

# Atmos SIM Online



## Helping operators run their pipelines safely and cost effectively while meeting the delivery schedule

### The challenge

To ensure the safe and cost effective operation of a pipeline, it is essential for the pipeline operators to have accurate and current information on the pipeline operating conditions. The ability to assess the feasibility of scheduled operations is important for early preventive actions.

Atmos SIM Online has the following main benefits:

- Conducts all simulation tasks using one software suite and a single configuration
- Provides a simulated view of unmetered areas such as subsea networks
- Forecasts the behavior of future activities in the pipeline
- Increases revenue for the company using effective look-ahead simulations
- EC 715/2009 compliance
- High model accuracy

### Main features

- Real-time modelling
- Can be used for both liquid and gas pipelines
- Predictive and look-ahead modelling
- Configurable alarms to report events that breach safe operating conditions
- Switch between online and offline modes
- Review model results from any machine on the network
- Easy integration with other systems
- Extensive equipment libraries within the software
- Drag and drop onto the canvas to build your pipeline

- Easy to integrate with third party systems such as GMS, SCADA and financial systems
- Import from or export to CSV files
- Easy to use wizard for customized reports
- Efficient network building with GIS data imports

### What is Atmos SIM Online?

#### Real time modelling

The real-time modelling (RTM) module provides an 'as it happens' display of pipeline information. This information includes, but is not limited to: flow and pressure profile, total line pack, survival time and composition tracking. The system is designed to cope with ever expanding topology. The model can be stopped and restarted smoothly and easily after new topology has been configured. Transient and steady state simulators can be used within the same tool. Alarms can be configured for the main variables at thresholds defined by the user.

#### Forecast the future

It is safer and faster to test future scenarios using a simulation than it is to try it on the pipeline itself. Forecast models provide an early warning of any dangerous conditions that may occur on the pipeline so that preventive actions can be taken.

Predictive modelling (also known as "what-if" modelling) analyzes what will happen in the future on a pipeline if certain operations are carried out. The simulation begins using data relating to the current state of the pipeline. To ensure accuracy, Atmos SIM Online saves the flow, pressure, temperature and density along the pipeline rather than just at the boundary conditions. The operator



can then create various scenarios of pipeline activities. These scenarios can be saved in the scenario manager and can then be run again as needed with no additional set-up.

Look-ahead models calculate what will happen in the coming hours if a pipeline or network continues to operate in its current state. Look-ahead models normally launch automatically on a periodic basis or are triggered by an operation and report if any pipeline safety limits are violated. They can also be launched on demand.

Both predictive and look-ahead modelling can be launched on multiple machines to allow concurrent analysis of multiple scenarios at the same time, no matter how complex the pipeline network is. Alarms can be configured to notify the operator if future operating conditions will violate safe operating limits. Alarm thresholds can be set for flow (mass, volume, standard volume, energy), pressure, temperature and velocity.

The entire simulation run can then be viewed in the trending tool, Atmos Trend, or monitored live using the on-canvas tables.

### Accuracy

Atmos SIM Online and the real-time module employ maximum likelihood state estimation (MLSE). This increases online model accuracy by taking the

best fit between instrument values and model calculations. MLSE minimizes the effects of poor instrument quality which makes the online model more robust.

### Increase Revenue

The forecasting ability of Atmos SIM Online allows the operators to fully utilize the pipeline's capacity, without fear of inventory violations, pressure protection shutdown or shortfalls of delivery. The operators also have a greater control over the line pack. This enhanced use of pipeline capacity can lead to significant cost savings and an increase in revenue.

### Atmos SIM leak detection

The Atmos SIM leak detection module continuously calculates the volume balance. This volume balance is obtained by calculating the total flow into the system minus the total flow out of the system, corrected by the inventory changes. The inventory is constantly calculated by the Real Time Transient Model based on the calculated pressures, temperatures and densities along the pipeline. Many variables and properties are taken into consideration for the inventory calculation: pipeline diameter, length, friction factor, ground temperature, flow velocity, fluid properties, elevation profile, pressure and flow measurements among others.



Look ahead showing a potential issue in 12 hours (circled in red)



To minimize false alarms Atmos SIM incorporates some of the statistical algorithms used by the most reliable statistical pipeline leak detection system - Atmos Pipe. Atmos Pipe has been applied to over 600 pipelines in 55 countries.

The volume balance is statistically analysed on a continuous basis by a Sequential Probability Ratio Test (SPRT), which calculates the ratio of leak probability over no-leak probability. This ratio is then tested against certain threshold values to provide leak warnings/alarms. The threshold value is usually set such that the false alarm probability is lower than 1%. Several leak sizes can be configured to optimize the leak detection time for small, medium and large leaks. In addition the pipeline operating conditions will be monitored so that leaks can be detected within the minimum time possible with a low false alarm rate under the following three scenarios:

- Steady state
- Small transient
- Large transient

Atmos SIM also monitors the discrepancies between measured and calculated pressures and flows. These discrepancies are processed by the sequential probability ratio test in order to generate reliable leak alarms.

Leak location is estimated based on the statistical difference between the measured and calculated flow and pressure along the pipeline.

Users can configure leak detection thresholds and sensitivity to decrease the likelihood of false alarms.

	Normal	Small Transient	Large Transient
Leak Size (Sm <sup>3</sup> /h)	5200	5000	10000
Sigma (Sm <sup>3</sup> /h)	12500	13930	27860

Confidence Count: 10

	Normal	Small Transient	Large Transient
Leak Size (Sm <sup>3</sup> /h)	163800	100000	200000
Sigma (Sm <sup>3</sup> /h)	125000	835629	1671258

Confidence Count: 10

	Normal	Small Transient	Large Transient
Leak Size (Sm <sup>3</sup> /h)	150000	1600000	1600000
Sigma (Sm <sup>3</sup> /h)	93426	317159999.7462...	317159999.7462...

Confidence Count: 10

Leak Size Period: 10 Initial Op Status: Normal

## Real Life Example

Case studies of Atmos SIM Online application at Gassco demonstrates how, through the use of stable hydraulic models, a great deal of additional revenue and savings can be produced.

Gassco is the operator of the largest subsea pipeline network in the world. They transport approximately 100 billion standard cubic meters (3.5 x10<sup>6</sup> MMSCF) of Norwegian natural gas to the European market through nearly 8000km (5000 miles) of large diameter high-pressure subsea pipelines each year.

The following papers are available from the Atmos International website:

[Application benefit of the online simulation software for Gassco's subsea network \(PSIG 2013\)](#)

[Tuning of subsea models to optimize simulation accuracy \(PSIG 2012\)](#)

Atmos International (Atmos) provides pipeline leak detection and simulation technology to the oil, gas, water, and associated industries. The company was founded in 1995 in the UK by the inventor of the statistical pipeline leak detection system – Atmos Pipe,

now one of a suite of leak and theft detection solutions from Atmos. These technologies are implemented on hundreds of pipelines in over 50 countries, including major oil and gas companies such as Shell, BP, ExxonMobil, and Total.

With associated offices in the USA, China, Russia, Singapore and Costa Rica, and local agents in 28 countries, the multi-cultural and multilingual team can provide effective support all over the world.

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