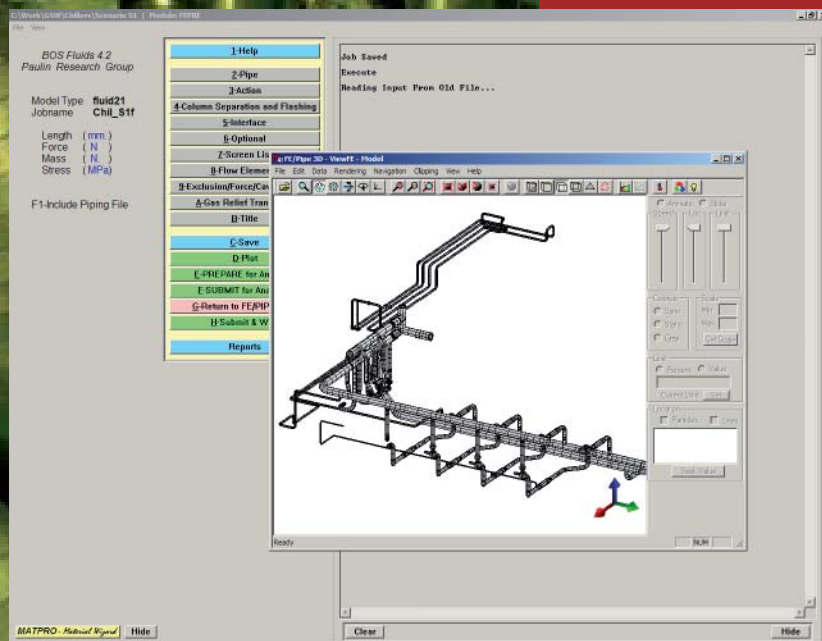
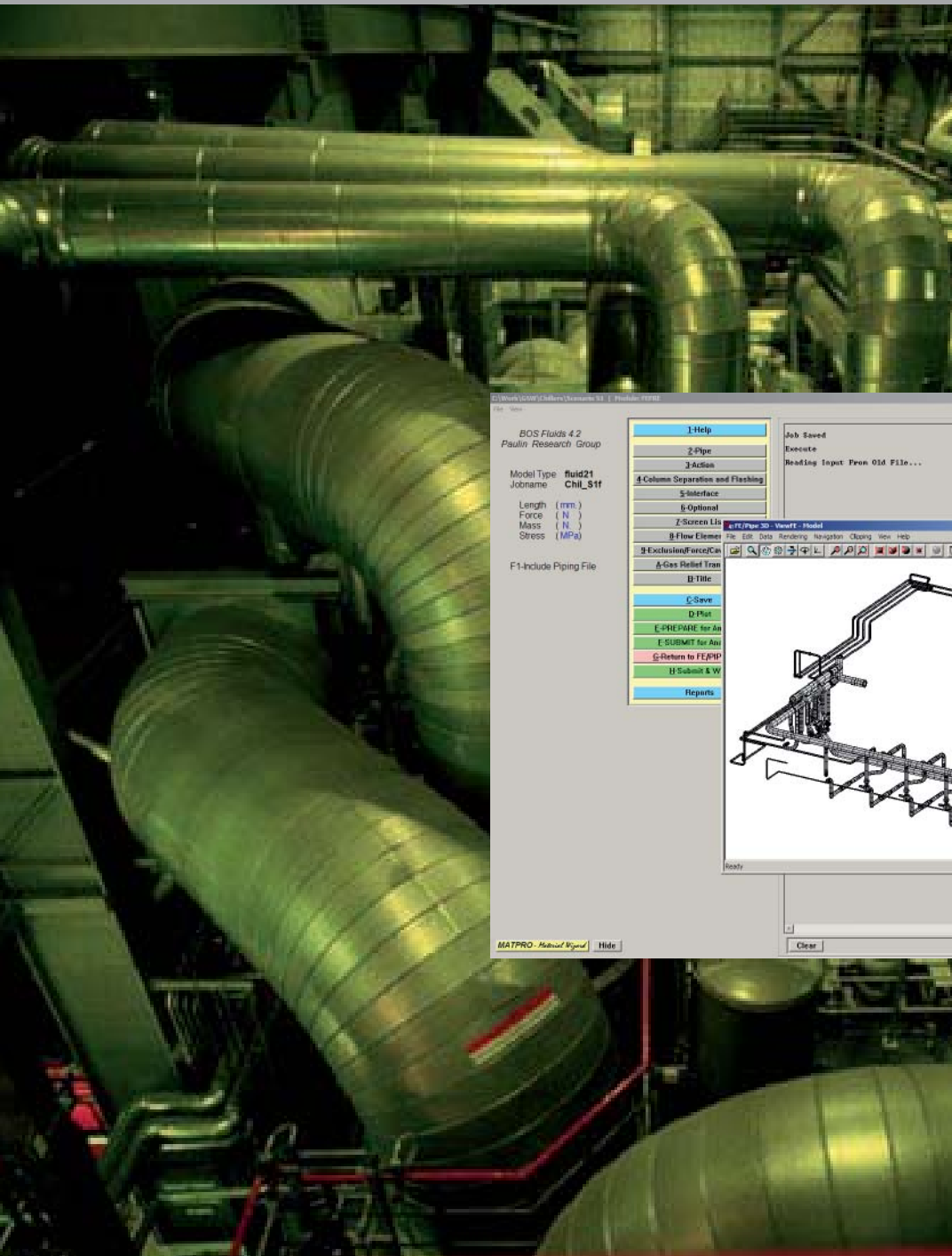


# BOSFluids

Analyzing Fluid Transients



*Software that allows you to predict waterhammer and other transient effects*

*“The most complete package around”*

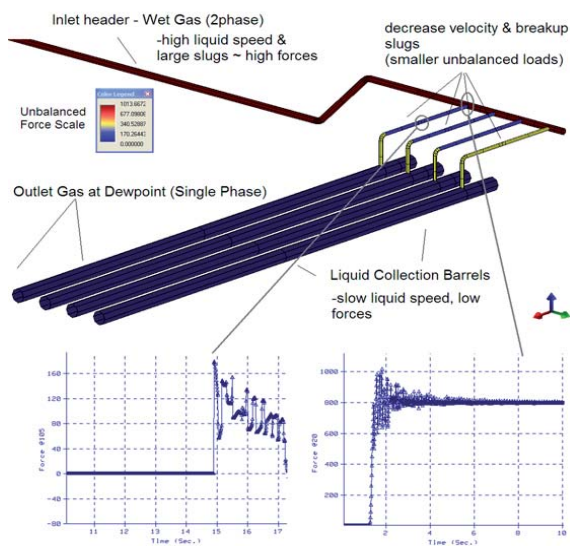
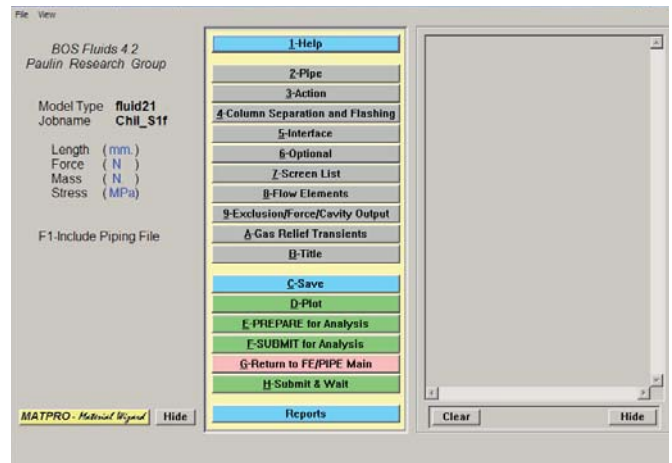
*A product of  
DYNAFLOW Research Group &  
PAULIN Research Group*

## A Brief Overview

BOSFluids is the engineering software package that analyzes fluid transients in pipe systems and relates this information back to the mechanical piping system transferring the fluid.

For years, piping engineers have laboured with simplifying hand methods, cumbersome analogue computers, or user-unfriendly software products when needing basic steady state and transient fluid analysis capability. BOS Fluids is written specifically to address the need of the piping engineer for fluid reaction forces, and to provide a system whereby the fluid simulation results can be easily integrated back into the piping system design and analysis.

BOSFluids is an interactive computer simulation package that models steady state and transient flow in liquid or gas carrying piping systems. The procedure is easy to use and interfaces with most pipe stress programs. BOSFluids makes fluid simulation simple and easily accessible and yet gives the analyst pressure transients and dynamic force results with an engineering accuracy.



## Applications

The application of a transient analyses are numerous. The most common type of systems BOSFluids analyses find applications are:

- Vessel blowdown
- Sewage water systems
- Oil product transport lines
- Triplex pump surge bottles
- Compressor piping systems
- Tanker loading and unloading systems
- Acoustical natural frequency calculations
- High pressure heat exchanger tube ruptures
- Water transmission and distribution systems
- Main cooling water systems for chemical plants
- Dynamic behavior of chemical liquid transport lines
- Combined (power-drinking water) cycle power stations

## Available Elements

- Standard Valves
- Relief Valves
- Damped Check Valves
- Air Valves
- Pumps
- Equipment
- Surge vessels
- Orifices
- Tube Ruptures
- Long Pipe Boundary Conditions
- Isolated Slug Evaluations
- Reciprocating equipment
- Pressure Regulator Valves

With BOSFluids simultaneously the transient response of multiple sources: Pump starts, Pump Failures, Valve Operations can be simulated. Both also the standing waves can be analysed using the harmonic option which allows the occurrence of standing waves.

The main results are the maximum and minimum pressures and velocities occurring during transient and/or harmonics, which are key parameters to come to a suitable design of your system.

## Easy model building

The program allows for a clear element by element way of building the model. Various pipe materials can be applied-both isotropic (Metals) and Orthotropic (FRP) materials are included. Buried and above ground systems can be simulated.

Based on geometry typical pump properties are generated automatically. The analyst can also pick different fluids from a database or add their own fluids to the database.

## Interface with stress programs

An easy to use interface is available for importing Pipe stress models from either CAESAR or PipePak for fluid analysis. The program can input neutral files from CEASAR II, Pipe Plus, Triflex, FE/Pipe, or the user can enter the piping topology using the standard input modus.

But also the other way around. The force processor allows an analyst to survey the time history of the unbalanced forces on pipe sections and preprocesses the force time histories to be used in the dynamical module of the pipe stress program. These unbalanced forces can easily be output in files suitable to be read into pipe stress programs.

## 3D graphical output

Graphical 3D output includes pressures, flowrates, velocities and unbalanced forces. The 3D output graphics can be viewed using a DirectX model viewer that allows the user to zoom, cut, slice and interactively rotate the results model.

A spectrum breakdown of force time histories is available. The analyst can see the natural frequencies of the fluid response that tend to excite the piping

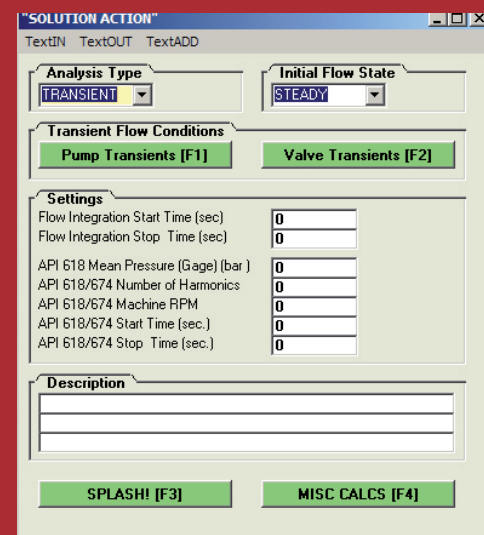
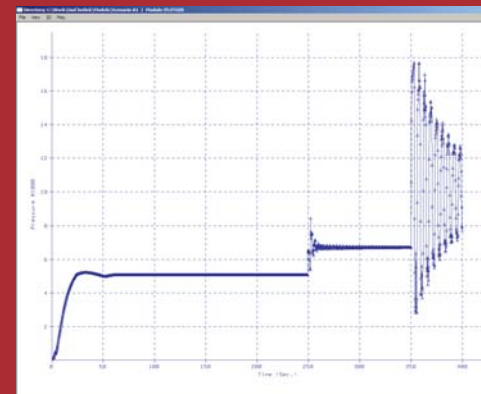
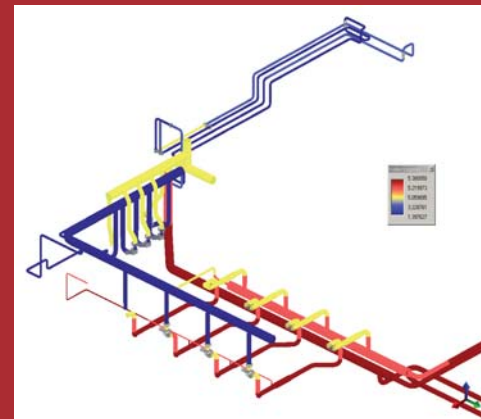
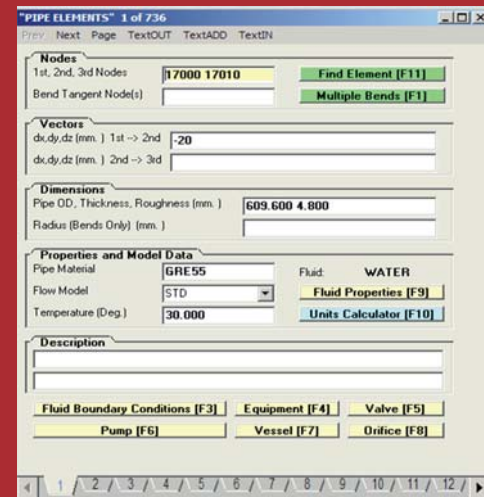
## Several types of Analyses

Typical analyses using BOSFluids include:

- Relief Valve Gas Transients incl. JT-Effects,
- Acoustic analyses for compressors and pumps.
- 2D-CFD Simulations of Free Surface Flows
- Column separation
- Pipe evacuation analysis
- Tube ruptures
- Two phase – homogeneous flow
- Isolated slug evaluations
- Deflagration

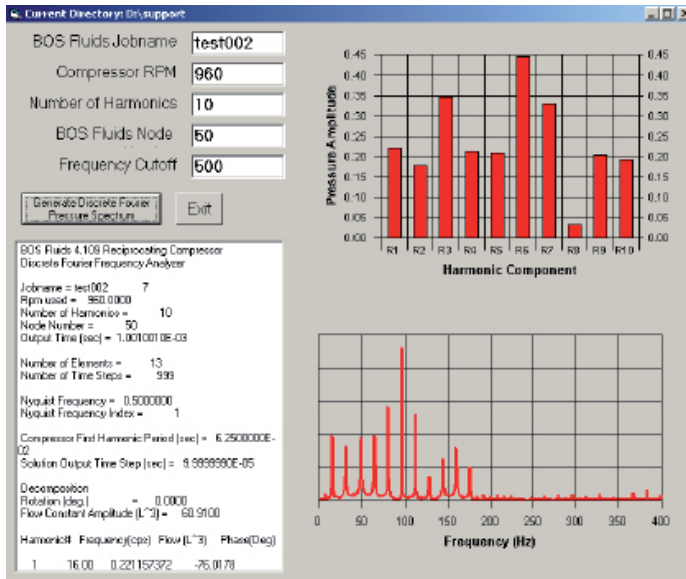
BOSFluids estimates slugging conditions and has a 2D user-defineable CFD simulator for free surface flow problems such as tank sloshing or slug impacts. The program also includes separate algorithms to compute characteristics of slug flow, gas relief and free surface fluid systems.

Both Metric (SI) and English Units can be selected.



## Theoretical background

Based on a number of realistic assumptions a simplified form of the time dependent conservation (Navier-Stokes) equations are solved for the internal channel flow.



The assumptions made are:

1. Fluid behavior in pipes is one dimensional i.e. similarity of cross sectional distribution of properties does exist
2. Fluid transport velocity is small compared to wave speed
3. Wave fronts remain plane while propagating
4. Gas simulations assume that flow velocities are below sonic, and that pressure drops through the system are less than 30%.

The present friction model used in BOSFluids is Colebrook-White. The Darcy-Weisbach flow model is used for steady state pressure drop calculations and the basic theory applied in BOSFluids can be found in Wylie & Streeter's "Fluid Transients" published by FEB Press.

Example of the Discrete Fourier Analyzer of BOSFluids

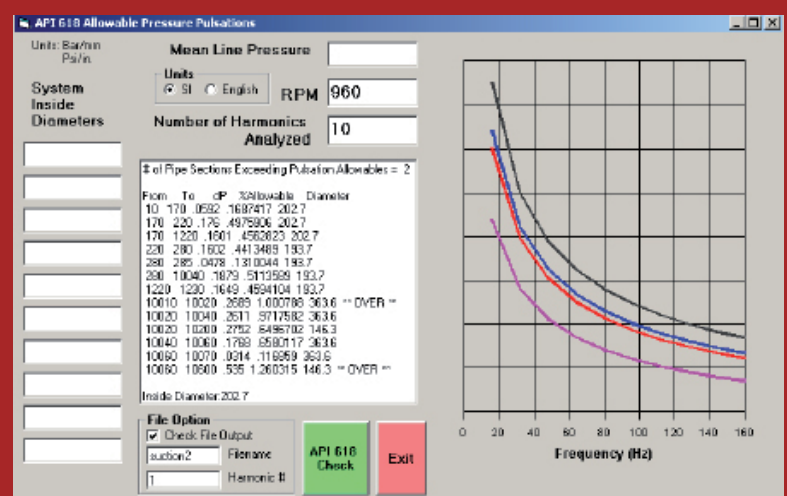
BOSFluids is capable of simulating both the steady and transient behaviour of liquid carrying closed conduit systems of pipes, valves, pumps and surge relief devices.

## BOSFluids code compliance

BOS Fluids uses the time history approach and automatically decomposes the solution pressure pulsations producing an API 618 pulsation compliance report for all sections of the piping system much like a stress analysis program reports the stresses and allowables for the B31 code.

Compliance with API 674 for Positive Displacement Reciprocating Pumps is similar to compliance with API 618 for compressors. BOS Fluids generates the API 674 analysis in exactly the same way it does for the API 618 analysis.

The user can also analyze each harmonic separately and this approach is described below as it is the most informative.



Example of the Allowable Pressure Calculations per API 618

BOSFluids can be purchased as a single station product or as a network version.

BOSFluids includes **Splash** and **Mat/Pro**

BOSFluids is a product of **DYNAFLOW** Research Group & **PAULIN** Research Group.

Additional information about BOSFluids or other products can be found at [www.paulin.com](http://www.paulin.com) or [www.dynafloengineering.com](http://www.dynafloengineering.com)