

Experimental validation case of a fast transient in a branched network

Introduction

This validation case study demonstrates the validation of the Flownex pipe element with experimental results of a fast transient in a branched network. A fast transient occurs with a rapid change in boundary values, causing pressure waves through the pipe network.

Validation Specification

This case considers the experimental validation of the Flownex pipe element, restrictor with loss element and junctions for transient pressure wave simulations. The experimental setup consists of a horizontal pipe with two separate pipes connected to the pipe at a 90° angle, i.e. PIP 300 and PIP 301 forming T-junctions with PIP 302 in Figure 1. At the start of the experiment VAL-111, VAL-300 and VAL-302 is closed and VAL-301 is open. Then VAL-111 is opened, allowing Vessel C to blow down from an initial air pressure of 320kPa, through VAL-301. At 1 second into the experiment, valve VAL-301 is closed suddenly, causing a pressure wave in the branched pipe network.

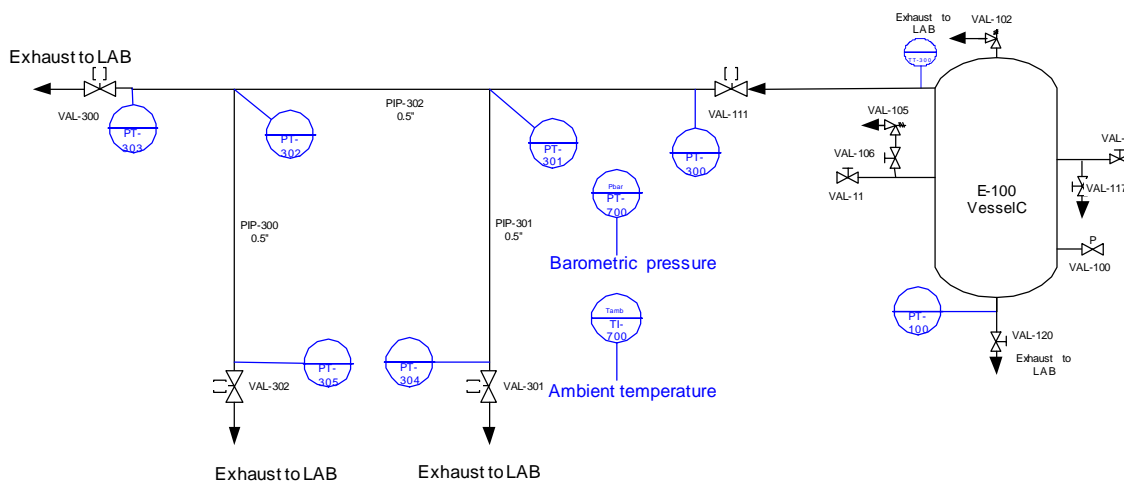


Figure 1: Experimental Facility – Branched Network

Flownex model

The different pipe sections of the experimental facility were simulated with the Flownex pipe element, and the valves were simulated using restrictor with loss coefficient elements. One boundary node was specified with a volume to represent Vessel C and the T-junctions in the branched network were simulated by specifying the intersecting nodes as junctions. The sudden valve closure was simulated by specifying a transient event set.

Benchmark

The pressure waves recorded at the pressure transmitters (PT-XXX on Figure 1) was used as experimental results and compared to the Flownex simulation results.

Results

The Flownex (FNX) simulation results and the experimental (EXP) results, illustrated in Figure 2 and Figure 3, were compared and satisfactory agreement between the results was observed.

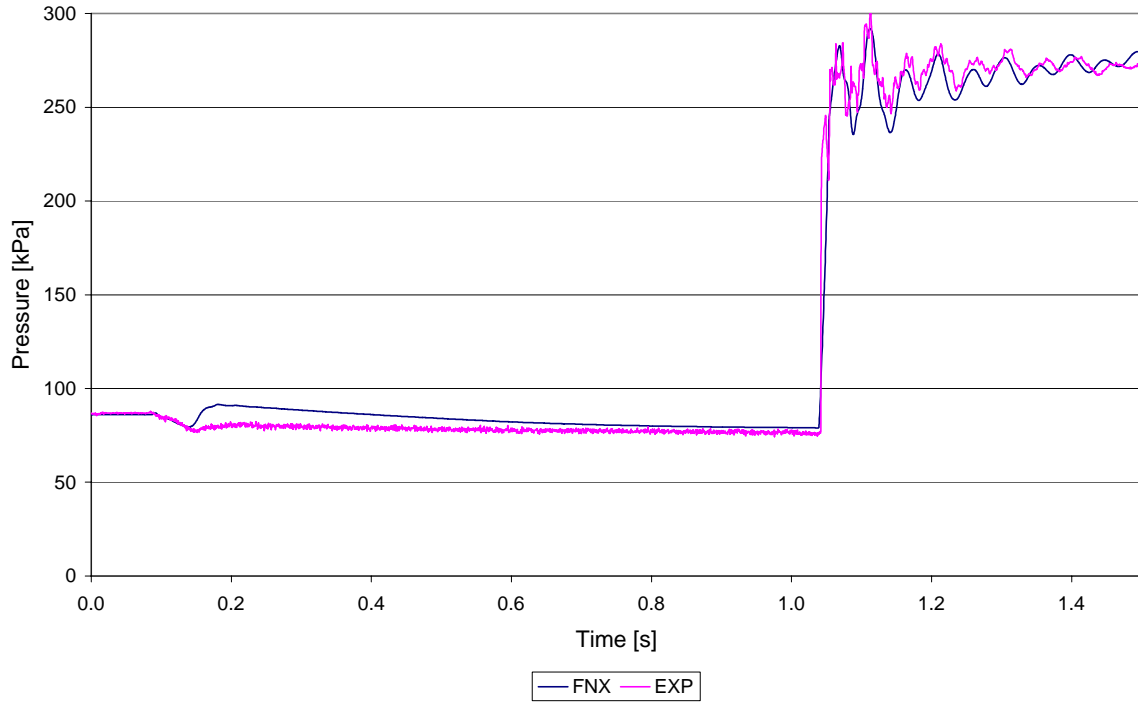


Figure 2: Pressure at PT-304

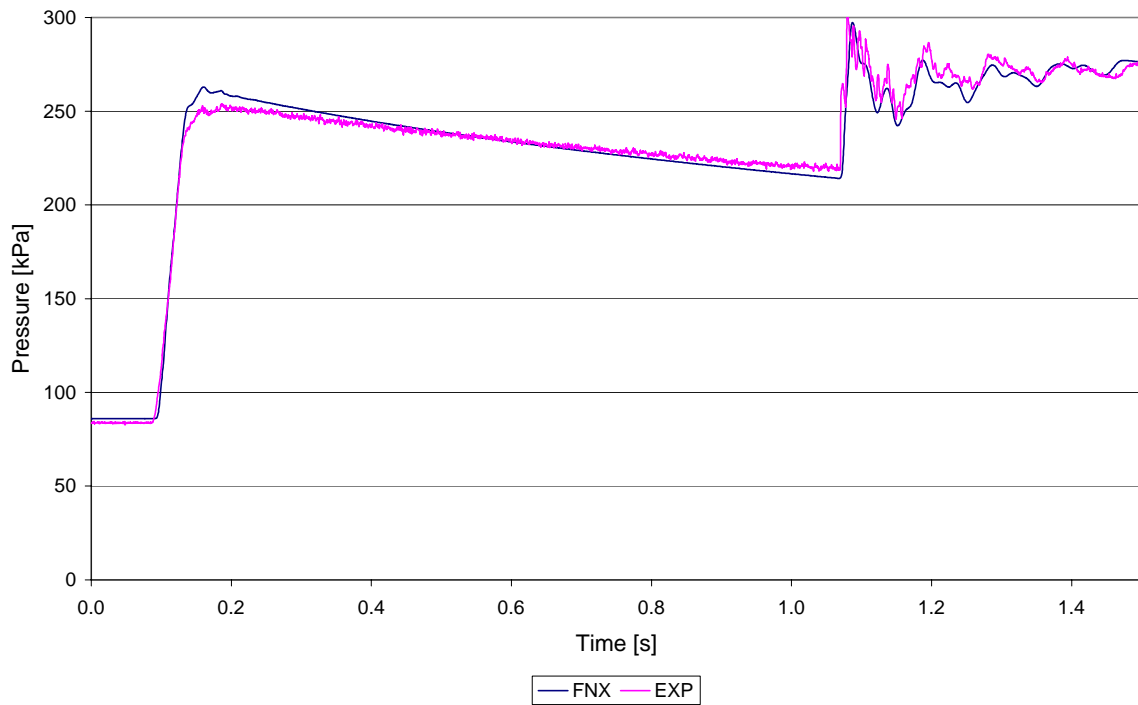


Figure 3: Pressure at PT-305

Conclusion

In this validation case the Flownex results compared very favorably against the experimental results for the fast transient in a branched network.