

Managing Gas Pipelines in the 21st Century

Gas pipelines can carry more gas than they think they can – quite a bit more.



» energy-solutions.com

The yield of existing gas pipeline infrastructure can be increased significantly by enabling a closer interaction – in Real Time – between the technical and commercial activities of the pipeline companies. Equivalent challenges in terms of business processes have successfully been overcome in many manufacturing industries and the tools exist today to capture these opportunities in the pipeline industry.

This paper focuses on how to increase the transportation capacity of existing pipeline assets at minimal additional cost. The potential rewards for pipeline companies and their customers are huge compared to the necessary investments.

Increasing capacity when conditions are near normal can increase revenue for any constrained pipeline. However, it is when the conditions are other than normal that the contributions of a truly integrated decision-support system can make a massive difference in the pipeline's ability to function optimally. Unusual conditions can be caused by changes in external conditions (with suppliers, customers, or shippers), by operational problems on our own pipeline, or by any disruptions on other pipelines that result in a change in the pattern of requests for capacity on ours.

The first phase of integration can improve the traditional scheduling process by including **Hydraulic Simulation** in the day-to-day business operations. It effectively considers the ability of the pipeline to transport gas based on all of the operating flexibility and variables that are available to the operators of the pipeline. Only a hydraulic model can determine the actual flow of gas through and around the constraints while optimizing the use of storage and linepack.

Stepwise Scheduling is a technique that gives the pipeline the ability to more accurately allocate capacity to shippers with higher priority contracts. This is most important when pipeline capacity is below normal and cuts must be made in firm contracts. Experience has shown that, in this situation, making cuts are perceived to be unfair can lead to serious and extremely costly problems with shippers and regulators.

For stepwise scheduling we do the following:

1. Select only the highest priority nominations.
2. Run a hydraulic scheduling simulation to determine how much of these nominations can be carried if they were the only nominations in the pipeline.
3. If we cannot carry all of these nominations, curtail them according to tariff rules so that we determine the maximum set of these nominations that we can carry.
4. Set the results of this simulation as "fixed" for the next run.
5. If there are additional, lower priority nominations, add the next set to the "fixed" list from the previous step, and go back to step 2.
6. Continue until we have scheduled or curtailed all of the nominations.

The ability of a pipeline to transport gas is dependent on both the physical characteristics of the pipe and the facilities and the **State of the Gas** in the pipeline and the gas in storage.

Obtaining accurate initial conditions for the scheduling period using real-time modeling will provide improved results for this process. Running a predictive model based on the current state provides for the most accurate estimate of what conditions will be at the start of the scheduling period.

A pipeline makes money by selling capacity, selling gas, and transporting gas. It does not make money by rejecting or cutting nominations.

Daily Load Forecasting provides another level of precision in the pipeline scheduling arena to provide data where nominations do not exist or are suspect. It can be applied to either supplies or consumptions, but is generally most useful for predicting consumptions, since they are more likely to vary systematically.

Progressing to **Hourly Load Forecasting** can add a significant increase in understanding of what is really going on in your pipeline. Just about every pipeline that has more than a few delivery points has a variety of hourly consumption patterns. Most larger pipelines only require nominations to be provided as daily quantities, but that does not mean that they can't squeeze additional effective capacity out of the pipeline by accurately predicting and planning using estimated hourly flows. Quite the contrary! And most certainly, the demand for new services based on hourly nominations will be growing during the coming years because it is a very cost-effective method to "fill-up" the pipeline.

In this, the final phase, **Long Term Load Forecasting** combines all of our techniques and provides a pipeline with a system that can be used to merge the commercial and technical data and techniques to provide for a truly controlled and efficient scheduling process. In this instance, "long-term" usually means a week, but can be pushed to two weeks if that is important.

The strategy here is to combine daily or hourly nominations, daily load forecasts, and hourly load forecast profiles to predict the precise supply and demand requirements of the pipeline over the period. Performing this kind of scheduling operation requires running of numerous sophisticated simulations in an interactive mode. When this is implemented, however, the net effect is that the pipeline company has:

- Effectively lined up its business objectives,
- Imbedded technical information into the Real Time decision making when dealing with its customers,

- Provided best possible estimates of commercial activity to the engineers, and
- Established operational goals that can actually be achieved in the Control Room

This combination of commercial information and engineering data and applications will accurately predict and plan for safe operation of the pipeline and maximize the ability to transport and deliver gas for the paying customers. The final result is that we have effectively expanded the capacity of our pipeline without building any new compressors or laying a single foot of new pipe.

Compared to the way most pipelines are being run today, some of these techniques sound like they are almost science fiction.

What is required is as follows:

- a pipeline nominations system
- a hydraulics-based scheduling engine simulator
- a curtailment system that knows the pipeline regulations and can run the scheduling engine
- a real-time modeling system that can acquire and massage SCADA data as needed by the model
- a predictive model to forecast start-of-cycle conditions
- a load forecasting system
- a pipeline and compressor optimizer
- a message broker to tie them all together
- a user interface to manage the process

While this list sounds foreboding, the truth is that all of the pieces of this puzzle are available today. For some, these tools may seem like overkill during "normal" operations, but when serious disruptions occur anywhere on the pipeline grid, these tools can be the difference between getting the gas to the consumers, or shutting down major areas of the market.

Not having these tools implemented means you are not getting the most out of your pipeline assets, and you are not prepared for managing your pipeline in the 21st century.

13831 Northwest Freeway,
Suite 235
Houston, TX 77040
United States
tel: 713 782 7500
fax: 713 895 8383

No.2 Guanghua Road
Room 1606, Building B
Sunshine 100
CBD Chaoyang District
Beijing, China
100026
tel: +86 10 51000 382
fax: +86 10 51000 385

Sapthagiri Towers
#408, 4th Floor
1-1--75/1/1 to 6
Begumpet Road
Hyderabad 500016
India
tel: +91 402776 1202
fax: +91 402776 1288

Hastings House, Falcon Court
Preston Farm Business Park
Stockton-on-Tees
TS18 3TS
United Kingdom
tel: +44 1642 677 755
fax: +44 1642 606 655