

# Fluid Pipeline Modeling Services

Southwest Research Institute® (SwRI®) has been involved in pipeline modeling for nearly 60 years. In the 1950s, SwRI developed a unique analog resistance simulator for the gas transmission and compression industry. Since that time SwRI has expanded its capabilities in this area using commercially available software while generating and validating its own computational tools as well, and now uses pipeline simulations to help customers all over the world with different needs and applications.

SwRI has used pipeline simulations as an optimization tool in many liquid and gas processes. New designs and equipment selections are usually validated through computational models due to their flexibility, time and cost. Simulation of an entire pipeline's operating conditions and process before proceeding with the detailed engineering is a very common strategy used on new systems. Simulation analyses usually include detailed validation and tuning against real conditions.

Transient and steady-state flow modeling of pipeline systems and other fluid transient responses are performed at SwRI with a variety of one- and three-dimensional fluid dynamic codes.

## Pipeline Modeling

SwRI modeling capabilities include:

- Design or modification of new installations
- Evaluation and optimization of transmission lines
- Gathering systems
- Pump and compressor stations
- Pipeline networks
- Valve manifolds

## Pipeline Simulation

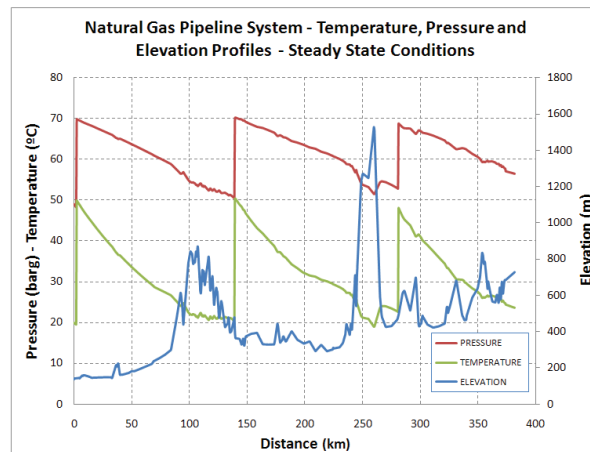
SwRI pipeline simulation services have been utilized for:

- Transmission Pipeline / Facility Hydraulic Evaluation
  - Design and optimization of new installations
  - Modifications of existing facilities
  - Hydraulic operation issues
- Transient Analyses
  - Centrifugal compressor surge control system design
  - Water hammer effects
  - 1-D/3-D flow pulsations
  - Leak detection
  - Startup and shutdown
  - Fluid batching
- Root Cause Failure Analyses
  - Valve manifold transient pressure and flow predictions
  - Compressor failures related to fluid/structure vibrations
  - Pipeline ruptures
- Liquid Drop-Outs in Gas Pipelines
  - Operating conditions to be avoided
  - Phase change prediction
  - Possible locations of liquid/corrosion accumulation

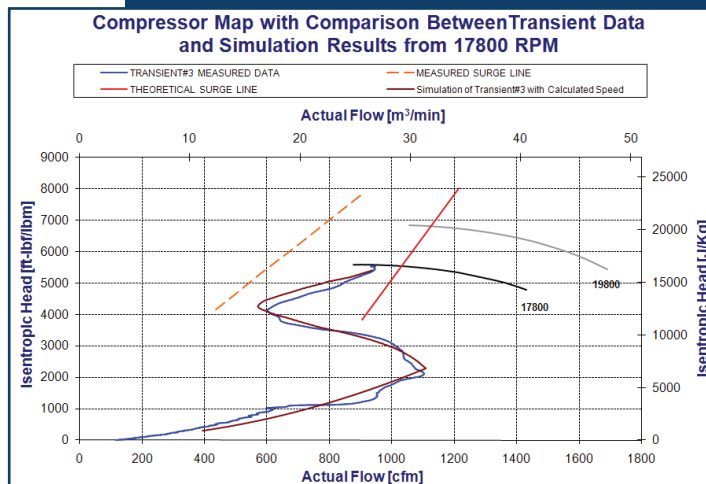
## Transient Surge Simulation

SwRI dynamic modeling can be a valuable tool in the design of an anti-surge control system. Results from the transient analysis are used for:

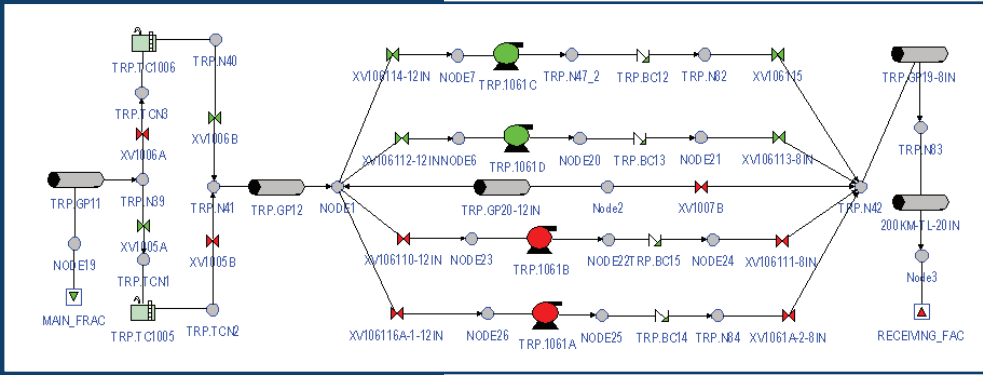
- Evaluation of the system piping design response time and operating performance
- Placement of the downstream check valve and anti-surge valve
- Valve/actuation system selection
- Surge control system safety confirmation



Flow and power usage maximization analysis of a natural gas looped pipeline system

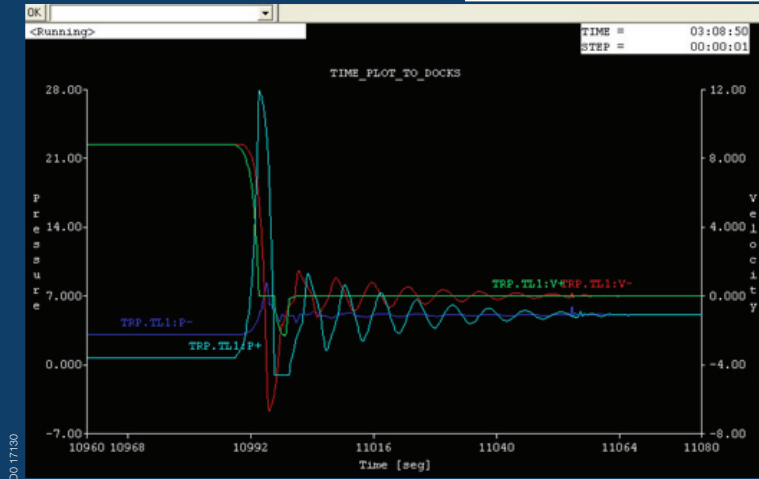


Validation of centrifugal compressor surge simulations using experimental transient surge data taken at SwRI Metering Research Facility



Interconnected pipelines of forwarding systems for hydrocarbon liquids

DO-17429



Example of water hammer analysis of a liquid transmission line

DO-17430



Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,300 employees who perform contract work for industry and government clients.



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