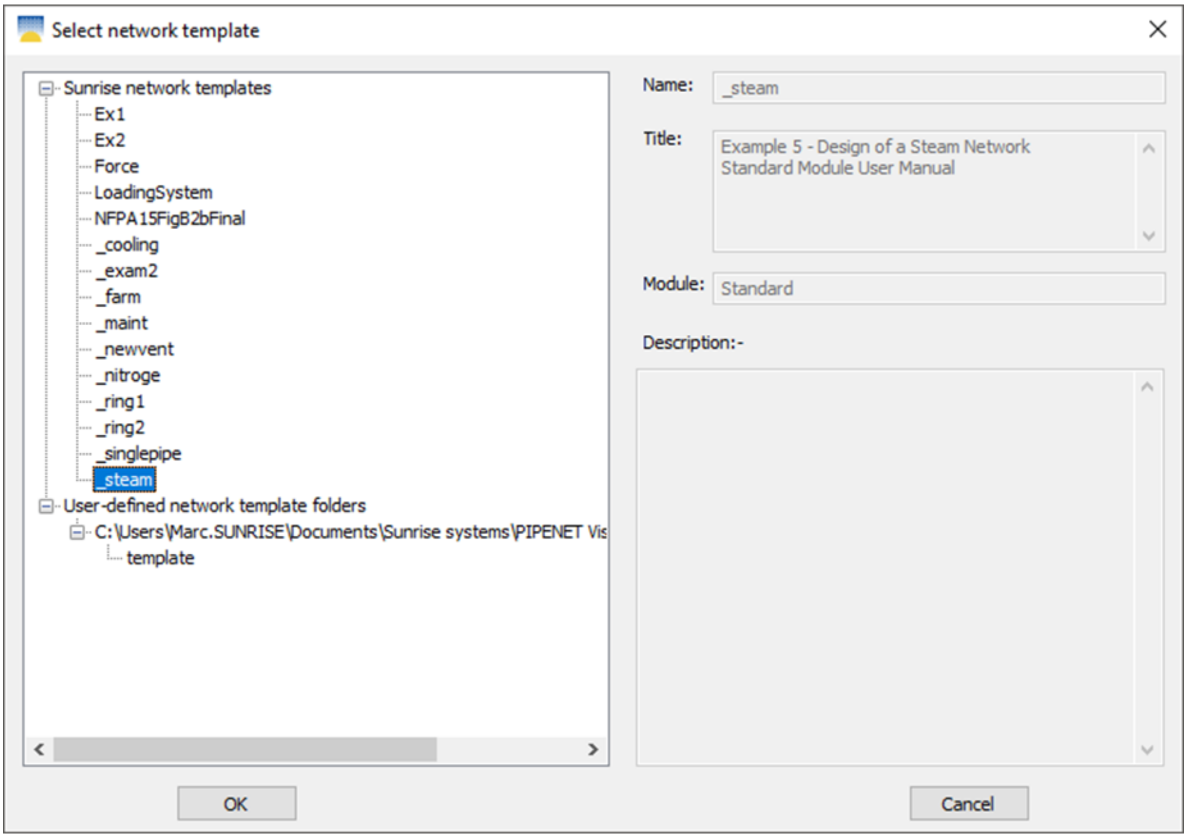
A PIPENET® template is a special type of network which can be used as a starting model for new networks. Templates have a different file extension to separate them from normal networks. Sunrise Systems Limited has provided some built-in templates and users can also create their own. A template can be anything from a complete network, a section of a network or even an empty network with only the network settings and library present.

Creating a new network from a template

A new network can be created from **File | Templates | New network from template**. The following dialog is then displayed:

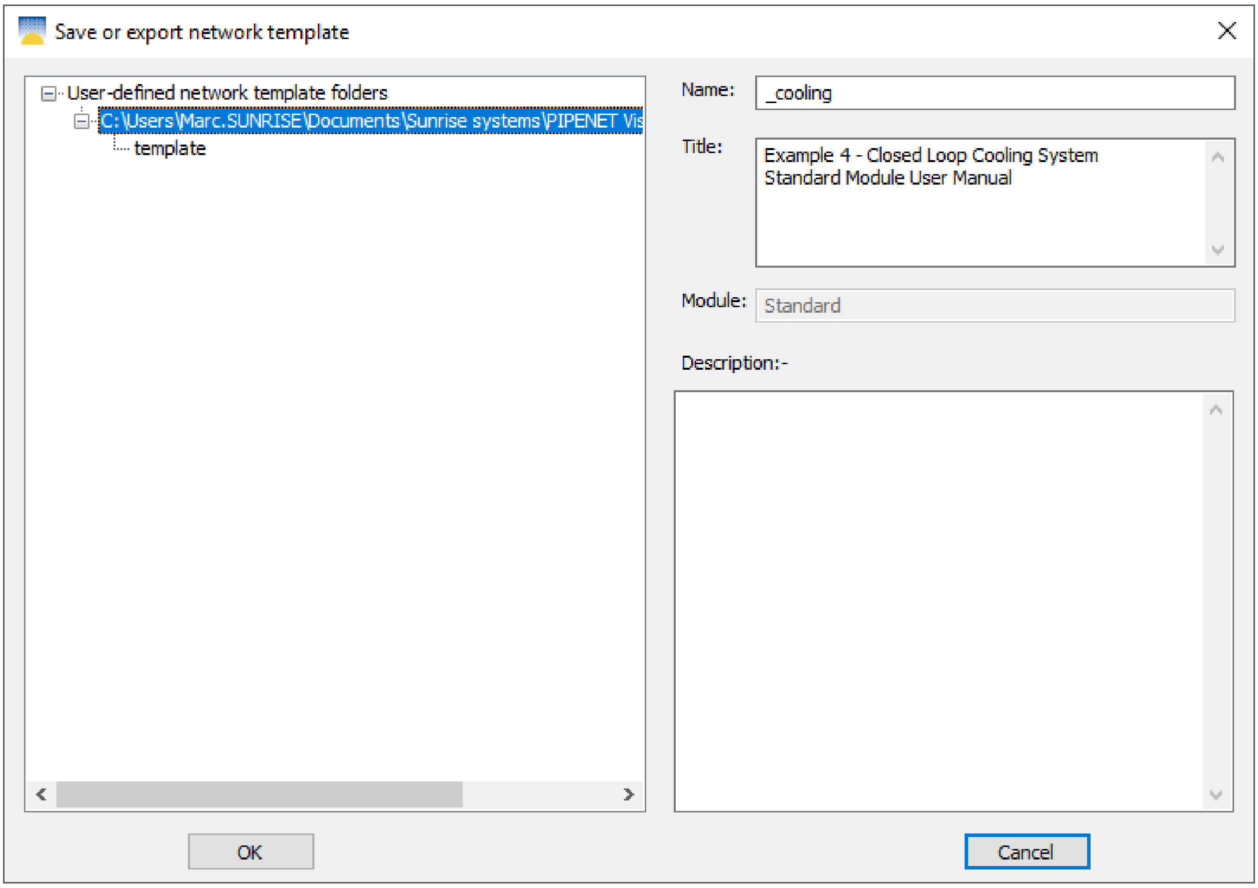


Select a template from the list and its name, title, module and description are displayed on the right. Click OK to create a network from the template.

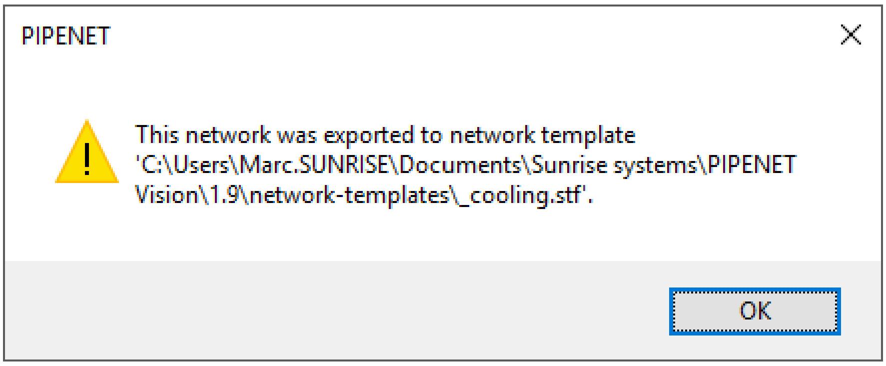


Creating a new template from a network

A new template can be created from the currently open network from **File | Templates | Export current network to template...**. The following dialog is displayed:

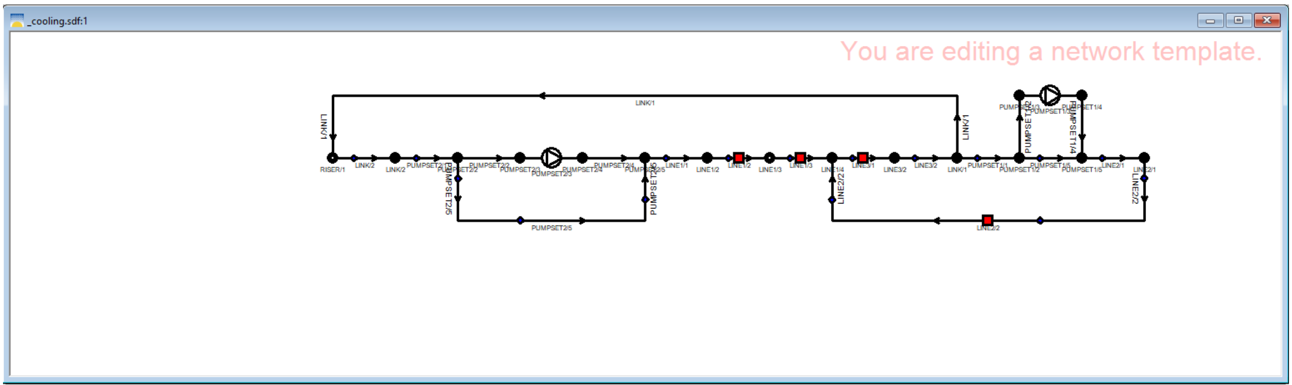


Select a destination folder on the left and enter a name for the template file. An optional title and description can also be added. Click OK to save the template. A pop-up will confirm the template has been saved.



Editing a template

A template can be opened for editing from **File | Templates | Edit template**.... Select a template to edit from the list on the left and click OK. The template will be opened in the main PIPENET® window. To make it clear that a template is being edited, rather than a normal network, a watermark is displayed at the top-right of the schematic window with the text "You are editing a network template".



Changes can be made to the template in the same ways they can be made in normal networks.

Saving a template

While editing a template it can be saved from **File | Templates | Save template** or **File | Templates | Save template as...**. **Save template** overwrites the current template file and **Save template as...** allows the template file to be saved under a different name.

Closing a template

While editing a template, it can be closed from **File | Templates | Close template**.

PIPENET® in LNG Industry

The LNG industry is growing rapidly around the world. In December 2017, the global community witnessed the launch of Yamal LNG operations, a landmark project that could reshape the oil and gas industry. Market analysts invariably forecast further growth of the LNG sector and envisage a wave of new LNG projects in the nearest future.

Sunrise Systems Limited proudly follows such news as PIPENET is used on the majority of LNG projects worldwide. Indeed, PIPENET has been widely used on Yamal LNG and on other LNG projects in several countries, including Qatar, Australia and Yemen.

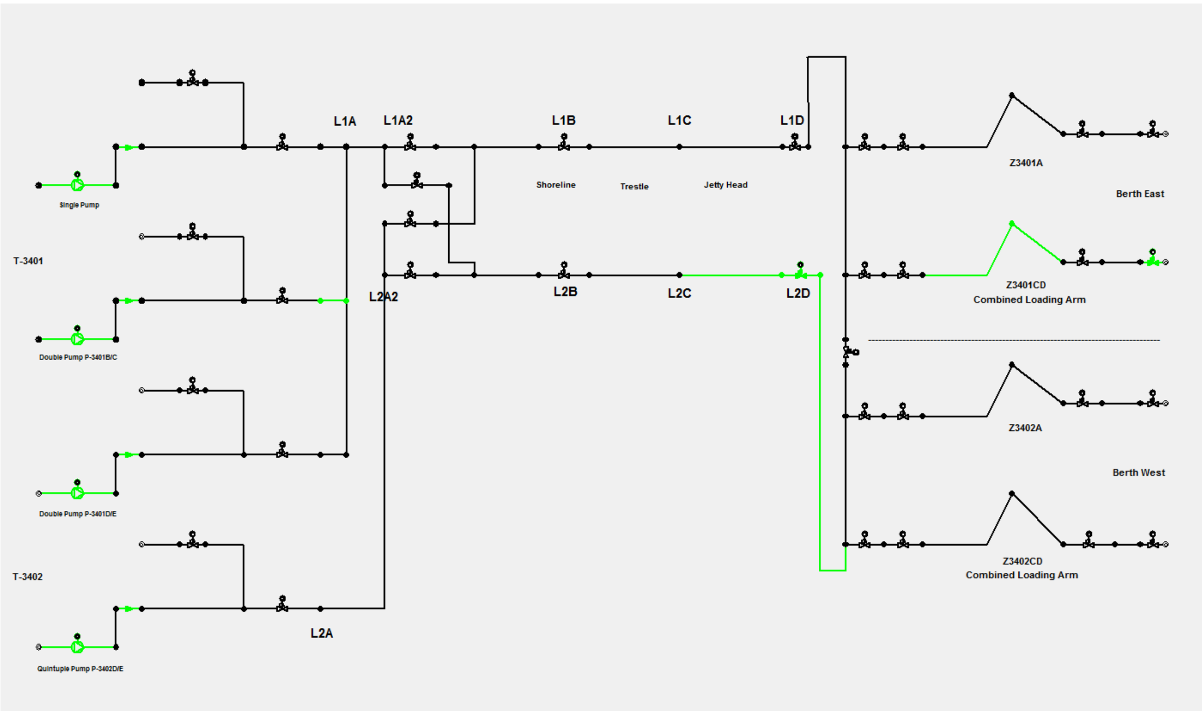
All three modules of PIPENET – Transient Module, Spray/Sprinkler Module, and Standard Module – are used in the design of LNG production, loading, unloading and regasification facilities. Applications include the design of loading and unloading systems, firewater systems, and cooling water systems.

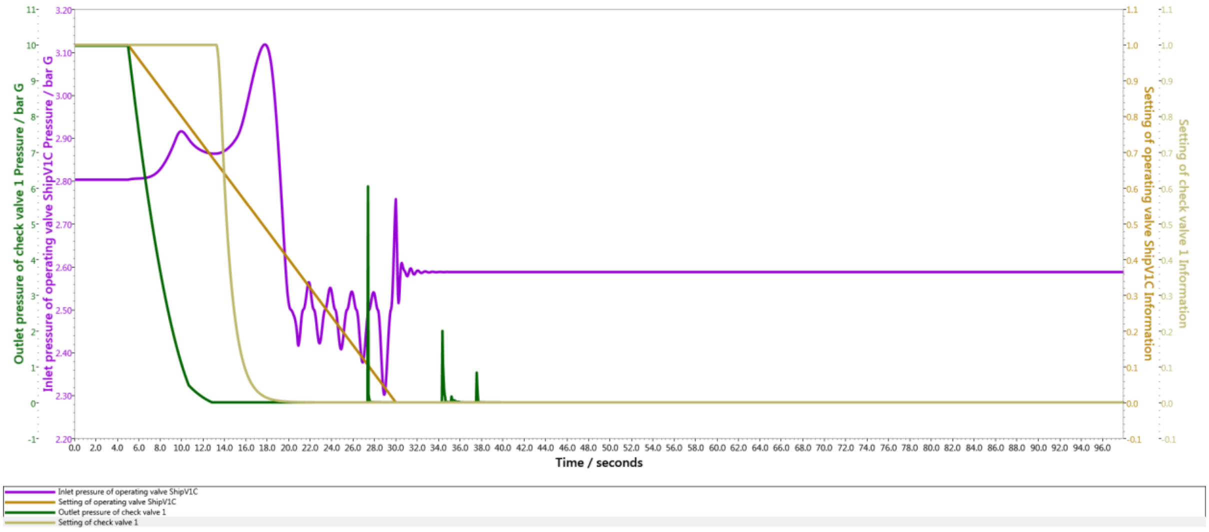
In this article, we provide a few examples of PIPENET use in the LNG industry.

PIPENET Transient Module

1. LNG Loading System

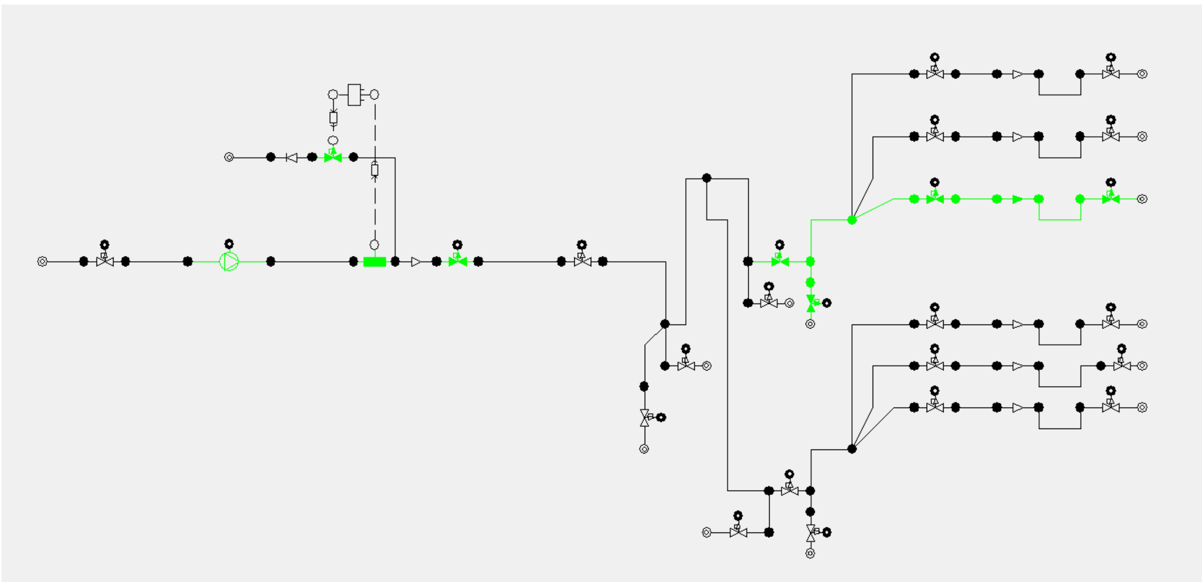
This is a system with 4 LNG pumps and 4 loading lines. This study considered the closure of the ship (LNG tanker) valves and the simultaneous shutdown of all LNG pumps. Two of the valves remained closed throughout. The other two valves closed simultaneously in 25 seconds (from 5 to 30). All 4 LNG pumps stopped in 10 seconds (from 5 to 15).

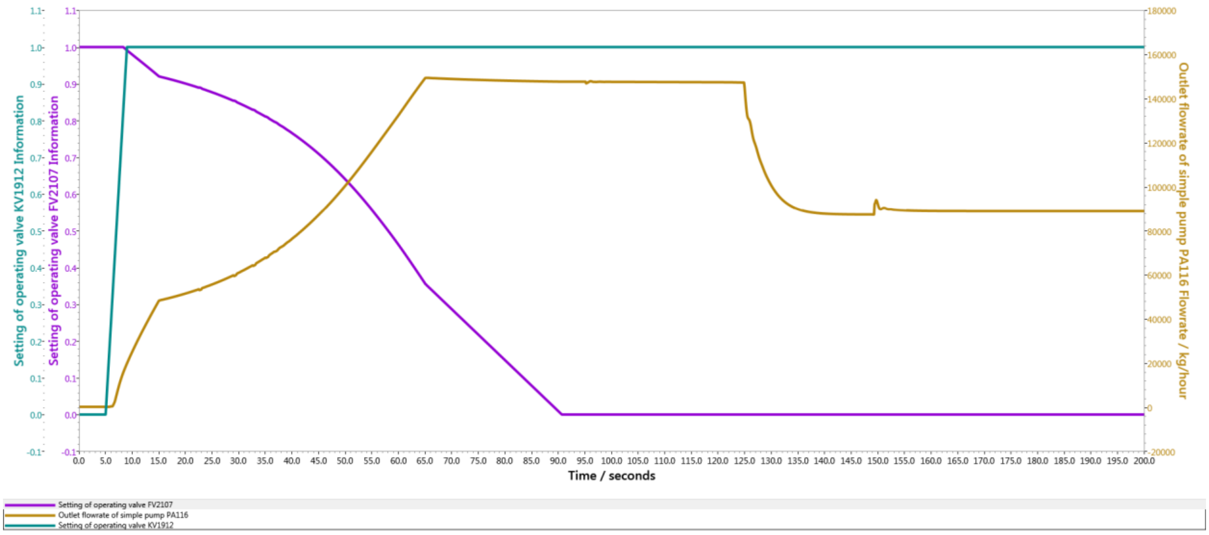




2. LNG Pump Startup

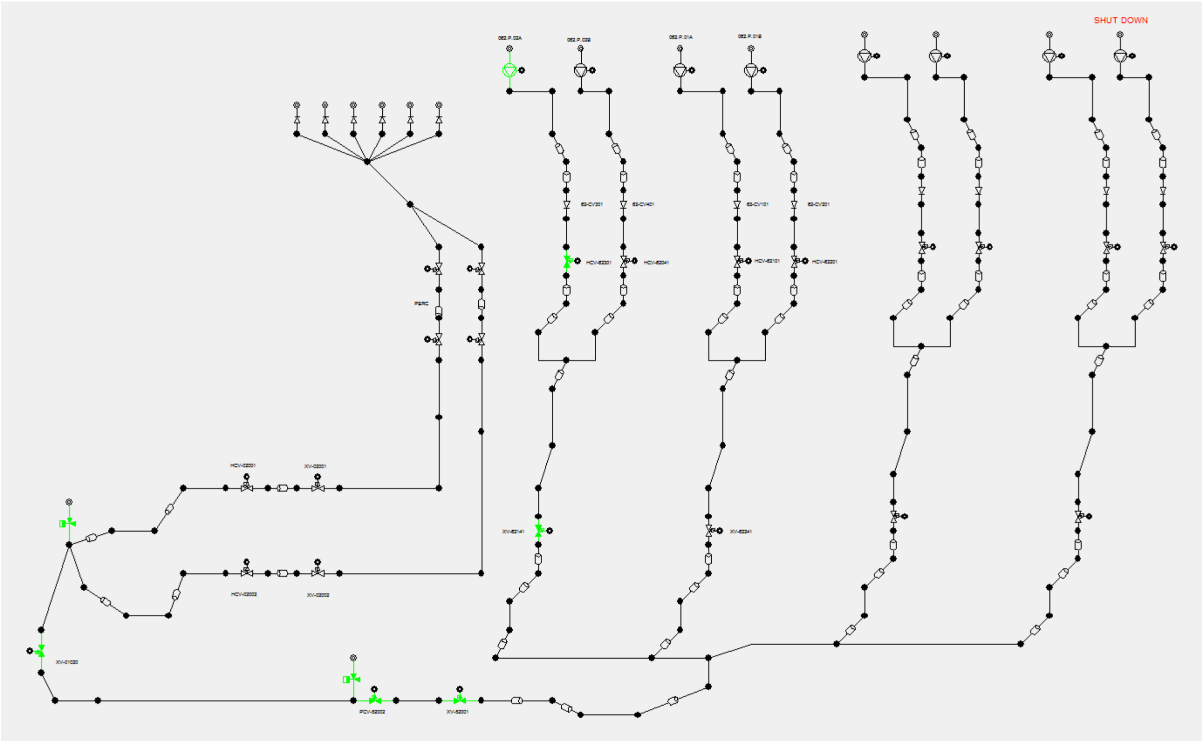
This is an interesting scenario which considers pump start up with the piping system fully primed. The pump starts and runs up during the time 5 – 15 seconds. The main valve downstream of the pump starts during the time 5 – 65 seconds. Some of the valves in the loading arms open during the time 5 – 15 seconds, while others remain closed.

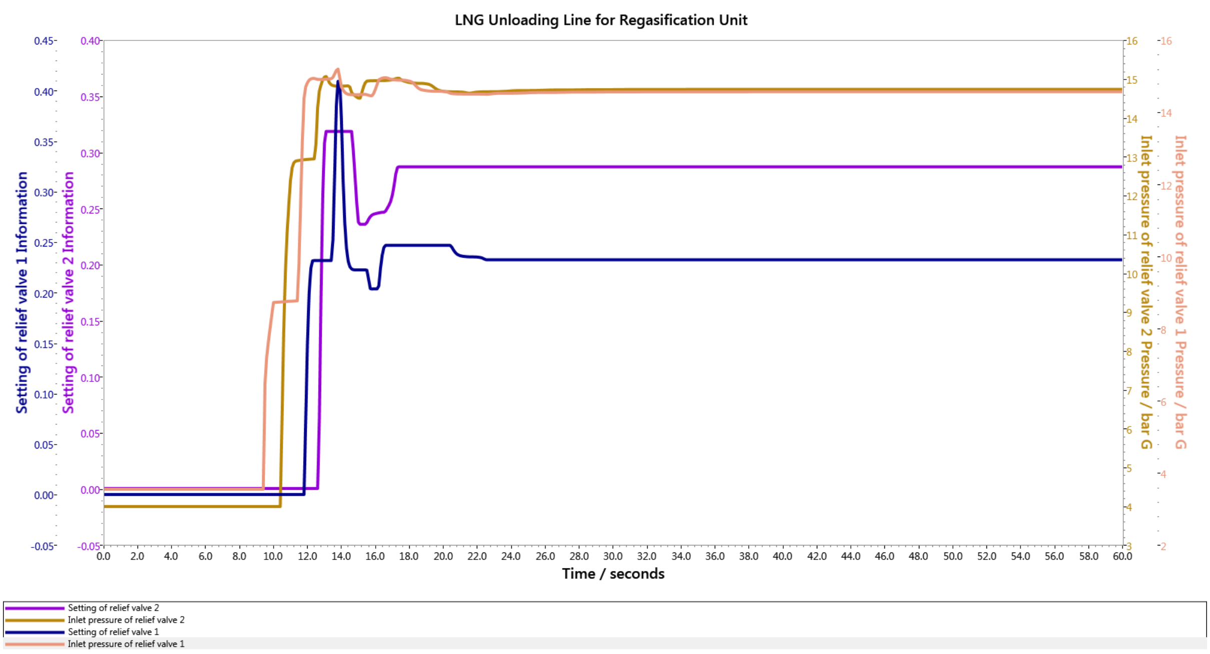




3. LNG Unloading System for Regasification

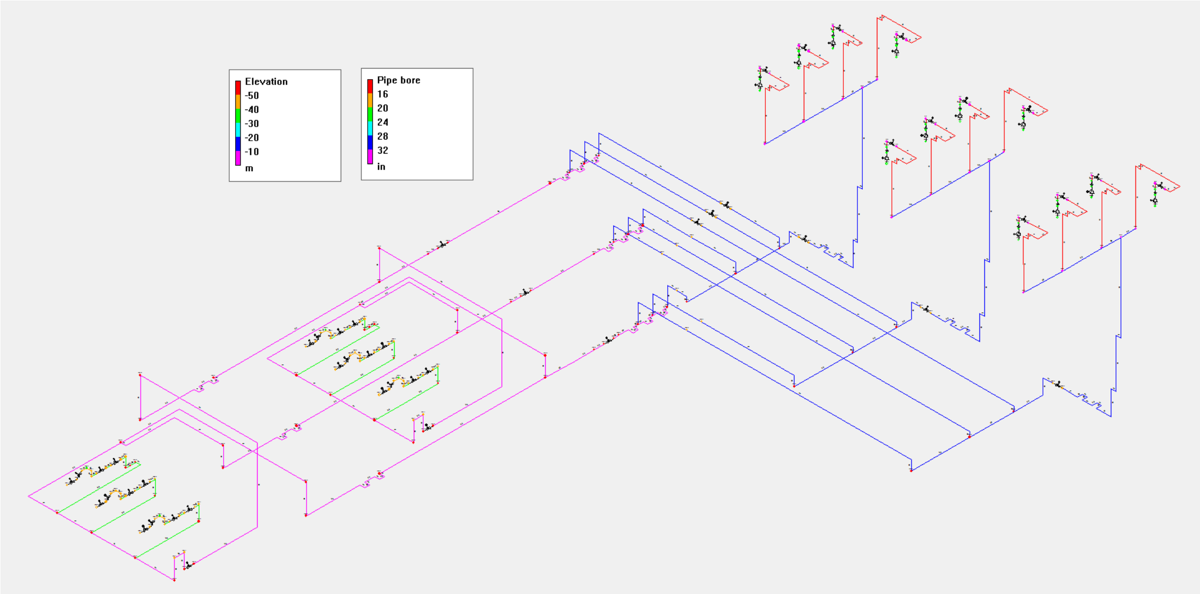
The system had 7 lead pumps and 1 standby pump on the ship for unloading purposes. The system has two surge relief valves. One unloading line is shut down. The valves in the other line close in 5 seconds.

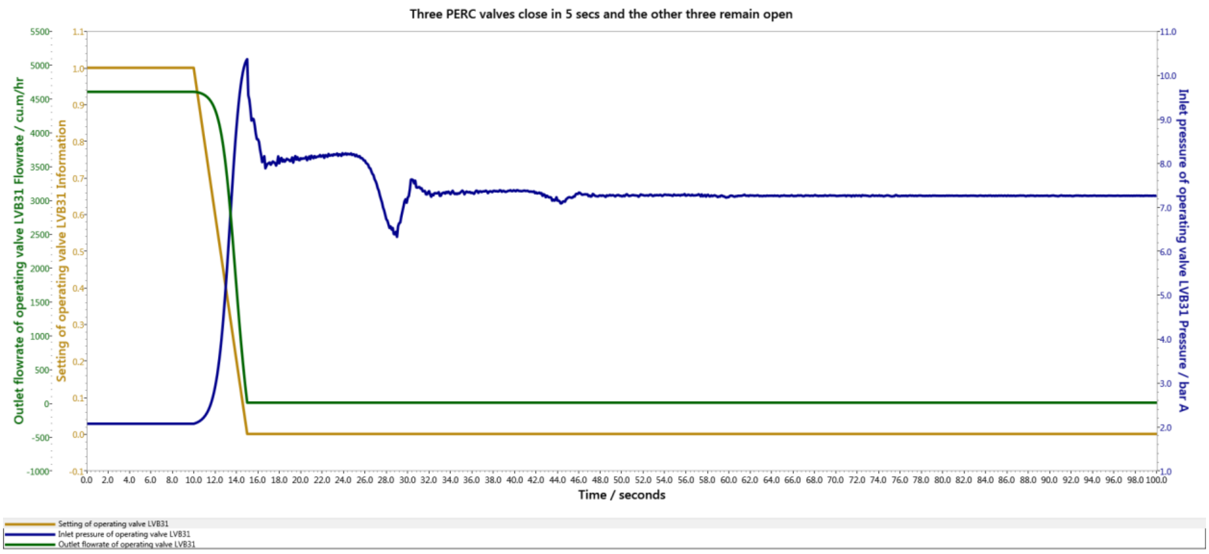




4. LNG Loading System PERC Valve Closure

In this LNG loading system the effect of the PERC (Powered Emergency Release Coupling) valve closure is considered. The system has 12 LNG pumps and 6 PERC valves. Three of the PERC valves close in 5 seconds and the other three remain open.

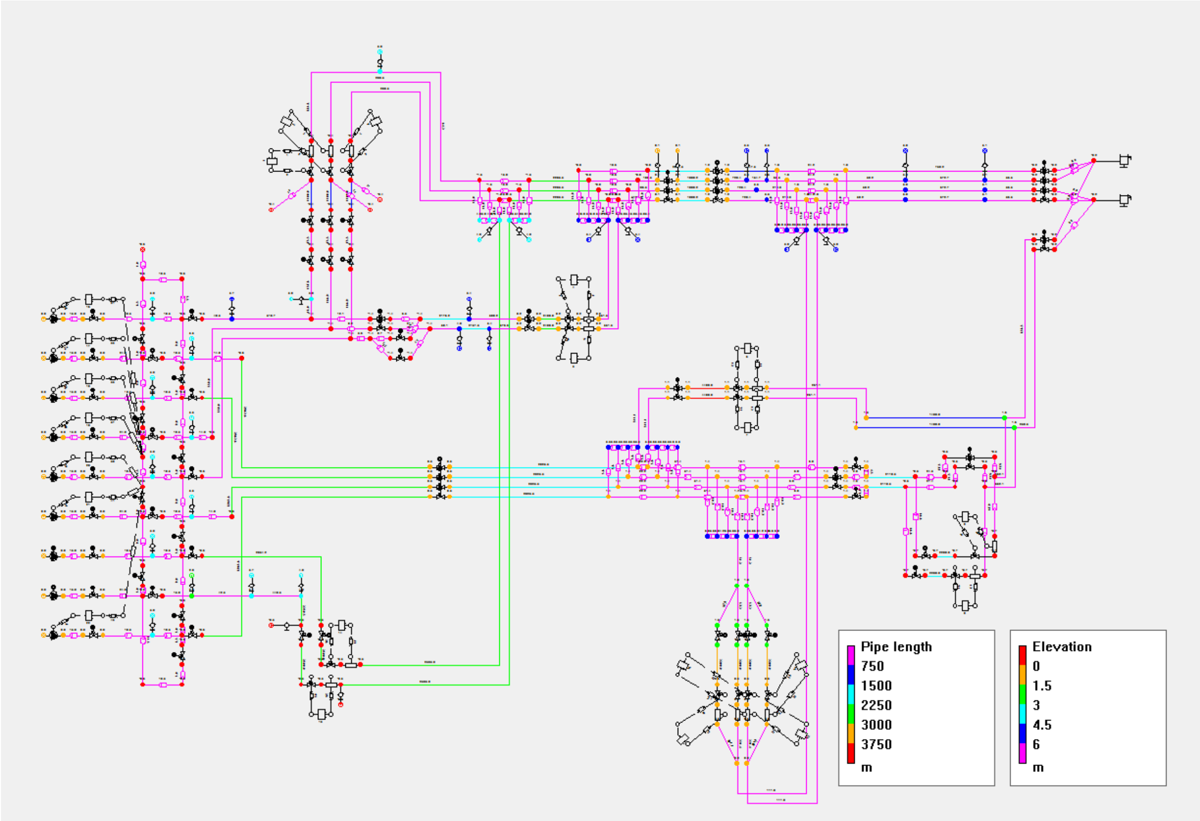


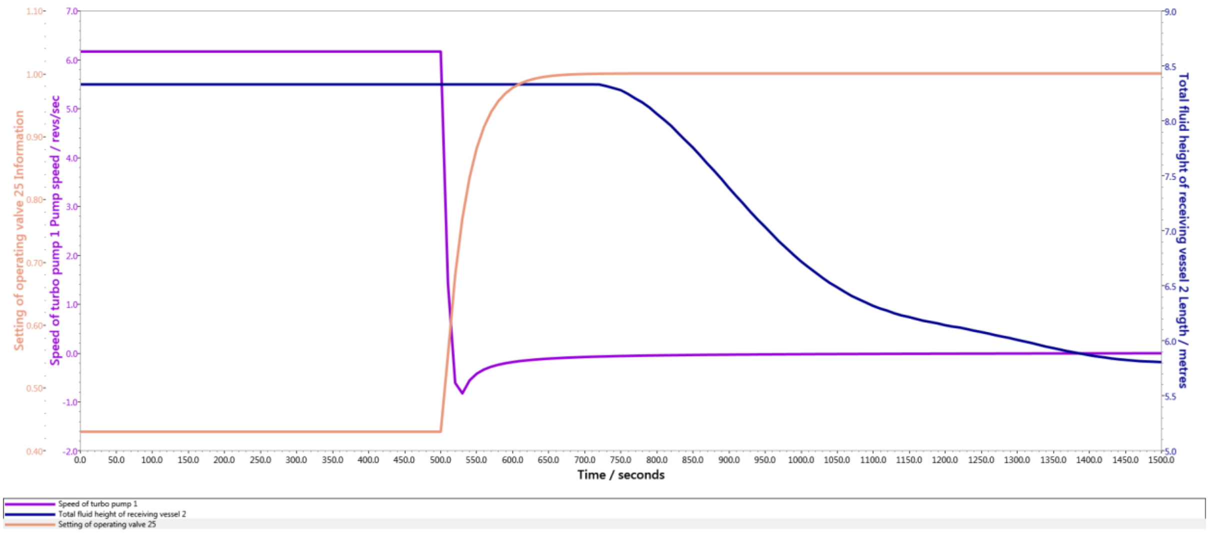


5. LNG Plant Cooling Water System

This shows the cooling water system on one of the largest facilities in the world. The system has 7 variable speed lead pumps and 2 standby variable speed pumps. The design flowrate of each pump is 42,840 m^3/hr. The main manifold is 3.5 m diameter and is made of GRP pipes. The minimum design pressure is -0.3 barg and the maximum is 6 barg. The system had a number of PID controllers in order to regulate the speed of the pumps and position flow control valves.

In this scenario the complete simultaneous shutdown of all the pumps due to power failure was considered. In order to protect the pipes from collapsing 190 vacuum breakers were installed.

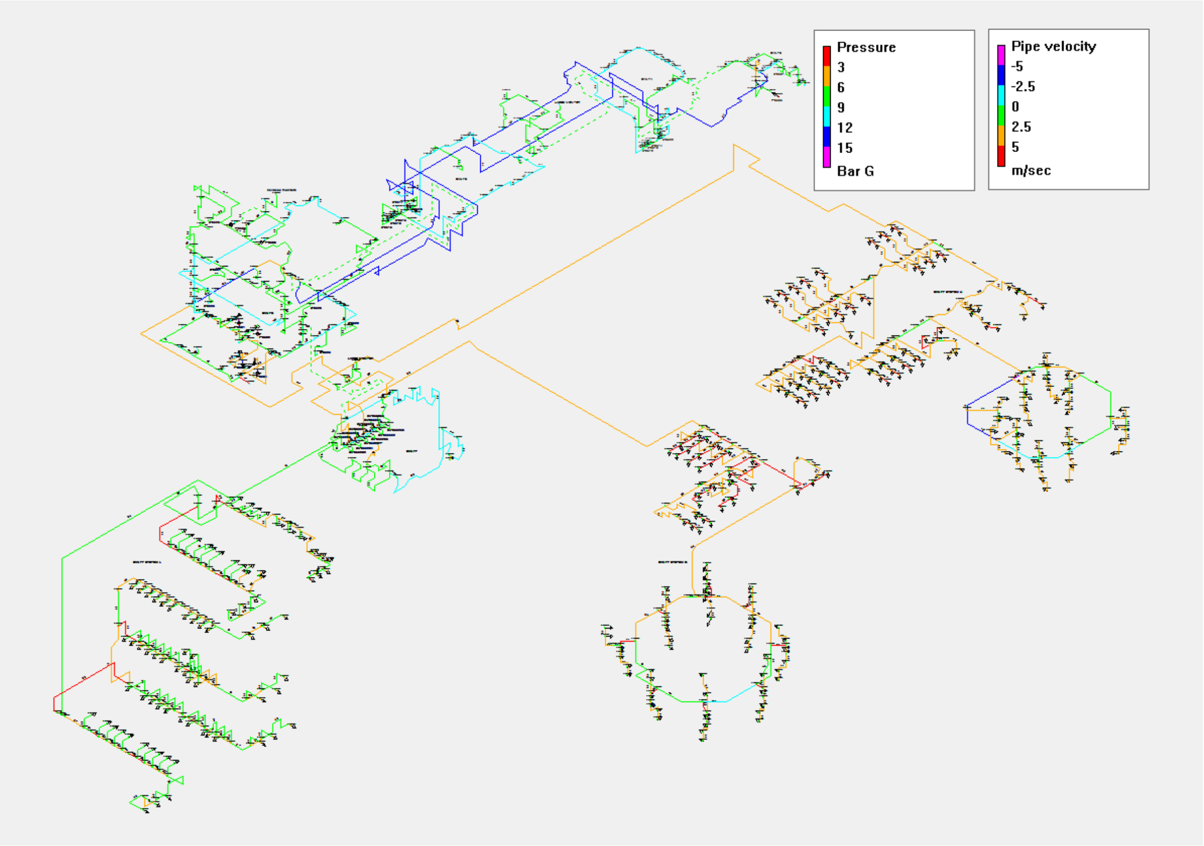




PIPENET Spray/Sprinkler module

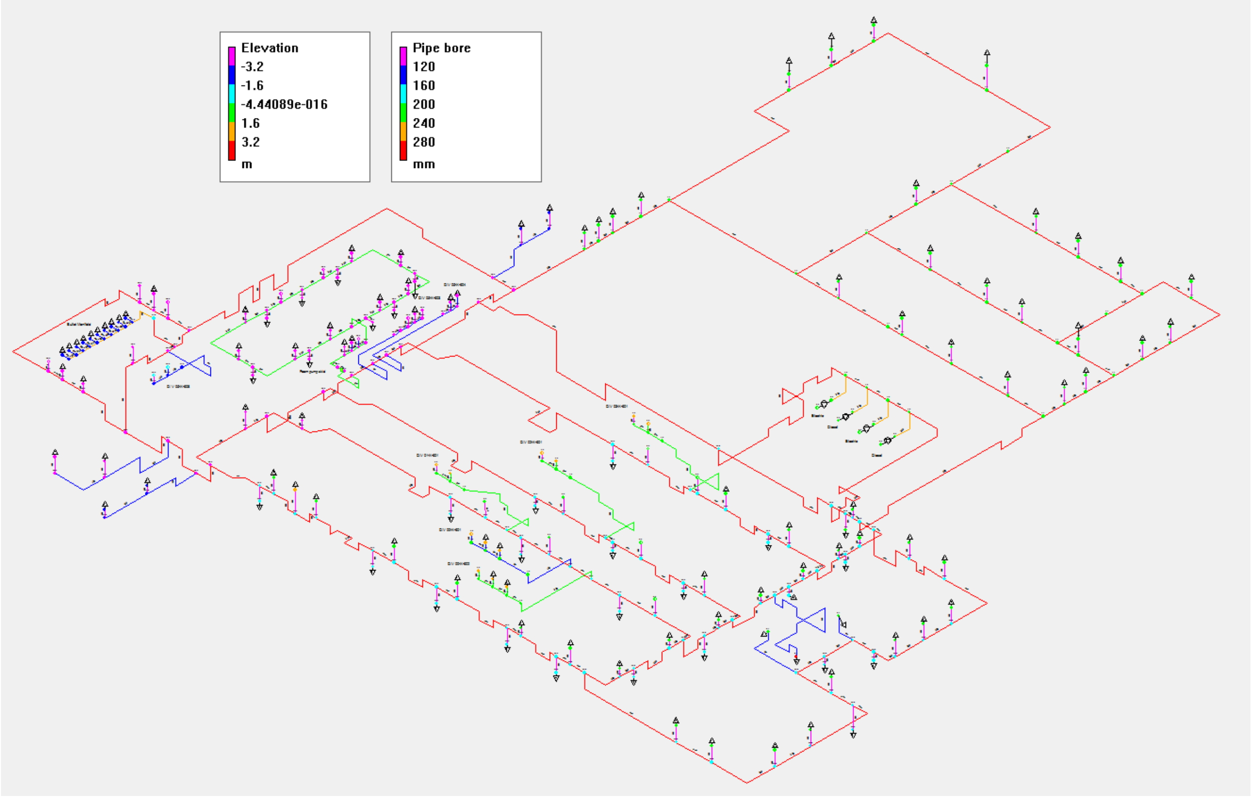
1. Offshore Platform Complex Fire Protection System

This fire protection system covered 6 offshore gas platforms which were bridge-connected. This shows a steady state calculation which is used for design and verification of operation.



2. Onshore Gas Processing Plant for Receiving Gas from Offshore Platform

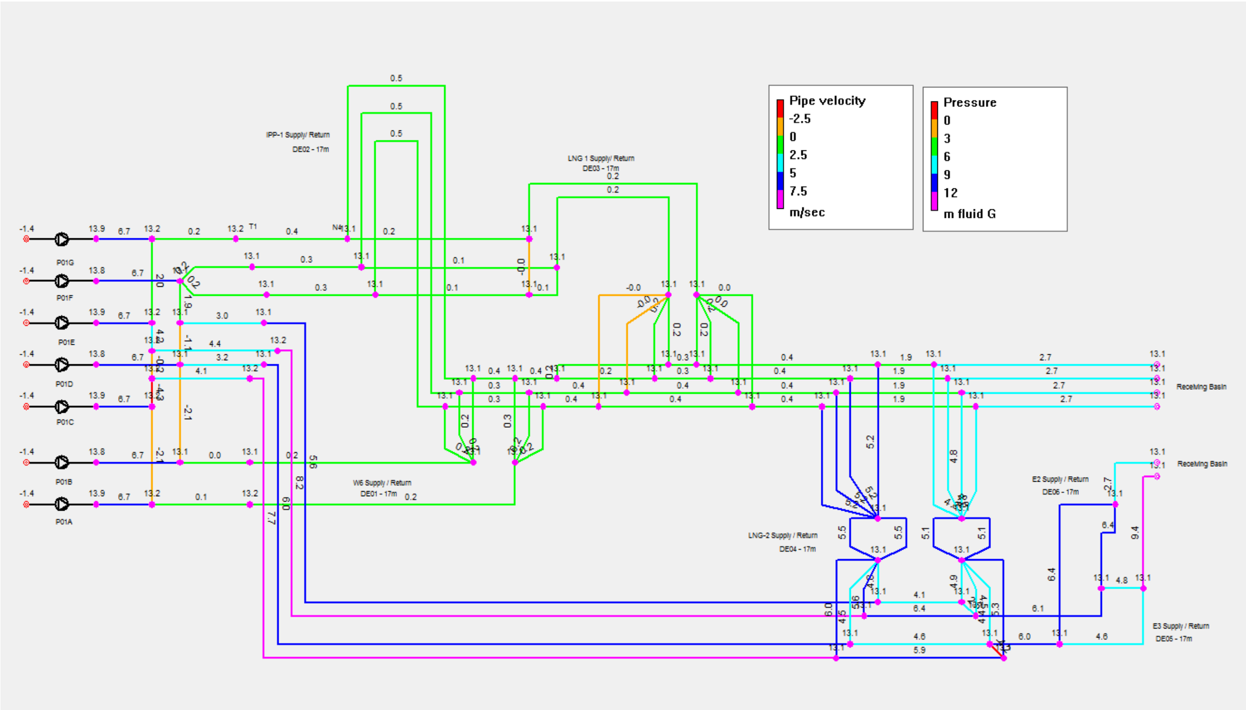
This shows the fire protection system on onshore gas reception facilities. The system had two diesel pumps and 2 electric pumps.



PIPENET Standard Module

LNG Plant Cooling Water System

This is the steady state version of Example 5 which was shown under PIPENET Transient Module applications. The purpose of this calculation was to select the pumps and size the pipes.



For more information, please visit our website www.sunrise-sys.com or contact us on pipenet@sunrise-sys.com.

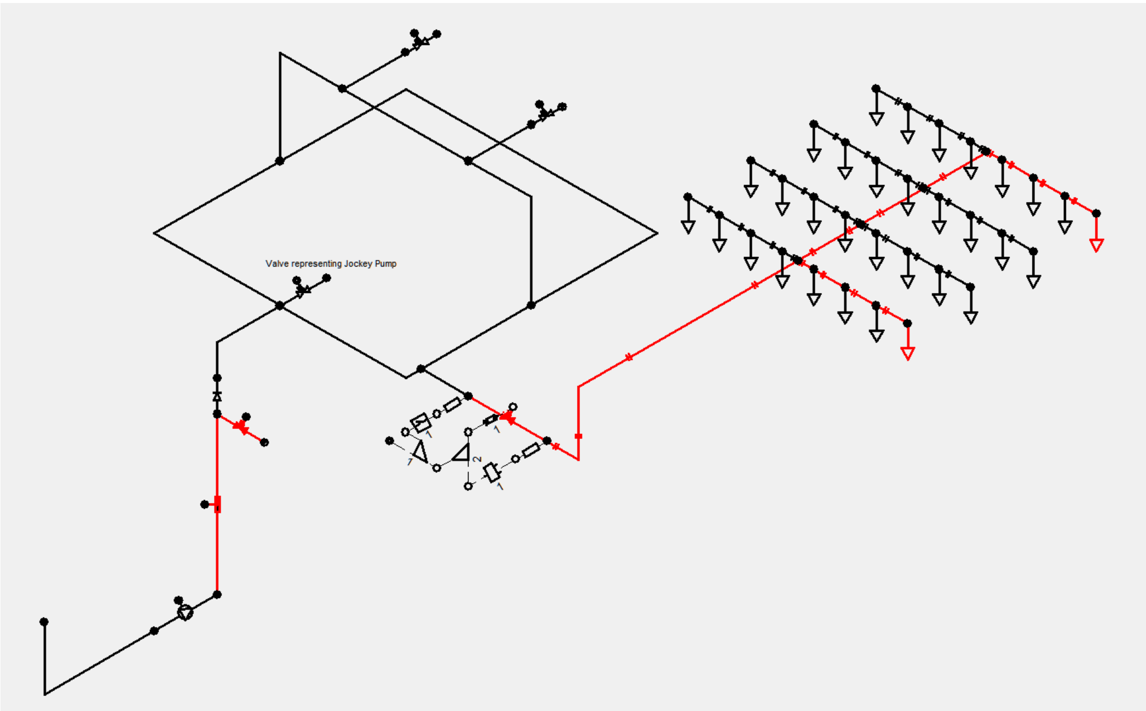
Discharge Time of Firewater Systems:

Calculating with PIPENET®

It is clear that discharge time of a deluge system is of critical importance in its operation, especially if it works in conjunction with a firewater ringmain. In the case of offshore firewater systems, the sequence leading up to the last nozzles discharging water is complex. Hitherto the estimation of the discharge time has not been possible and it has not been a requirement of the NFPA rules. This document shows that it is now possible to estimate the discharge time, even in the case of an offshore firewater system. In this case we will assume that an elastomeric deluge valve is used. Similar principles apply with 'clack' shut type of deluge valves.

The network and the simulation

The system considered for simulation purposes is shown in the schematic drawing below. The items of specific interest are shown in red.



A system such as this is complex from a simulation point of view and has the following stages.

1. During the quiescent state the ringmain pressure is maintained at 7 barg by a jokey pump.

2. On detection of fire the fire pump is sent a signal to start and the relevant deluge valve is sent a signal to open. It is assumed in this simulation that fire is detected 1 sec into the simulation. This is simply to show the steady state results before the dynamic event starts.

3. The dry riser pipe, often called 'the caisson' gets filled up with water. During this time air is expelled through an air release valve on the caisson.

4. When the caisson gets fully primed, water goes back to the sea through an overboard dump valve which is already fully open.

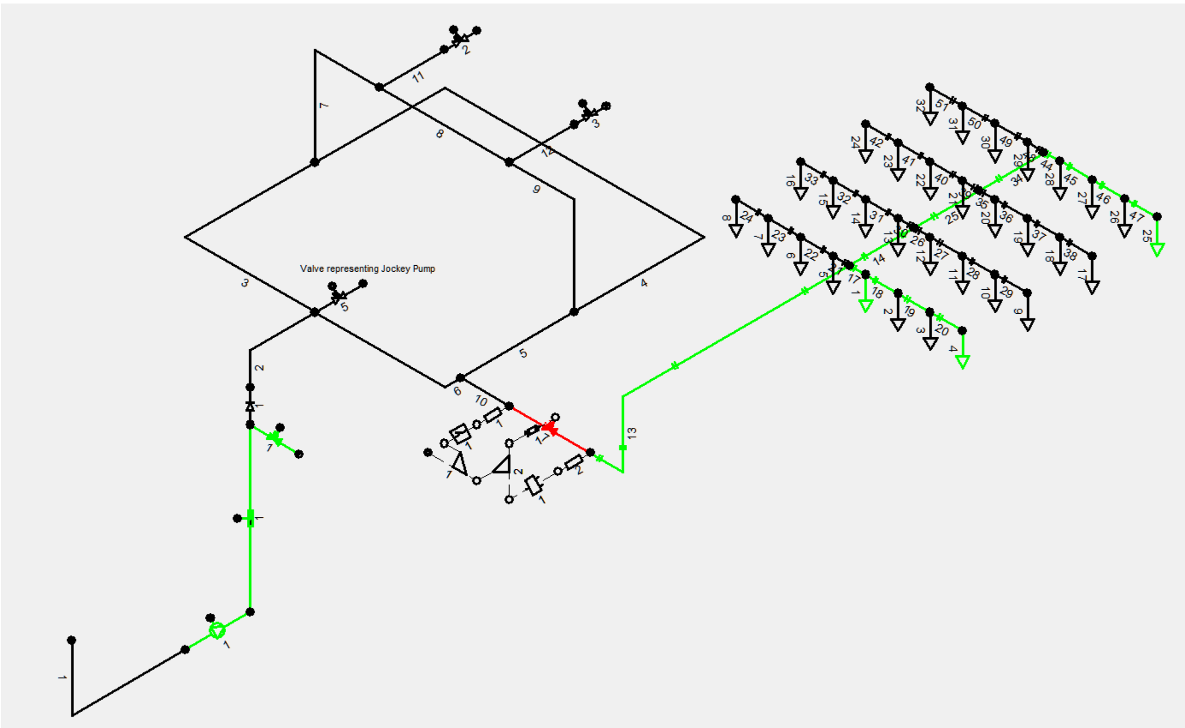
5. PIPENET simulation confirms that the caisson fully primes in less than 12 secs. For this reason the overboard dump valve is assumed to close from 12 to 17 secs (5 secs closure time)

It can be seen from the schematic that the deluge valve has a control system associated with it. The control system uses the following logic.

- As mentioned in above point 1, fire is detected at 1 sec into the simulation. For this reason the system is assumed to be in its quiescent state during the initial
- 0 -1 sec.
- It is assumed that the minimum required pressure in the firewater ringmain for the elastomeric seal to operate is 2 barg.

- Once the above conditions are satisfied the position of the deluge valve responds in order to control the downstream pressure at 7 barg pressure.

- The network items for which graphical results have been chosen are indicated in green. This would allow us to follow the passage of water until it reaches the last nozzle.
- In particular graphical results we will show the following:
- Priming of the caisson
- Operation of the overboard dump valve
- Operation of the elastomeric deluge valve
- How water primes the pipes in sequence until it finally discharges through the most remote nozzle.

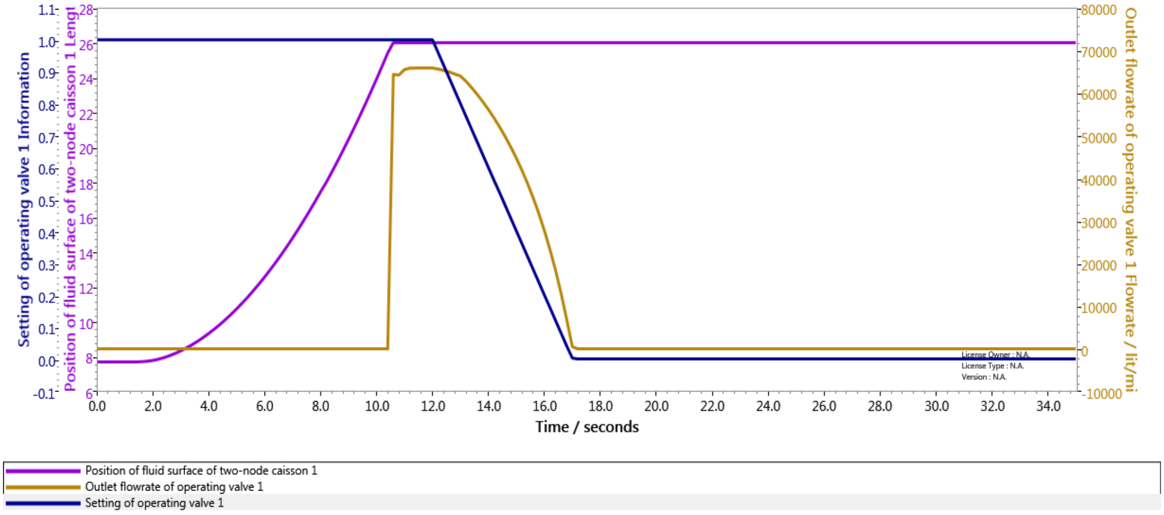


Discussion of the results

Priming of the caisson

The purple line shows how the liquid level rises in the caisson. It can be seen that the water level reaches the top of the caisson at approximately 10.4 secs.

The blue line shows the position of the overboard dump valve. It can be seen that it starts to close at 12 secs and is fully closed by 17 secs.
The brown line represents the flowrate through the overboard dump valve. It rises instantaneously when the water level reaches the top of the caisson and decreases to 0 as the overboard dump valve closes.



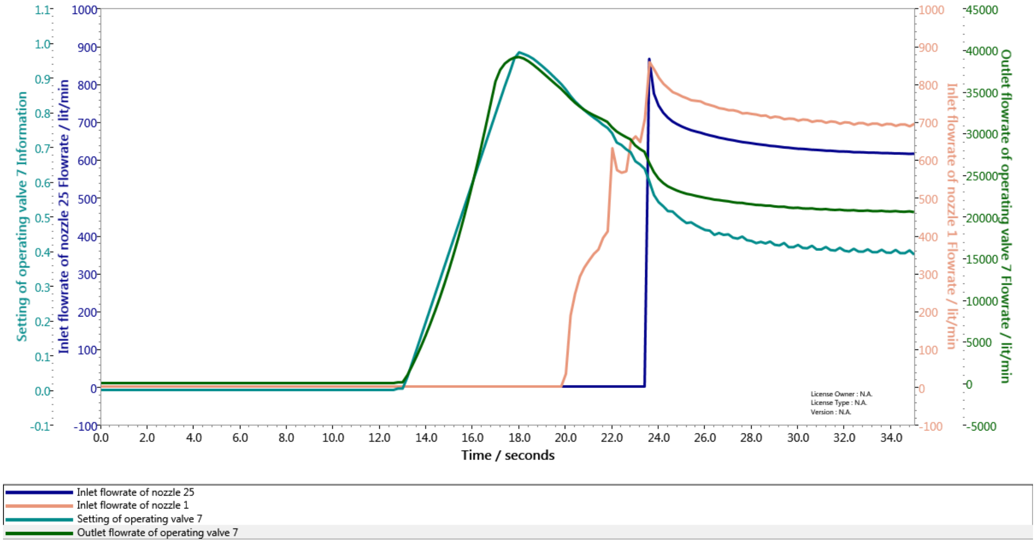
Operation of the deluge valve and the flowrate through the nozzles

The light blue line represents the position of the elastomeric sleeve on the deluge valve. It can be seen that its position overshoots before settling down at its final position. The overshoot occurs because the pressure downstream of the deluge valve is low to begin with and the deluge valve tries to compensate for this.

The green line is the flowrate through the deluge valve. It roughly follows the position of the deluge valve.

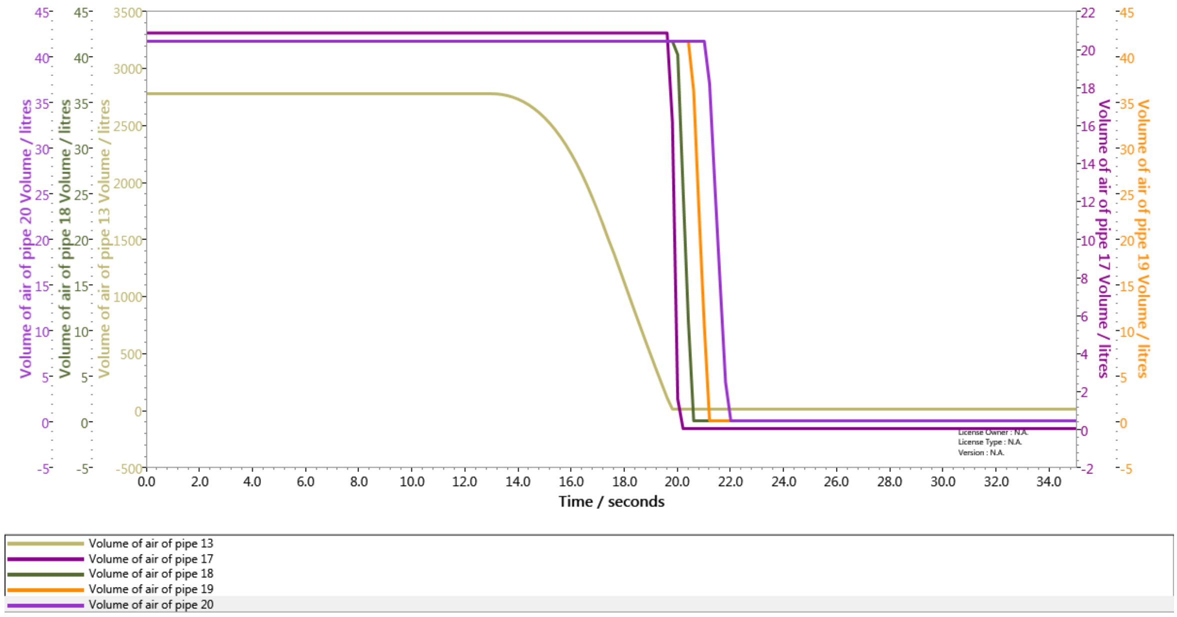
The pink line is the flowrate through the nozzle which is closest to the inlet of the deluge system. It discharges first.

The dark blue line is the flowrate through the most remote nozzle. The most remote nozzle discharges a full 3.6 secs after the nearest nozzle. When the water reaches the most remote nozzle, it creates a shock. This is because all the air has been expelled the water flowrate slows down with a shock. It can be seen that this shock travels back to the nearest nozzle and the flowrate through that nozzle momentarily overshoots before returning to its steady state level.



Expulsion of air from the pipes

It can be seen that the expulsion of air from pipes 13, 17, 18, 19 and 20 happens sequentially.



CONCLUSION

Calculation of the discharge time of firewater is one of the most complex simulation problems. Novel new techniques and methodologies are now available for estimating the time of air expulsion and discharge time calculation.

Calculating Forces:

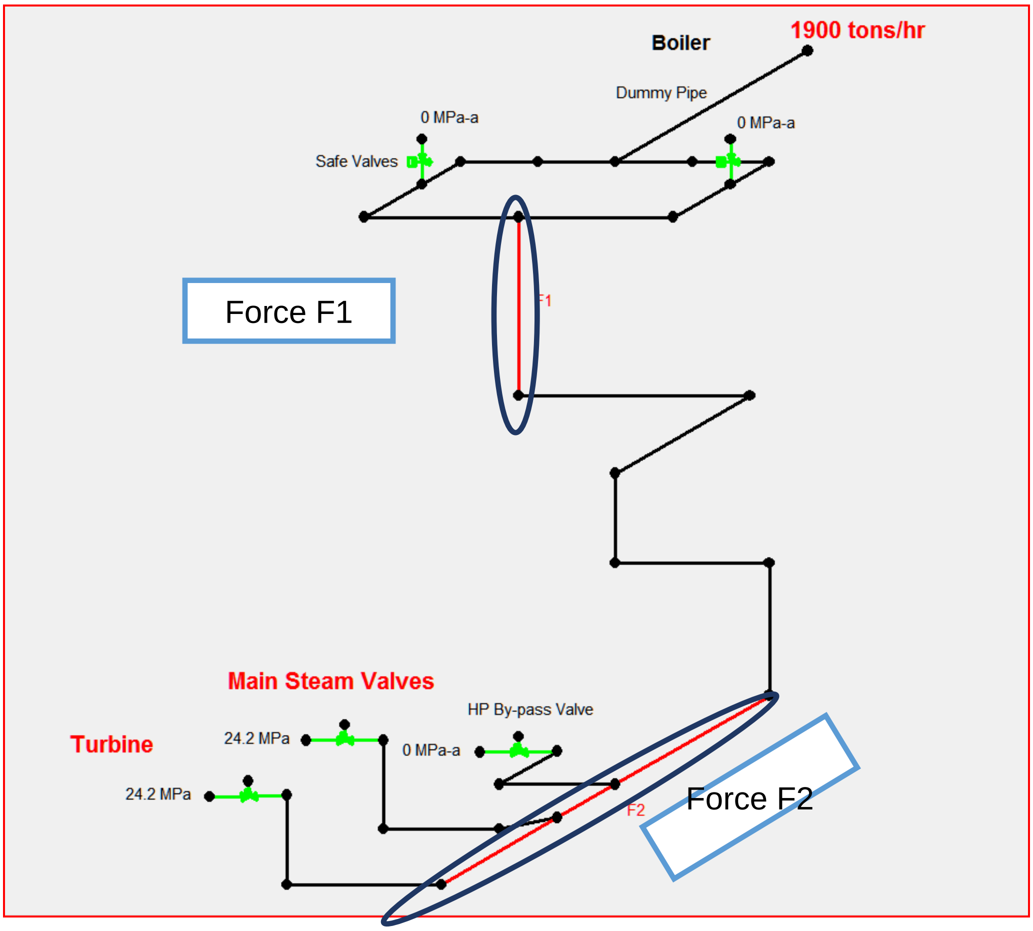
PIPENET Transient Module and Pipe Stress Analysis

One of the many unique features of PIPENET Transient module is its ability to calculate hydraulic transient forces. Transient flow in piping systems such as pressure surge and water hammer can cause both high pressures and high forces. Hydraulic transient forces can be both large and they could be oscillating.

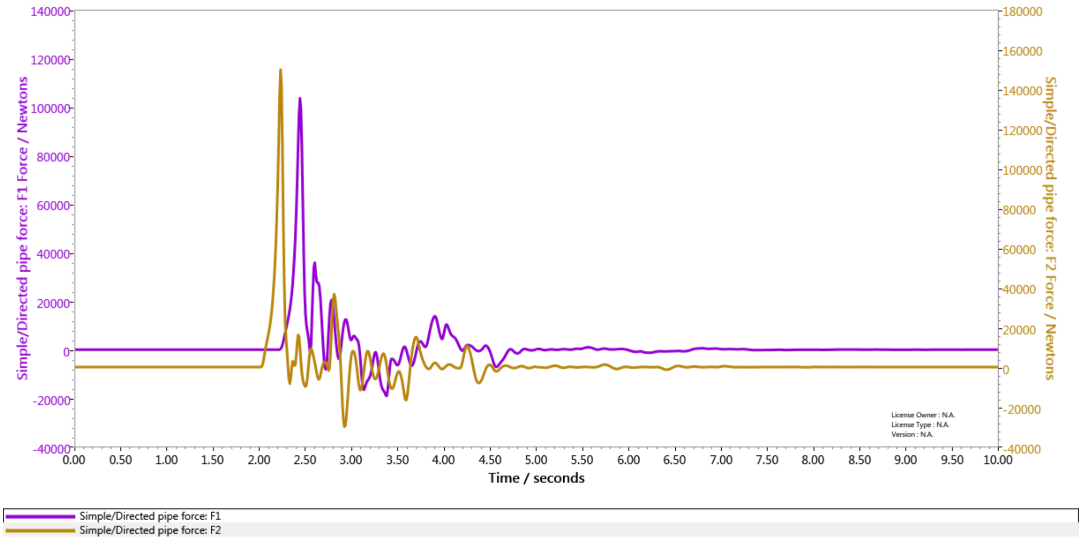
In many cases the potential for piping systems to get damaged is more likely because of unbalanced hydraulic transient forces than because of simply high pressures. Unbalanced hydraulic transient forces can create unacceptably large reaction forces on pipe supports, vibrations in the piping system and unacceptably high stresses in the pipes. For example, the main steam line in a power station, both thermal and nuclear, can experience unbalanced forces of around 200,000 Newtons. Special pipe restraints need to be designed to withstand such high forces

Main steam line of a power station

In this example we consider the unbalanced forces which can occur in the main steam line when there is a turbine trip and the turbine isolation valves close quickly in 0.2 second. The PIPENET schematic drawing is shown below.



The graphs of the extremely high unbalanced forces F1 and F2 can be seen below.

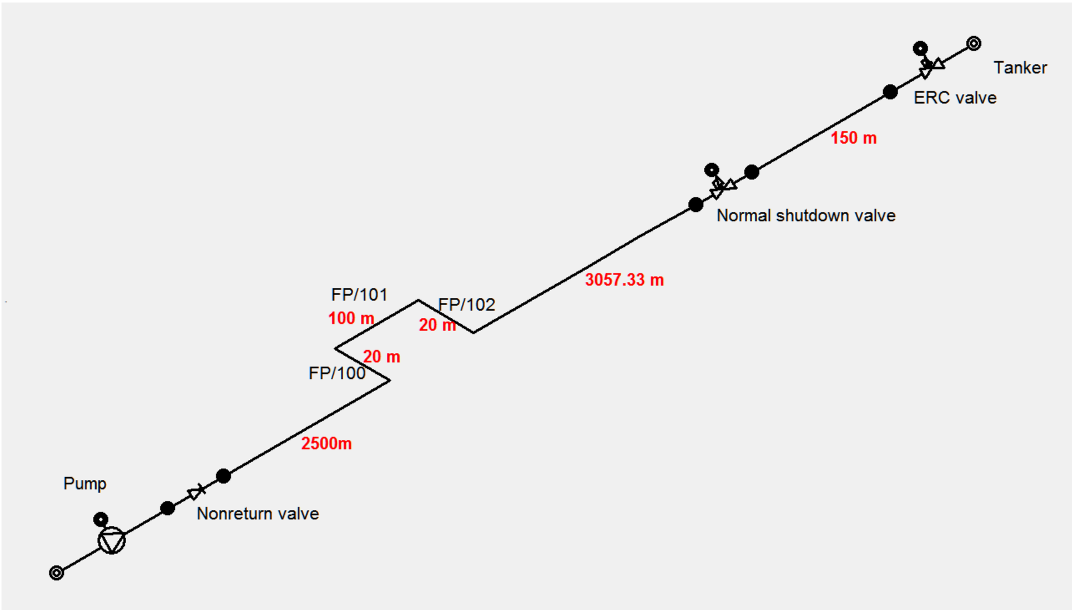


Interface with pipe stress analysis programs

Typically, users of pipe stress analysis programs also use PIPENET Transient module. High stresses in piping systems, vibrations and movements can occur because of hydraulic transient forces. One of the powerful and important features of PIPENET Transient module is its capability of calculating the force-time history under hydraulic transient conditions.

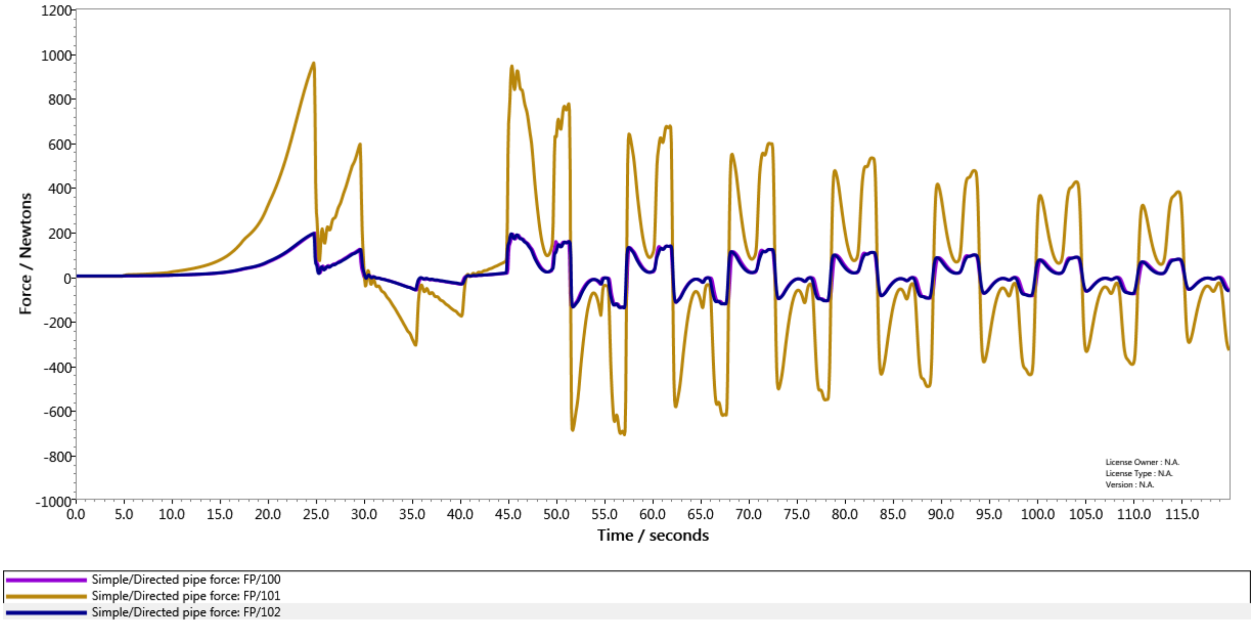
PIPENET can generate a force-time history file. Pipe stress analysis programs can import this file and perform pipe stress analysis and related calculations.

PIPENET Schematic drawing:



In the above schematic FP/100, FP/101 and FP/102 are the hydraulic transient forces which need to be calculated.

PIPENET graphical display of force-time history:



PIPENET force-time history file:

Time, sec	Force, N
.490280E+2	92.0075
.490960E+2	92.6033
.491640E+2	94.8967
.492320E+2	98.8628
.493000E+2	104.512
.493680E+2	111.991
.494360E+2	121.427
.495040E+2	132.911
.495720E+2	149.763
.496400E+2	231.246
.497080E+2	387.048
.497760E+2	539.206
.498440E+2	623.446
.499120E+2	622.043
.499800E+2	626.663
.500480E+2	660.159
.501160E+2	692.531
.501840E+2	704.158
.502520E+2	697.569
.503200E+2	686.454
.503880E+2	677.987
.504560E+2	674.642
.505240E+2	686.669
.505920E+2	710.677
.506600E+2	736.535
.507280E+2	754.093
.507960E+2	760.038
.508640E+2	756.395

.509320E+2	747.820
.510000E+2	740.780
.510680E+2	740.446

Conclusion

Calculating hydraulic transient forces is one of the powerful capabilities of PIPENET Transient Module. PIPENET generates a force-time history file which can be imported into pipe stress analysis programmes, where further related calculations can be performed. For this reason, users of pipe stress analysis programs also typically use PIPENET Transient module.

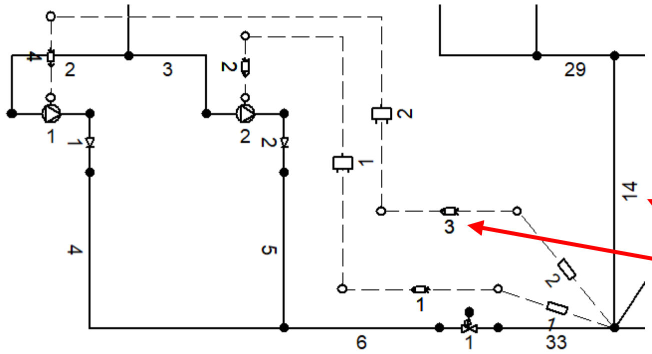
For more details on how to define a force in PIPENET® read the technical paper **"How to Define a Force in PIPENET Transient Module"** on our website www.sunrise-sys.com.

Component Labels in PIPENET®

A network built in PIPENET consists of various components. Each component and each node in the network must be given a label that uniquely identifies it. PIPENET has certain rules for component labels. Labels may either be tagged or untagged.

Untagged labels

An untagged label is simply a number.



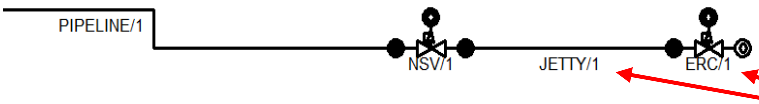
Examples of untagged labels:
1
1273
9999

Tagged labels

Tagged labels consist of a 'tag' (i.e., a string of up to 8 characters), usually followed by a slash (/) and a number. Tags can be used to make labels more meaningful, and to allow sections of large networks to be more easily identified.

Please note:

1. Tags must begin with a letter, and may contain only letters or both letters and numbers. Tags not followed by a slash and a number are valid labels but note that each one counts as a new tag.
2. The number of tags is limited to 100 in one system.
3. Tags are case insensitive; that is, RING is taken to be the same as Ring and ring



Examples of tagged labels:
JETTY6/1
JETTY6/876
P/12

Labelling Rules: Transient Module

In Transient Module, any number in the range 0 – 9999 can be used as either an untagged label, or as a numeric part of a tagged label. If you use a number bigger than 9999, PIPENET will give out a warning message that the numeric part of the label is out of range.

Labelling Rules: Standard and Spray/Sprinkler Modules

In Standard and Spray/Sprinkler Modules, the rules are the following:

- If you are using only untagged numeric labels, any number within the range 1 – 32765 can be used.
- If you are using both tagged and untagged labels in one system, the numeric part of all labels is limited to 999.

Iterations

Sometimes calculation may fail while the user cannot easily identify why. The reason for calculation failure may be an unsuitable number of iterations set for the particular case. By default, the number of iterations is set at 50. However, for some more complex or numerically sensitive calculations, the default value of 50 iterations may not be enough. In this case, increasing the maximum number of iterations to the maximum value of 5000 allows the calculation to complete successfully.

The maximum number of iterations can be changed in **Options | Calculation**.

The calculation fails with the message “Failed to converge after 50 iterations” in the output file.