PIPENET® NEWS

SPRING 2021

LEADING THE WAY IN FLUID FLOW ANALYSIS

PIPENET Vision® 1.11.0 Release

Welcome to PIPENET VISION 1.11.0!
We are pleased to deliver some fabulous enhancements across all modules to save time and make the PIPENET experience even better.

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Surge analysis of the firewater system on an FPSO

In this document, we demonstrate some of the capabilities of PIPENET Transient module for performing surge analysis of the firewater system on an FPSO. The study shows that cavitation is likely at the high points of the system unless surge alleviation devices are installed.

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Unbalanced forces: answering some FAQs

PIPENET Transient Module users often have questions about the following two aspects of calculating forces in PIPENET:

1. How do unbalanced forces arise and why are they important?
2. What are rigid and elastic joints?

Read more on Page ……………………………….. 9

Helpful Tips: How to…?

Dear valued PIPENET customer!

We hope you are all faring well and keeping safe in the uncertain current world circumstances.

We are delighted to inform you that **PIPENET Vision 1.11.0** is already out.

The download link has been sent to all the customers with active PIPENET Maintenance, Updates and Support and/or active short-term licences. Please do contact us if you have not received the link or did not manage to download the files for any reason.

If you are not a current customer and you would like a copy of PIPENET VISION 1.11.0, please contact us at **pipenet@sunrise-sys.com**

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We are pleased to deliver some fabulous enhancements across all modules to save time and make the PIPENET experience even better.

PIPENET Vision® 1.11.0 Transient Module

- A new discrete gas cavity model (DGCM) is now available. The new model considers the effect of a small quantity of free gas in continuous liquid.
- The vacuum breaker model has been improved to speed up calculation and enhance numerical stability in extremely large systems.
- The force results output file format has been improved for enhanced compatibility with stress analysis programs.

PIPENET Vision® 1.11.0 Spray/Sprinkler and Standard Modules

- Spray/sprinkler Overboard Dump Valve improved.
- All calculation elevation warnings and errors are clearly reported, rather than only the first.

PIPENET Vision® 1.11.0 Transient, Spray/Sprinkler and Standard Modules

- New Auto-backup functionality and manager application - avoid losing data through power-cuts or other system errors.
- Improved output browser page navigation.
- More accessible Scenario Manager results presentation.
- Enhanced support for Asian locale in dialogs.
- New, separate user guides for Scenario Manager and Auto-Backup Manager.
- Netutil licensing utility no longer requires elevated privileges. This simplifies network licence client configuration.
- Handling of system libraries improved.
- Measure and calculate using ‘litres per second’ in all modules

Surge Analysis of the Firewater System on an FPSO

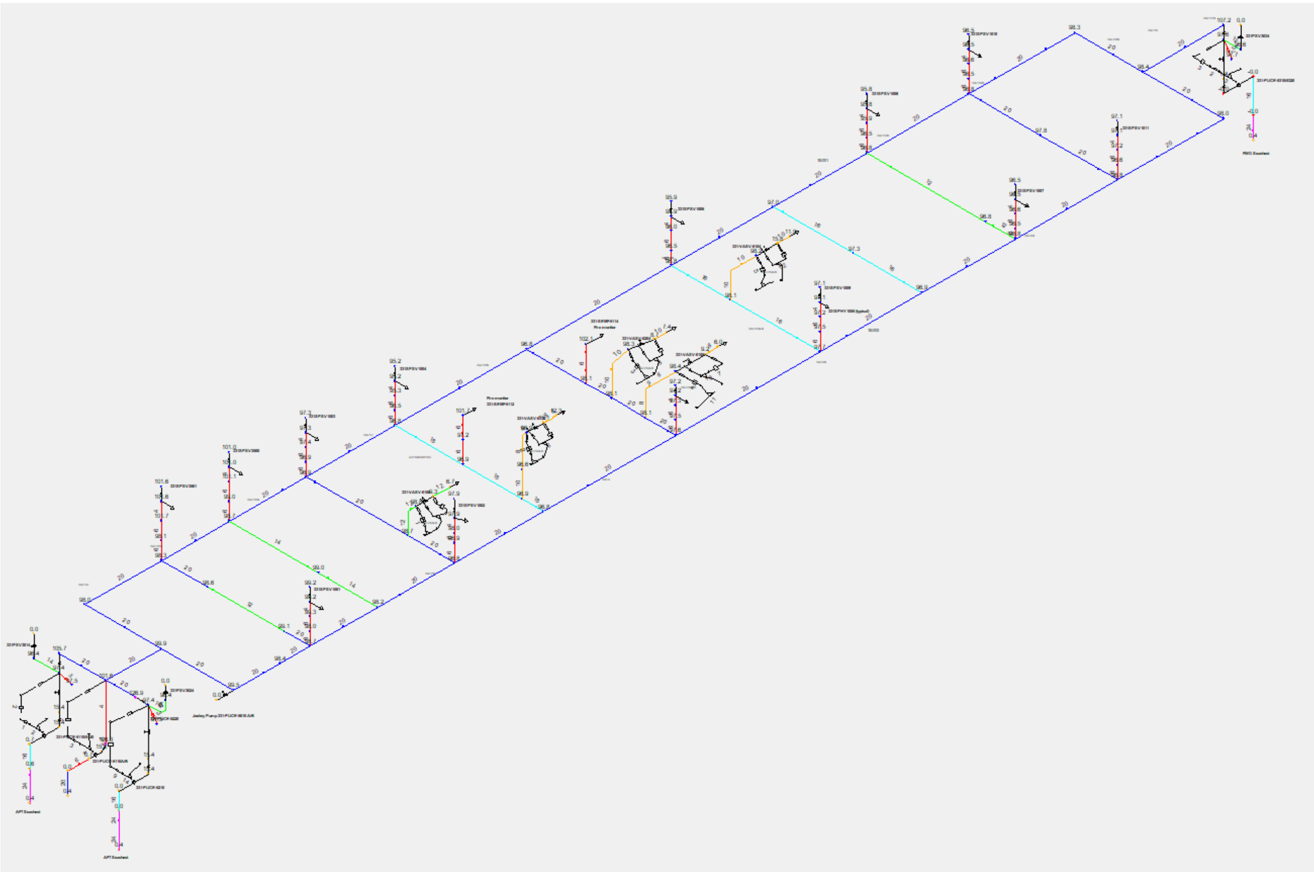
BACKGROUND

PIPENET Transient module is being used for performing surge analysis of the firewater system on the fire protection system on an FPSO which will be deployed in the Caribbean Sea.
The purpose of this document is to show some of the capabilities of PIPENET Transient module for performing surge analysis of the firewater system on this FPSO.
Fire protection systems in applications such as FPSOs and offshore platforms are often susceptible to high pressure surges which can damage pipework. The aim of this Application Bulletin is to calculate the potential pressure surges which can arise due to deluge system and fire pump start up. If the pressure surge is high, then the Application Bulletin will show a method of reducing the pressure surge to acceptable values.

1. The Scenarios

The firewater system has one forward fire pump and three aft fire pumps. In this scenario all three aft fire pumps start but the forward pump is stopped. The deluge valves which operate are of the elastomeric type which is intended to maintain the inlet pressure at the deluge.
Case 1 – The aft pumps start and the deluge systems discharge, without vacuum breakers.
Case 2 - The aft pumps start and the deluge systems discharge, with vacuum breakers. The air inlet valve of the vacuum breaker is set to 50 mm and the air outlet is set to 5 mm.

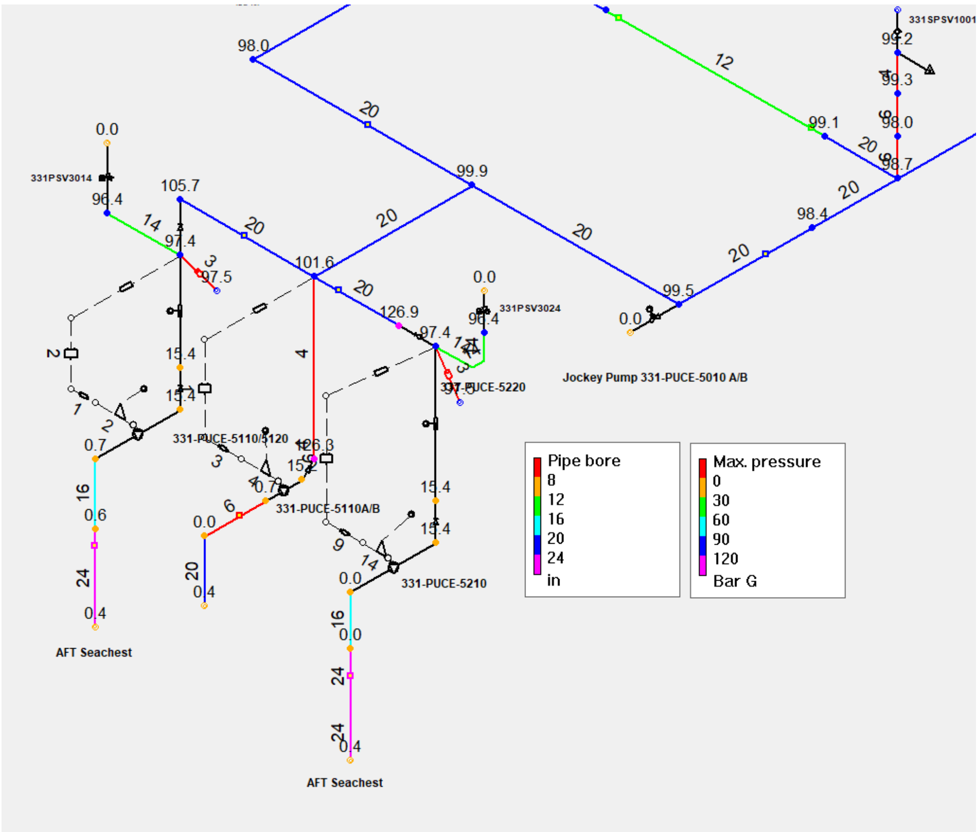
2. The Network



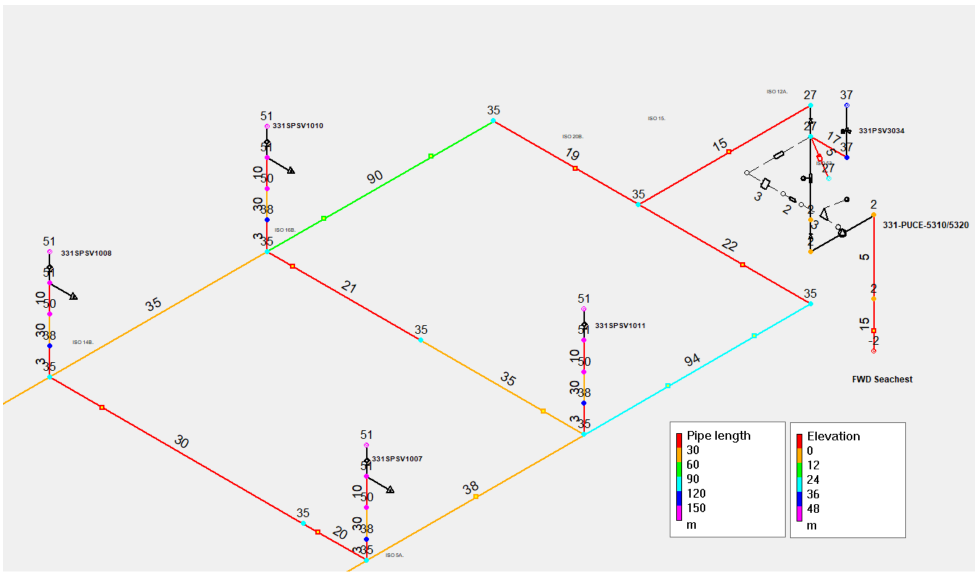
3. Salient Features of the System

3.1. Three aft pumps start at 10 secs and run up. A control system is intended to maintain the pressure

It is assumed that the fire is detected at 10 secs into the simulation. The aft pumps run up in approximately 40 secs starting at 10 secs into the simulation. They have a control system which is intended to maintain their discharge pressure at 12 barg.
Aft pump arrangement:



3.2. Forward pump arrangement: The forward pump is stopped throughout the simulation.



3.3. Deluge Systems:

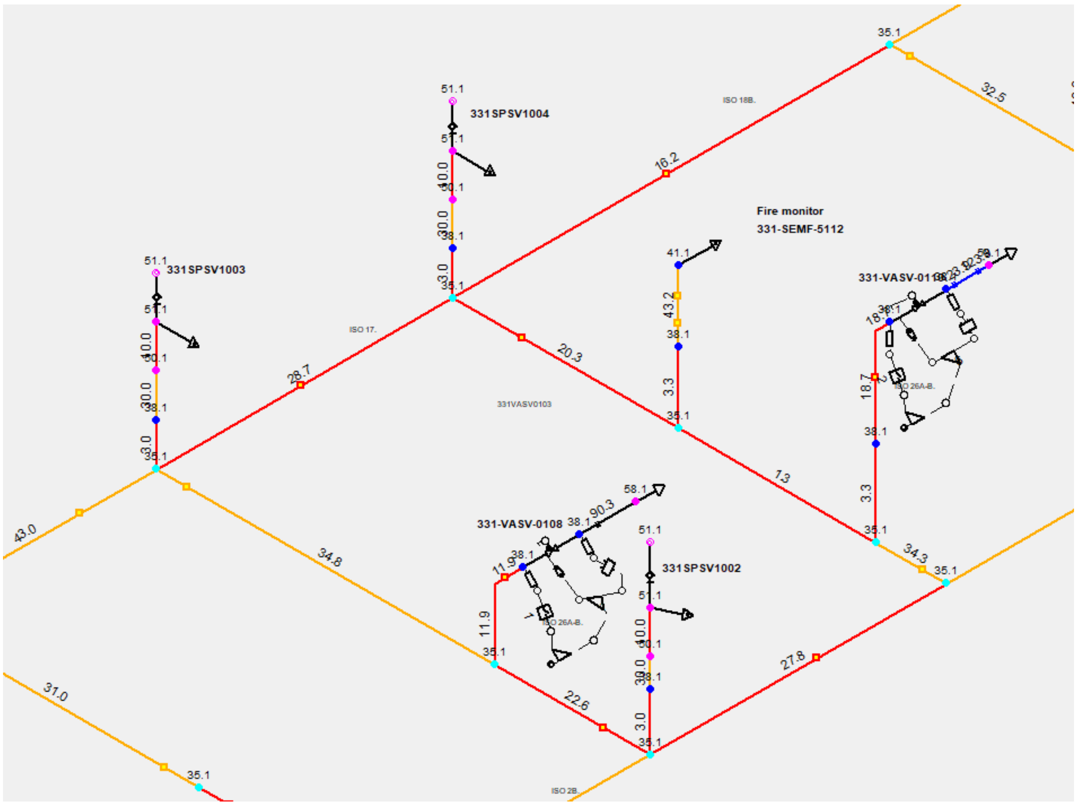
Operation of the deluge valves: The deluge valves are of the elastomeric type which regulate the downstream pressure at its set point. It is assumed that fire is detected at 10 secs after the simulation starts. The deluge valves are pressure activated and so if their inlet pressure is less than 0.3 barg they will remain closed. If the following conditions are satisfied then the deluge valve will begin to regulate the downstream pressure.

(i) It is 10 secs after the simulation starts.
(ii) The fire pumps have started and they create a pressure above 0.3 barg at the inlet of the deluge valve.

A total of 5 deluge systems start up at the same time.

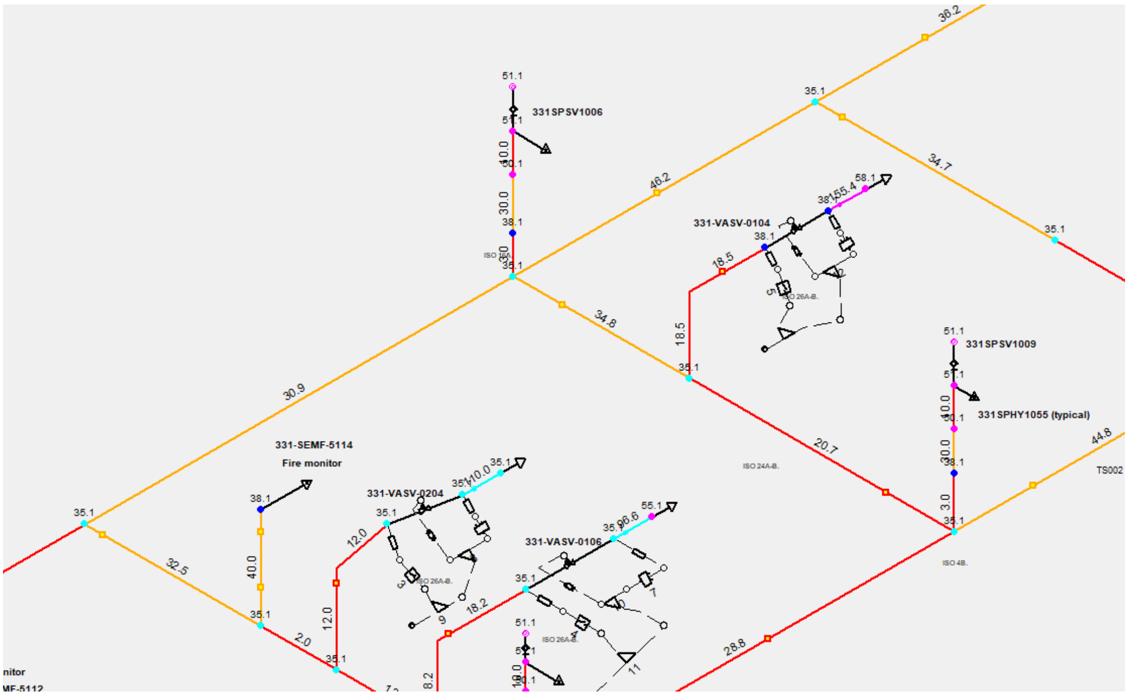
Deluge Systems on aft side:

The two deluge systems which are on the aft side half of the FPSO and which operate are shown below.



Deluge Systems on the forward side

The three deluge systems which are on the forward side half of the FPSO and which operate are shown below.



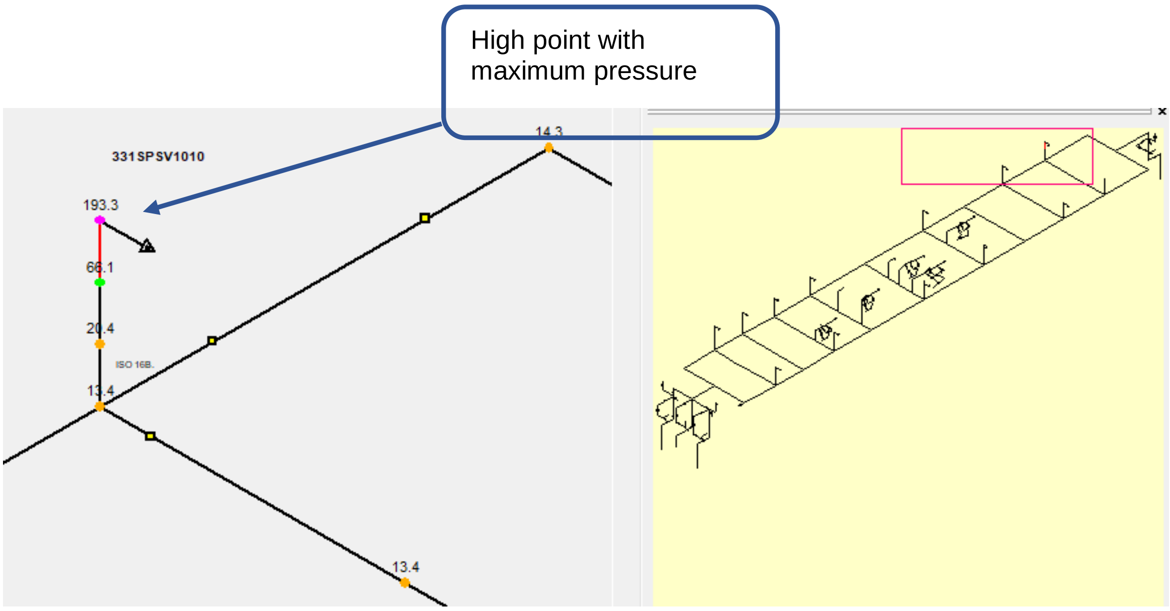
4. Graphical Results:

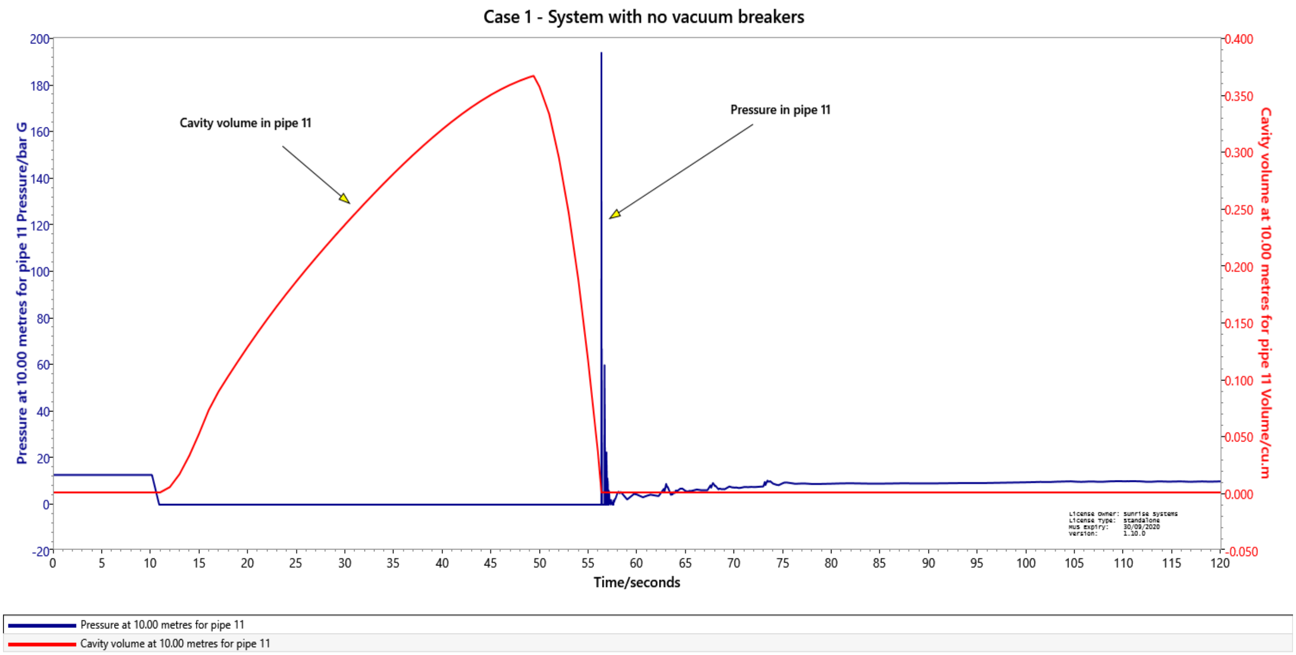
Case 1: System without vacuum Breakers.

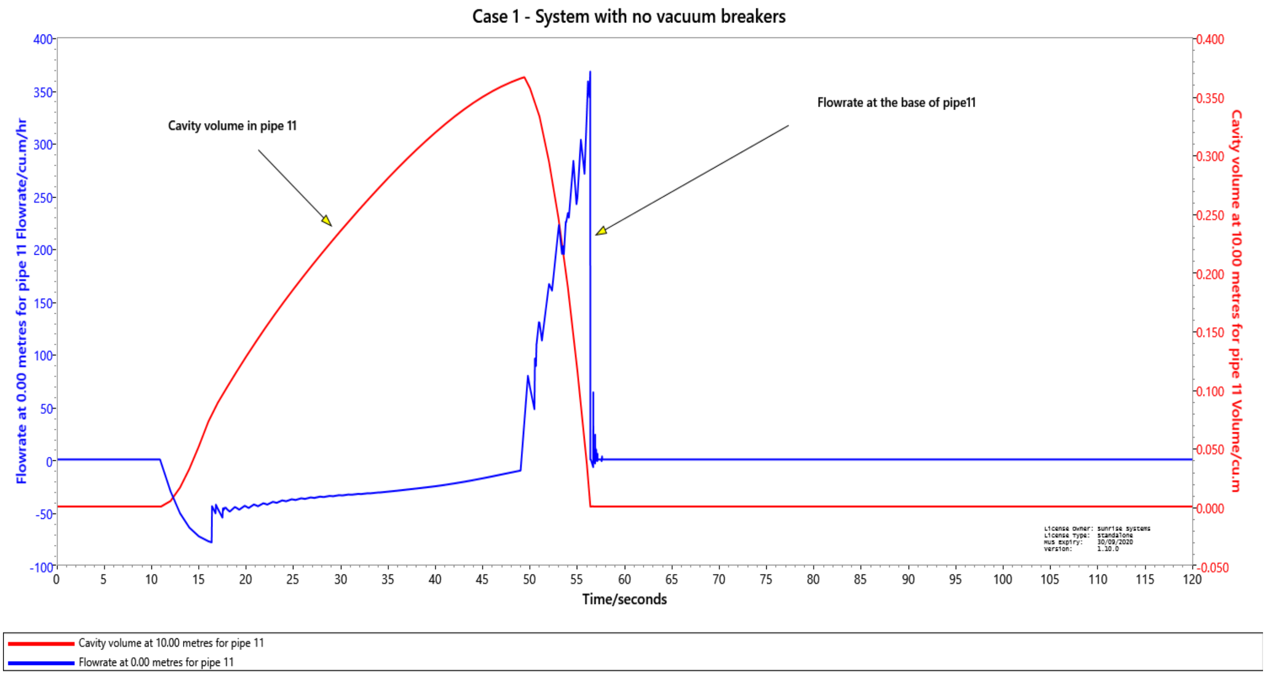
```
PRESSURE EXTREMA
----------------

Maximum pressure is 193.298 bar G
          on pipe 11 at the outlet
          at time 56.37000 seconds

Minimum pressure is -0.960000 bar G
          on pipe 11 at the outlet
          at time 10.91000 seconds
```





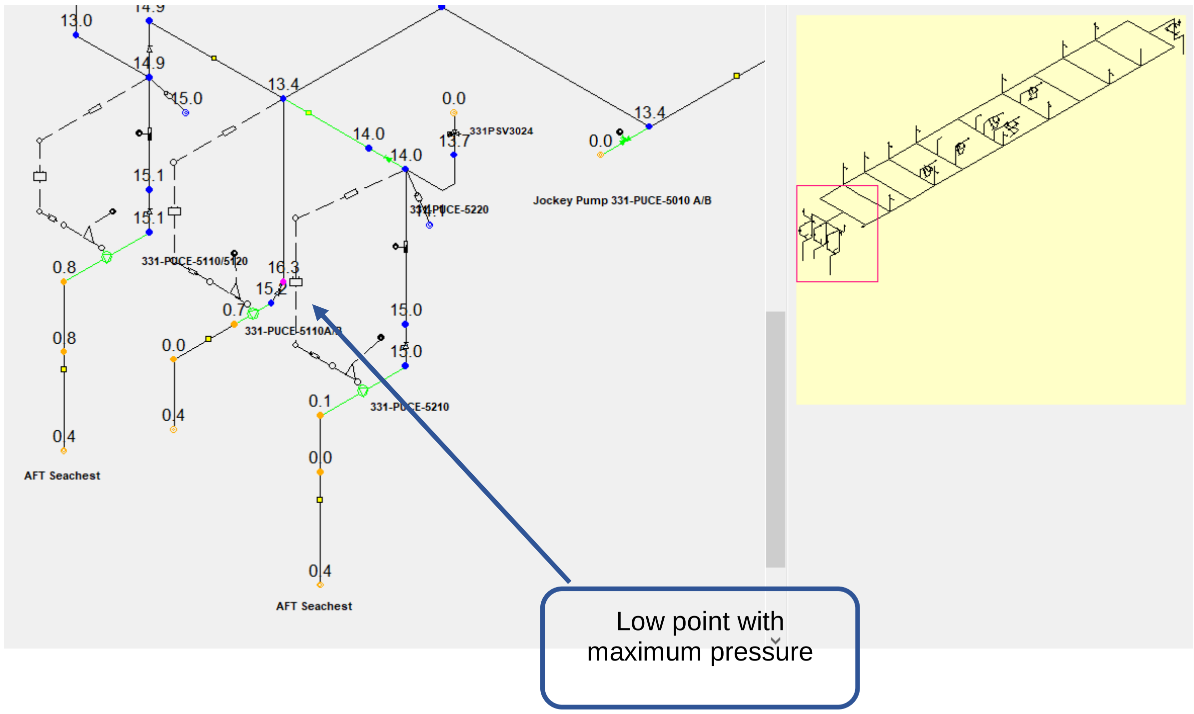


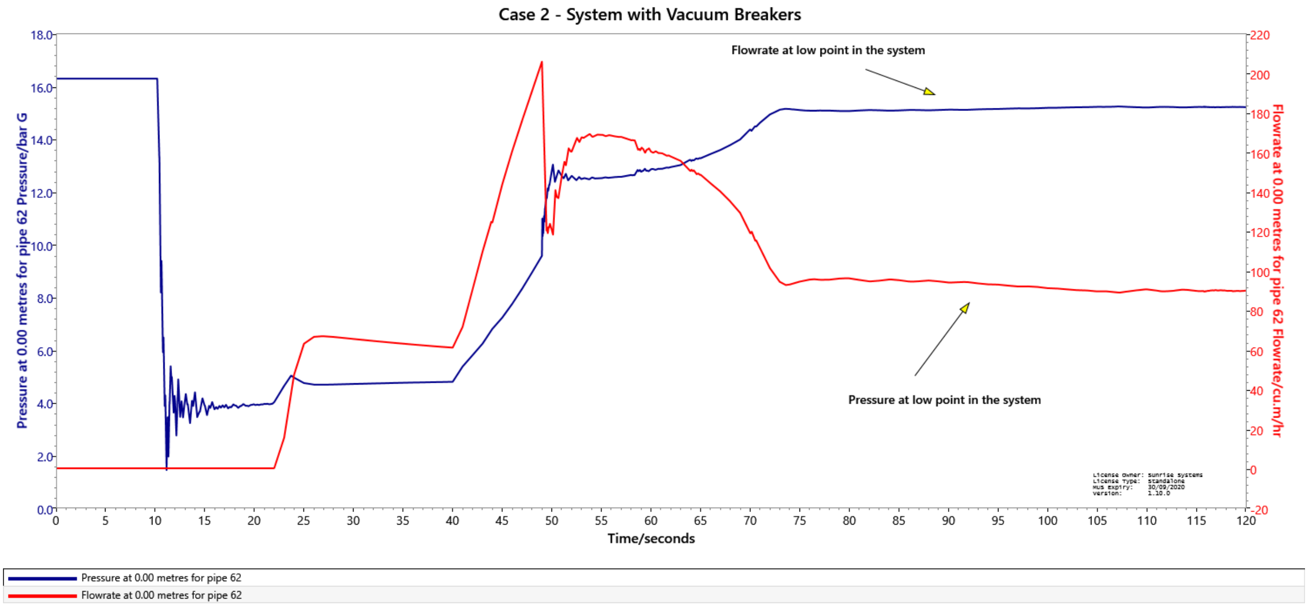
Case 2 – System with vacuum breakers

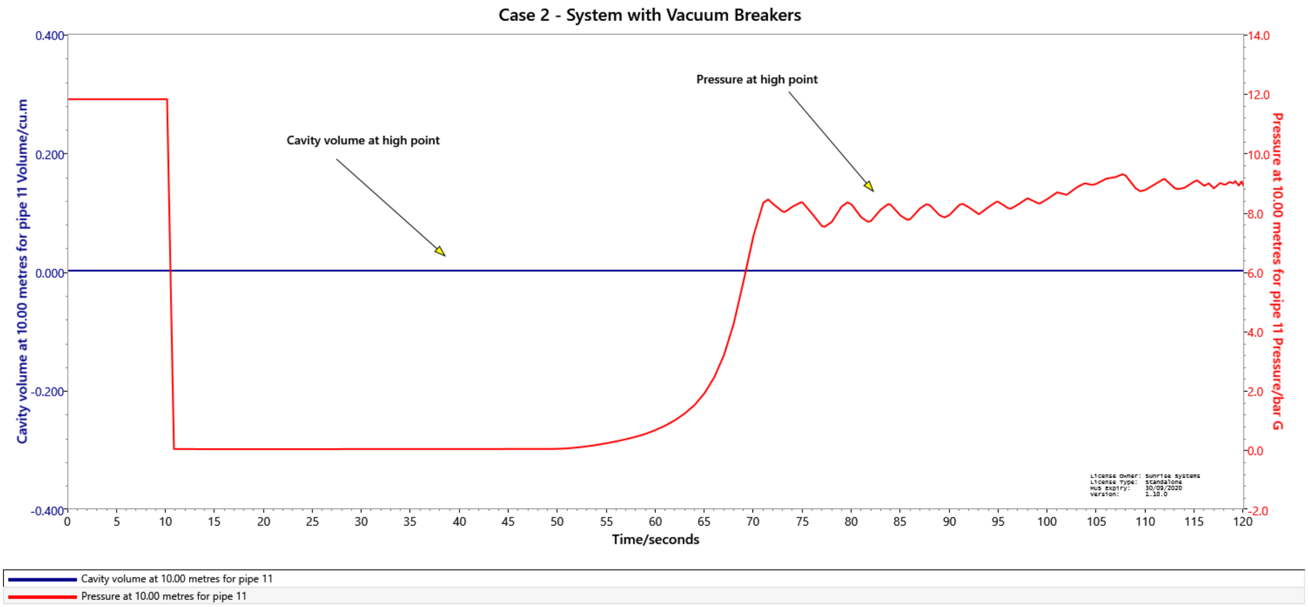
```
PRESSURE EXTREMA
----------------

Maximum pressure is 16.2841 bar G
           on pipe 62 at the inlet
           at time 3.720000 seconds

Minimum pressure is -0.960000 bar G
           on pipe 60 at the outlet
           at time 10.98000 seconds
```







5. Conclusion:

The simulation results show that cavitation is likely unless surge alleviation devices are installed. Cavitation is likely at the high points of the system. The potential pressure surge is around 193.3 barg. By installing 13 vacuum breakers at the high points cavitation is eliminated and the pressure surge comes down to 16.3 barg

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

Unbalanced Forces: Answering Some FAQs

PIPENET Transient Module users often have questions about the following two aspects of calculating forces in PIPENET:

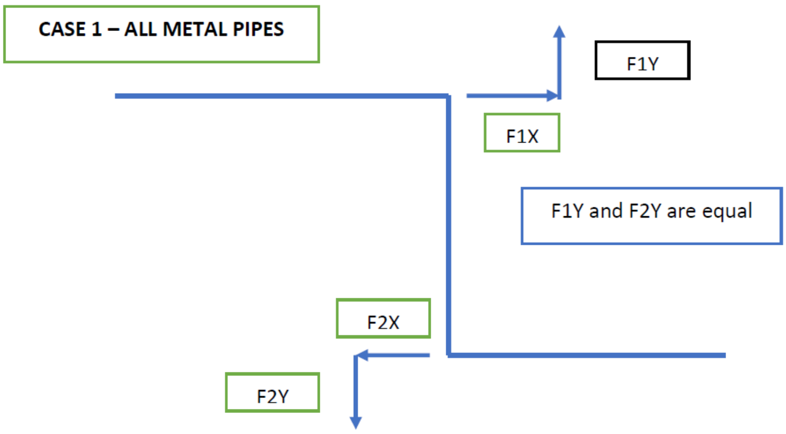
1. **How do unbalanced forces arise and why are they important?**
2. **What are rigid and elastic joints?**

Part 1: Steady State Condition

We do not consider forces in steady state. We only make sure that the pressure is below the allowable pressure. What is the reason?

Let us consider an elbow pair in the horizontal plane.

Elbows 1 and 2 will individually experience forces even in steady state. This is because the pressure inside the pipe is higher than the pressure outside. The direction of the momentum also changes. Furthermore, there are frictional forces acting on the pipe wall. However, F1Y and F2Y will exactly cancel out each other. Please note that friction will act on the wall of the pipe. That will compensate for the difference in the pressure due to frictional loss.



Why do we need elastic joints? Do we need to use them even in steady state conditions? There are circumstances in which one end of a force control volume must be defined as an elastic joint. It should be noted that an elastic joint does not necessarily mean it is a connection with a flexible pipe. PIPENET allows the user to choose between rigid and elastic joints depending on the purpose for which the user wants to generate the forces.

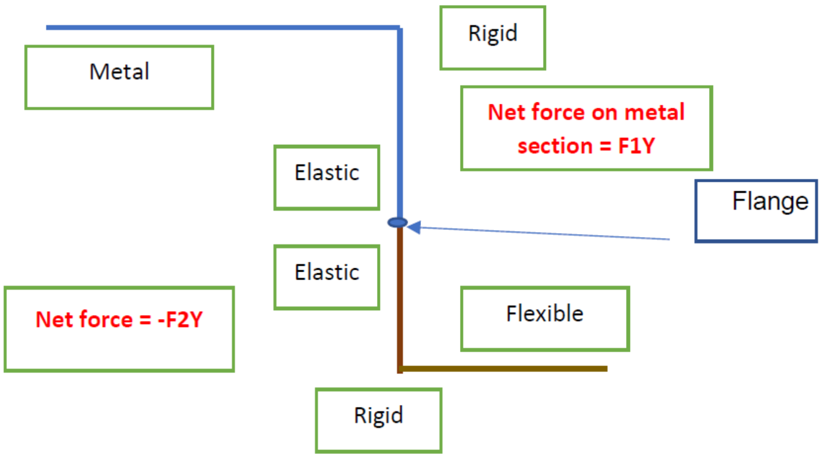
Let us consider the upper half of the system. There are a few reasons why we may define one end point as elastic.

i. Let us suppose that the upper half of the system is metallic and the lower half is flexible. The force on the metal section in the y-direction will be solely the force on the elbow on the metal section. The flexible pipe will not exert a restraining force on the metal section.

ii. If there was a flexible connector without tie rods, then it must be defined as an elastic joint even if it has metal pipes on both sides. Or, if it is a flexible connector and our aim is to calculate the force on the tie rods, then it must be defined as an elastic joint.

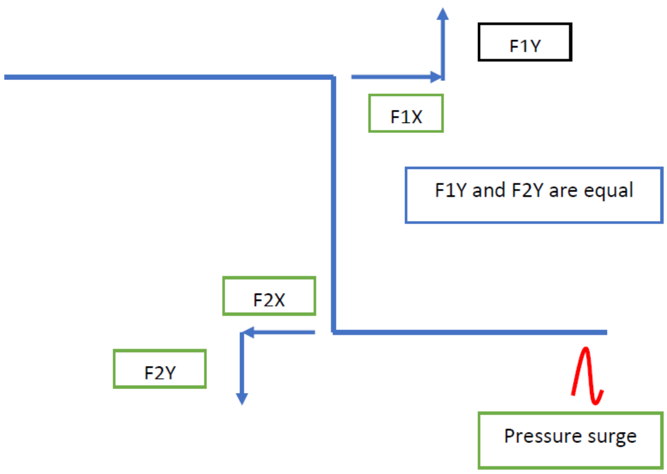
iii. Suppose the pipes are completely metal, are there circumstances in which I would use an elastic joint? Yes. If the force on the bolts of the flange needs to be calculated, then the flange end of the pipe must be defined as elastic.

iv. Suppose the flexible pipe was not there, would I use an elastic joint? This depends on the exact configuration. If the free standing end of the pipe has pressure = 0 specification and there is flow at that end, then it must be defined as elastic. Examples are nozzles and open valves. On the other hand, if there is no flow then it must be defined as rigid. Examples are blank flanges and closed valves.

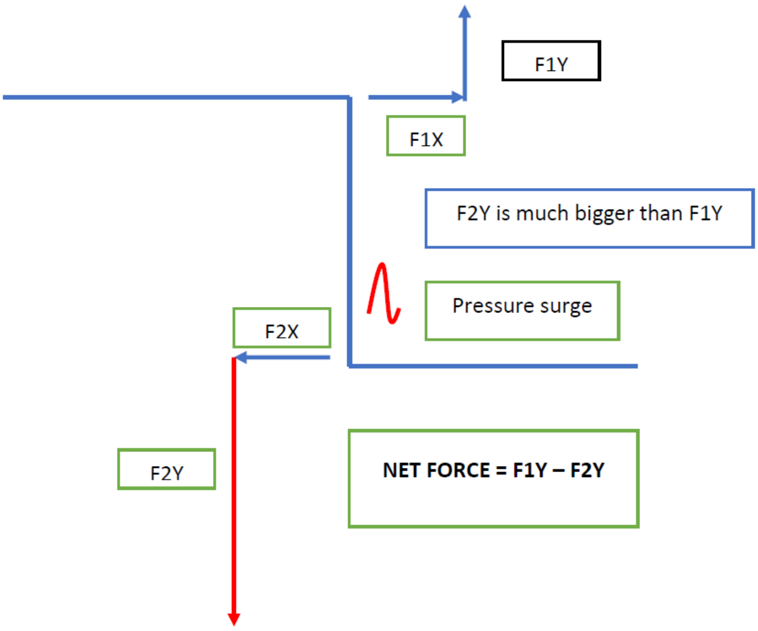


Part 2: Unsteady State

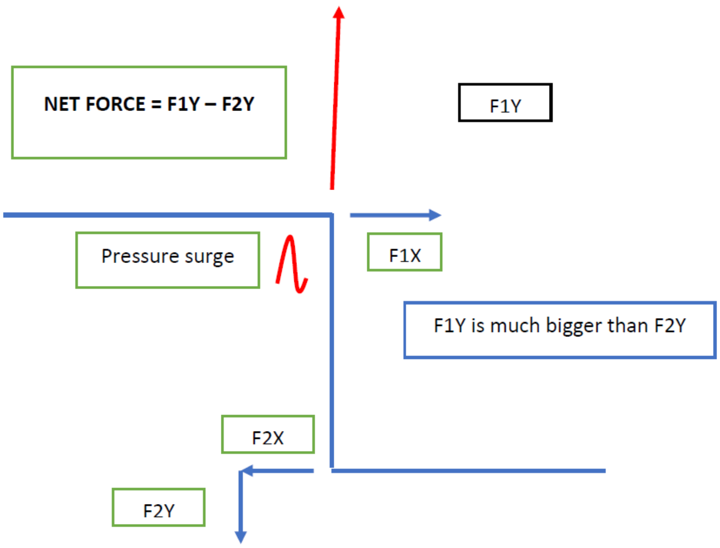
Let us suppose we generate a pressure surge at the end of the system. Let us assume that this pressure surge is a very narrow spike. The unbalanced force will be 0 when the pressure surge is generated because it has not reached the elbow yet.



When the pressure surge reaches elbow 2, F2Y will become a large value because the pressure will reach a high value. The net force F1Y- F2Y will be the net force on the pipe section between the elbow pair.



When the pressure surge reaches elbow 1, F1Y will become a large value because the pressure will reach a high value. The net force F1Y- F2Y will be the net force on the pipe section between the elbow pair.



When do we have to define rigid or elastic joints? The reasons are the same as what was described under steady state forces. For convenience they are reproduced here.

Let us consider the upper half of the system. There are a few reasons why we may define one end point as elastic. Please refer to the drawings below as appropriate.

v. Let us suppose that the upper half of the system is metallic and the lower half is flexible. The force on the metal section in the y-direction will be solely the force on the elbow on the metal section. The flexible pipe will not exert a restraining force on the metal section.

vi. If there was a flexible connector without tie rods, then it must be defined as elastic joint even if it has metal pipes on both sides. Or, if it is a flexible connector and our aim is to calculate the force on the tie rods, then it must be defined as an elastic joint.

vii. Suppose the pipes are completely metal, are there circumstances in which I would use an elastic joint? Yes. If the force on the bolts of the flange needs to be calculated, then the flange end of the pipe must be defined as elastic.

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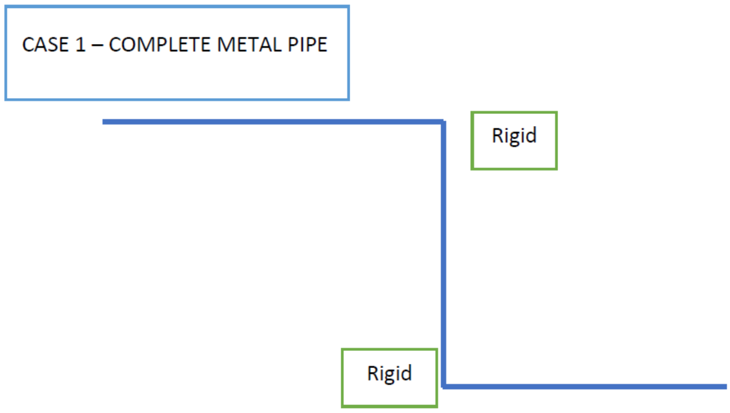
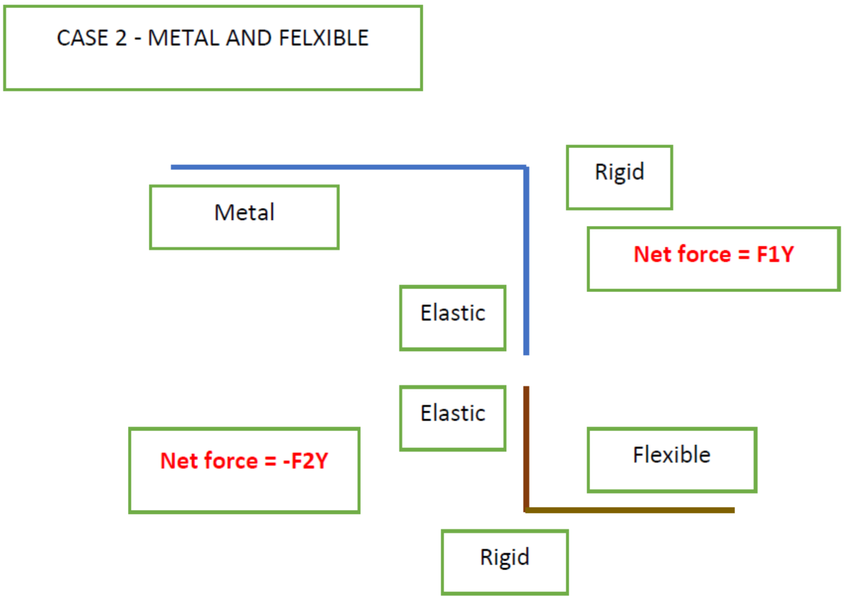
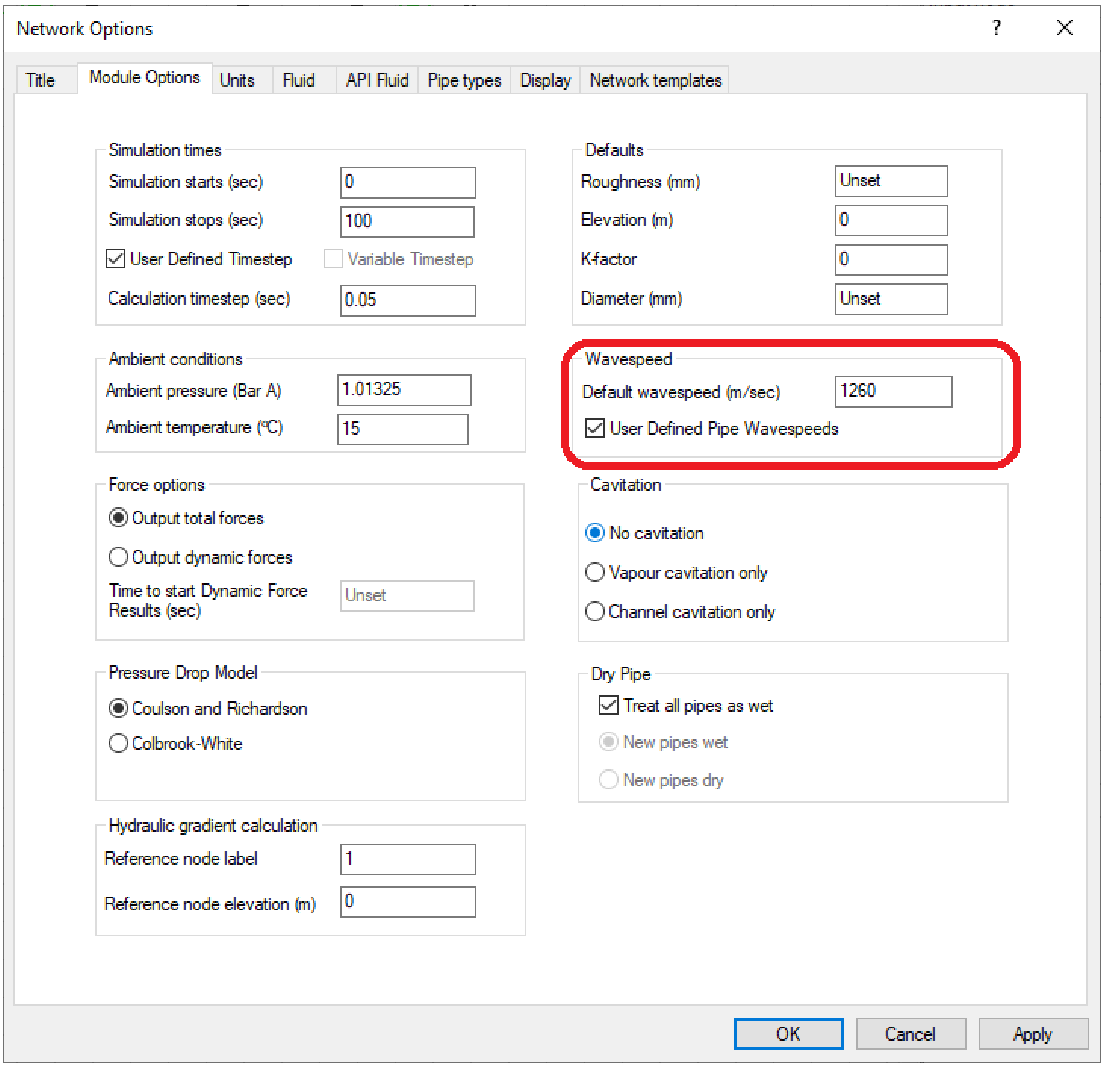




How to…?

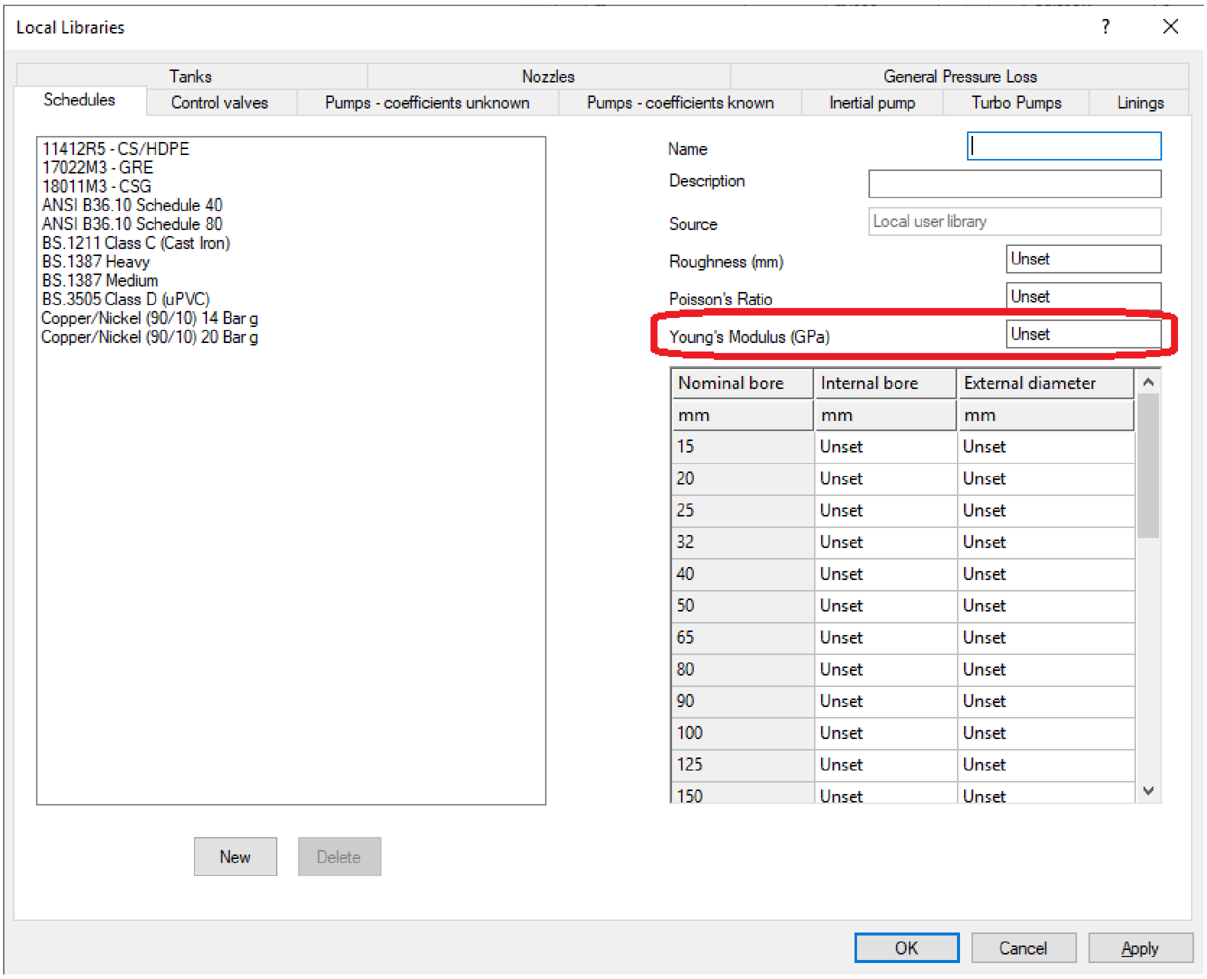
How to model a flexible hose in PIPENET Transient module

In PIPENET Vision 1.9.0 onwards, the user can set all pipes as “No pipe type” and input different wave speeds for each pipe, where there is no pipe type defined. Please also note that the diameter input in the properties window should be the pipe interior diameter rather than the nominal size because no pipe type has been selected.

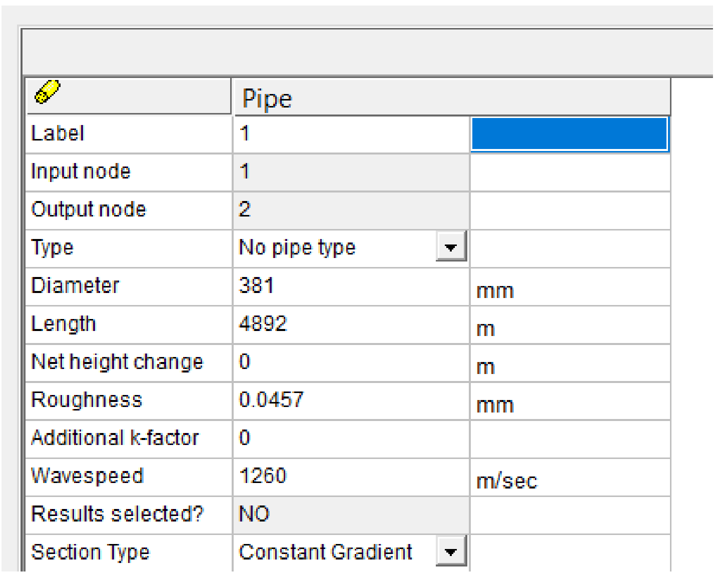


The Young's Modulus for a flexible hose is much smaller than it would be for a rigid pipe.

PIPENET users can change Young's Modulus in the pipe schedule library and PIPENET will calculate the wave speed automatically.



Pipe properties window:



General Pressure Loss Component: When and How to Use it

General Pressure Loss component in PIPENET can be used to model any item for which the pressure loss against the flowrate is known or can be guessed. Examples are heat exchangers, filters and orifice plates.

1. Resistance equation

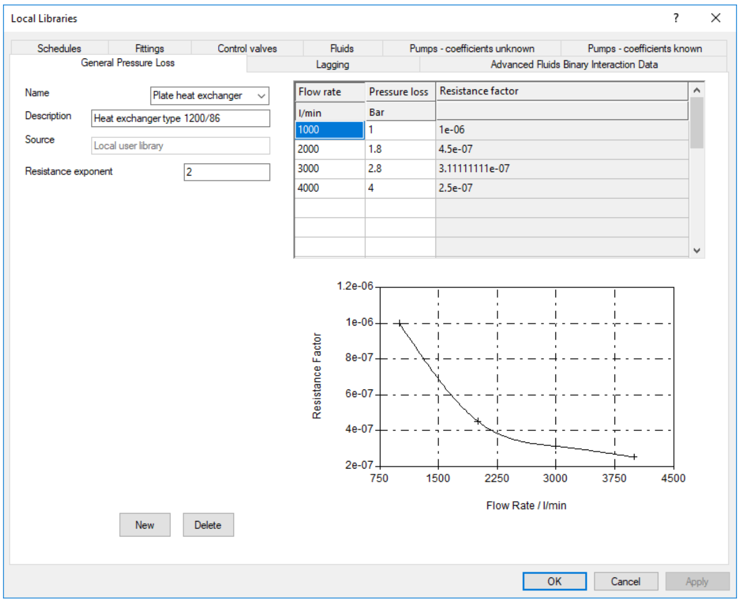
$$P_1 - P_2 = KQ|Q|^{m-1}$$

where:

P_1 is the inlet pressure,
P_2 is the outlet pressure,
Q is the flow rate,
K is the resistance factor,
m is the exponent.

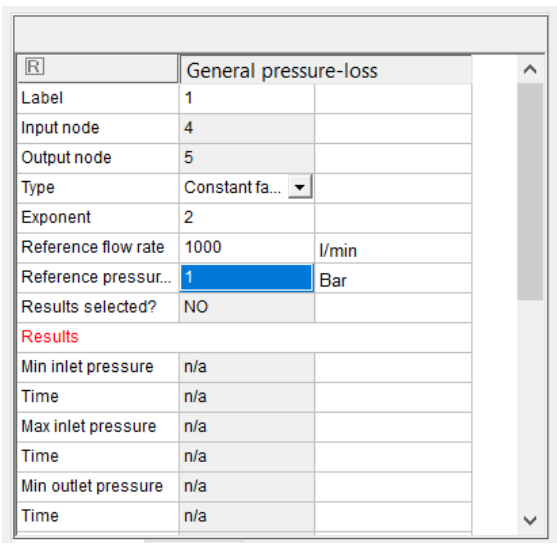
Method 1: Input a table into the library.

The resistance factor (K) is variable and depends on the flowrate. If the data for the flowrate and pressure loss is available, input it into the library for General Pressure Loss component:



Method 2: Direct input.

The resistance factor (K) is constant. Input a reference flowrate and pressure loss direct into the properties window for General Pressure Loss component:



How to Contact us

PIPENET has been developed by engineers and for engineers. We take pride in the fact that thousands of engineers all around the world choose PIPENET for its powerful capabilities, intuitive and user-friendly interface, and the simplicity of use.

We would very much welcome your feedback on how we could make PIPENET even better.

Please share your ideas with us or contact us if you have any questions at
pipenet@sunrise-sys.com

If you are an existing customer and require technical support, please contact our excellent Support Team at
support@sunrise-sys.com

If you would like to join our free online training webinars that are periodically held in different regions, please contact us at
pipenet@sunrise-sys.com

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