Atmos Simulation Suite

Pipeline operators need to respond quickly to ongoing changes in supply and demand. Under emergency situations their actions can be critical to the safe operation of the pipeline. The simulation suite can help them run the pipelines safely and cost effectively at all times.

Why use a simulation system?

Access to unmetered areas - Pipelines with large unmetered areas, such as subsea networks, rely on a simulation system to monitor the behavior of the pipeline. Most subsea pipelines do not have any intermediate measurements available due to the high cost of installation and maintenance.

Forecasting ability - By knowing accurately and confidently that future operating regimes are safe, pipeline operators can run the operations efficiently. Warnings are given if the schedule is likely to fall outside of the allowable operating limits. Operators can control linepack more easily and provide accurate estimated product arrival times to customers.

Revenue Increase - Gassco, Europe's leading natural gas supplier, runs the largest subsea pipeline network in the world. A cost benefit analysis noted a saving of USD 7.5 Million per annum to Gassco as a result of running a few operational scenario simulations each year.

Modelling of a variety of operating conditions - It is able to model the pipeline in a variety of states without having to use multiple tools. It can model low pressure distribution lines as well as high pressure transmission lines.

Training and design - Training can be expensive, a tool that trains operators at their own pace can help reduce the cost. This can be achieved within an offline environment that does not affect the actual operations of the physical pipeline.

Benefits of Atmos simulation suite

Atmos simulation systems use the maximum likelihood state estimation (MLSE) to minimize the simulation error by using the level of confidence in the meters. It differentiates measurements from good quality meters from those that are failing or providing faulty readings. The user is not required to select applicable measurements, which reduces user intervention and increases model robustness.

The real-time modeling (RTM) module provides an 'as it happens' display of pipeline information using the MLSE. It is designed to manage ever expanding network topologies. Following network topology configuration changes the model can be easily stopped and restarted smoothly. Transient and steady state simulations can be used within the same configuration.

Alongside real-time modelling, forecasting capabilities are a key feature of the system. They use the current state as a starting point for analysis of what will happen in the future.

Atmos simulation systems provide a wide selection of industry standard pipe flow equations and equations of state. Different flow equations are available for different pipeline sections within the same model. The help menu provides advice on the selected equation and its best use.

Features of liquid simulation include:

- Can be used for oil, water, multi-product, high pressure ethylene and chemical pipelines
- Predicts and notifies the operator on risks of slack flow
- Operational scenario analysis for planning, emergency or upset analysis
- Models the behavior of multi-product or multi-crude pipelines
- Design and sizing of new pipelines and associated equipment such as pumps, heaters and coolers
- Model-based leak detection and leak simulation

Features of gas simulation include:

- Line pack (inventory) calculation and survival time analysis
- Simulation of natural gas, low pressure ethylene and chemical pipelines
- Different gas compositions can be assigned to different inlets and tracked throughout the network
- Maximum capacity utilization using look-ahead simulations
- Increase of short-term sales using look-ahead simulations
- Notification of off-specification deliveries
- Model-based leak detection and leak simulation

Atmos Simulation Suite includes:

Atmos SIM Online

Atmos SIM Online models the pipeline using real time data from DCS and SCADA systems. It allows operators to monitor areas where there is limited or no instrumentation, such as at mixing and tie-in points.

Forecasting modules allow the operator to view the forecasted behavior in the pipeline and assess the safety of the schedule.

'Look-ahead modelling' shows what will happen if the pipeline continues to operate in its current state. 'Predictive modelling' shows the pipeline's behavior in a variety of future scenarios that can be configured, saved and used again. Alarms can be configured for a variety of set thresholds to determine if the current schedule is likely to violate safe operating conditions. There is an easy to use wizard for creating customized reports of any model calculated property. These reports can then be scheduled for generation at user defined intervals.

Atmos SIM leak detection

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 volume balance is statistically analyzed by the 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%.

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.

Atmos SIM Offline

Atmos SIM Offline is an efficient network building tool with GIS data import functionality. Atmos SIM Offline works independently of any real pipeline control systems and is the ideal tool for design, equipment sizing and locating, operational tuning, capacity planning and training.

During tuning operations, the tuning assistant automates the tuning process by calculating specified parameters to achieve the correct hydraulic behavior. This ensures the model's accuracy without the need of intensive tuning performed by the user. The configured model may also be used for online hydraulic simulations if required.

Atmos Surge Analysis

As an additional module to Atmos SIM Offline, Surge Analysis automates some of the analysis procedures and produces a detailed surge analysis report. This would normally be a huge task for a pipeline operator. It conforms to the US Department of Transport (DOT) requirements, identifying locations where the pipeline is most likely to rupture and which operating conditions would be considered safe.

Atmos Trainer

Different options of Atmos Trainers are available to suit each operator's requirements. Atmos offers everything from a standard Atmos GUI connected to Atmos SIM Offline to a bespoke online trainer fully replicating the SCADA system in line with actual pipeline operations. The latter may even include simulations of emergencies outside the pipeline, such as fire alarms, earthquakes or electrical failures.

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