

2002 Canadian Gas Association

Gas Measurement School
Kelowna, British Columbia

TransCanada's Use Of "Near Time" Measurement For Supply/Demand

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Abstract

Daily supply/demand management of over 12,000,000 GJ's/day of natural gas commodity allocated to 350+ shippers/connecting pipeline operator accounts presents a significant challenge to timely measurement processing. TransCanada uses hourly measurement, automated validation, exception based problem reporting and energy impact based prioritization to meet the demanding "Near Time" supply/demand balancing deadlines.

TransCanada

We are a leading North American energy company, focused on natural gas transmission and power services. Our employees are experts in these businesses. Our network of approximately 38,000 kilometers of pipeline transports the majority of western Canada's natural gas production to the fastest growing markets in Canada and the United States. TransCanada also owns, controls, or has under construction approximately 2,250 megawatts of power. An equal amount of power can meet the needs of more than two million average households.

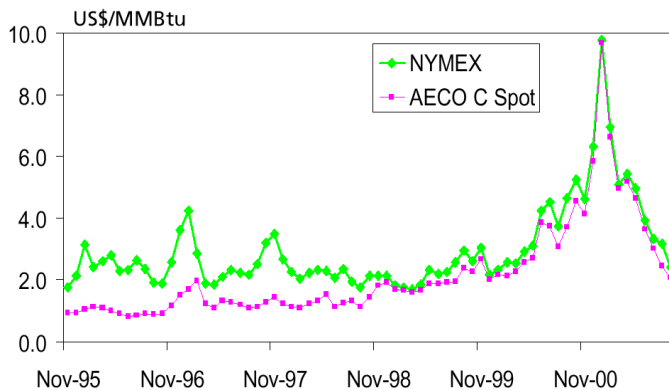
Measurement and Customer Allocation Processes

TransCanada receives natural gas at 950+ major receipt meter stations and delivers at 400+ major delivery stations, 950+ Gas Coop/tap stations, 250+ compressor fuel facilities on its Alberta, Mainline and BC systems. The Gas Measurement System (GMS) hourly validation and material balance identifies in “near time” measurement and imbalance problems. Once an hour ~99% receipt and delivery measurement is collected, validated and finalized. The remaining sites, heating fuel/operating losses and linepack change are estimated along with any sites with significant measurement or communication problems. At the start of each workday field technicians review any stations that haven’t been finalized and analyze the reported problems. In the majority of cases the primary or check measurement can be selected, corrective action scheduled and any data related problems managed with-in a working day.

The next part of this process is to allocate the energy measured at each facility to one or more of the 350+ customers transporting natural gas on TransCanada’s systems. Each customer or operator’s receipt and delivery energy is accounted for at each location they participate in. Energy inventory (“paper gas”) transfer between customers is also accounted for. The difference between all of the receipt and delivery transactions determines the supply/demand imbalance. It should be noted that the quantity of “paper gas” business has grown in Alberta over the past few years. On a typical day it accounts for 1-3 times as much energy custody transfer as the physical receipts.

Market Conditions

Over the past few years supply and demand volatility in the energy and petrochemical sectors has created significant price fluctuations. The temperature related trend of prices increasing for



the winter heating season has always existed. The size of the change has ranged from undetectable to double the average price for a two or three month period.

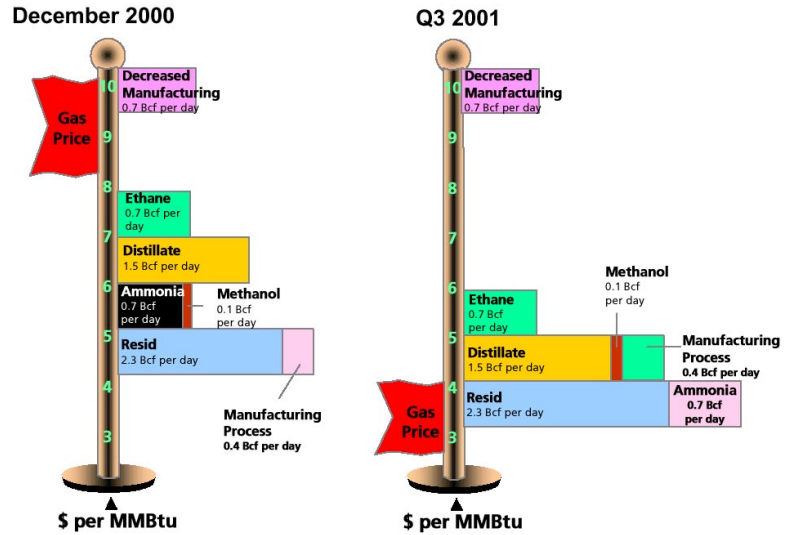
The 2000/2001 winter heating season changed all that. It experienced month to month price changes that were 2 times the historical commodity price and the monthly price peaked at 5 times the historical average.

The fall-out from this significant change to historical prices - **Increased need to match customer supply to demand daily.** Knowing how much production is available to sell, finding buyers and matching the timeframes for all of the remaining business transactions until it reaches its final destination is impossible if the measurement is not accurately known in a timely manner. Buying gas at \$6/GJ and selling it a \$8/GJ may be good but buying it a \$9/JG and selling it at \$7/GJ causes some real customer concern. An even bigger concern is customers thinking they have sold gas at \$10/GJ, only to find out later that the measurement is lower and they didn’t sell what they thought.

If that wasn't enough, in December 2000 the relationship between the price of Natural Gas and Ethane/Natural Gas Liquids (NGL) changed to substantively favor Natural Gas energy. The result, a large number of gas plants significantly changed their process to maximize the production of natural gas energy over NGL.

This resulted in - **Added complexity of gas composition determination.** Gas sampling methodology relies on historical gas plant operation and the

commodity value of the estimate gas sampling error. If the estimated gas sampling error is +/- \$500/month, it is very hard to spend real money to increase gas sampling or install gas chromatographs. However, when natural gas price increases by a factor of 5 or the average price over a month is equal to the historical average price, then the value of this error changes significantly.



Supply/Demand Balancing to Manage Daily Operating Conditions

All pipelines face the Supply/Demand imbalance dilemma – **If Supply doesn't equal Demand, then the difference is made up from linepack change, storage or pipeline to pipeline OBA's (Operating Balance Agreements).** Because supply/demand is the responsibility of the customers transporting gas on each transmission systems, both the Alberta and Mainline systems have established Supply/Demand Balancing processes.

The Alberta System Supply/Demand Process

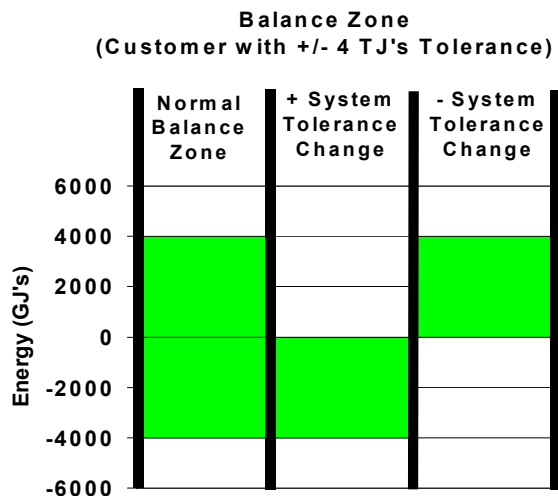
The objective of the Alberta System Supply/Demand process is two-fold: to balance the total system's supply to demand, staying with-in the pipeline's operating linepack range and to balance each customer's supply to demand, minimizing the impact of one customer's imbalance on other customers. Sounds simple enough, but there are 300+ customers who transport gas on the Alberta System, each with different business models. Customers fit into one or more categories of producers, marketers, LDC's, aggregators, government sponsored agencies and petrochemical plants and some defy typical categorization. As a result each customer has varying amounts of physical and "paper" supply and demand.

"Paper gas" is transferred from one customer to another and is like writing a check on one bank

	Example 1	Example 2	Example 3	Example 4
Physical Receipts	0 TJ's/d	100 TJ's/d	50 TJ's/d	100 TJ's/d
Physical Deliveries	0 TJ's/d	0 TJ's/d	50 TJ's/d	50 TJ's/d
Balance Zone	+/- 2 TJ's	+/- 4 TJ's	+/- 4 TJ's	+/- 6 TJ's

account and depositing it to another. These transactions must balance out on the day and are not used in calculating each customer's balance zone. Storage is another account management tools, it isn't used to determine balance zone. What is used to determine the allowable imbalance limits

are physical receipts and physical deliveries which are used to calculate the balance zone. The upper limit of the balance zone is the larger of 2 TJ's or 4% of daily average of the physical receipts plus 4% of daily average of the physical deliveries. The lower limit is the negative of the upper limit.



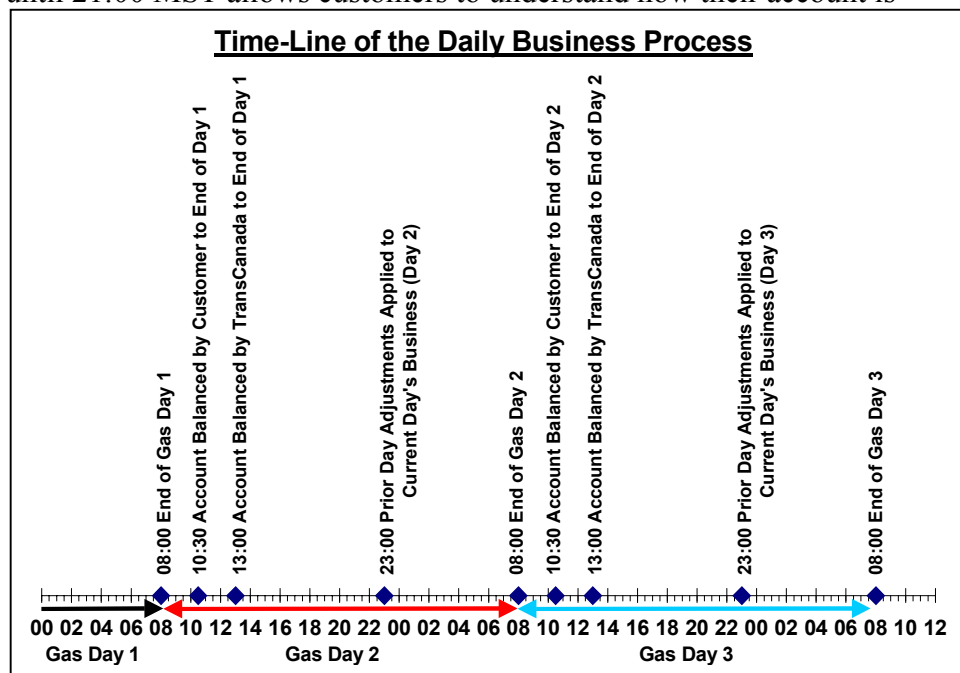
If the pipeline balance is outside of its operating linepack range and is not being managed by the supply/demand process, then a system wide tolerance change will be made. This change adjusts the balance zone of all customers and makes their upper or lower balance zone limit 0 to offset the system's packed or drafted state.

All customers are required to be with-in their balance zone by 10:30 MST for the previous gas day that ends at 08:00 MST. If the customer has not managed their previous day business by 10:30, TransCanada must ensure

compliance by either canceling "paper gas" transactions, decreasing receipt or delivery nominations and/or decreasing receipt or delivery allocations. These changes are made by 13:00 MST and reported to the customer.

At this point business is already 5 hours into today's Supply/Demand management process and customers are focusing on how the current day is shaping up. Measurement for the current day is being collected, the Gas Measurement System is estimating measurement to the end of the gas day and field technicians and the Data Integrity group in Calgary have been busy fixing measurement problems. The corrections for the current gas day are applied as they are fixed, while corrections for previously completed gas days are held and applied at 21:00 MST. Holding the historical changes until 21:00 MST allows customers to understand how their account is changing as they work from 06:00 MST to 10:30 MST buying and selling gas to balance their account for the just closing gas day.

The historical changes are also identified as discretionary changes, allowing them to be managed in the next mornings trading or as part of the next days business.



The Mainline System Supply/Demand Process

The objective of the Mainline System Supply/Demand process is to enable operators to manage supply to match market demand. As with the Alberta System process, it is the operator's responsibility to manage their imbalance to acceptable levels.

There are three main differences between the Mainline System and the Alberta System. The first difference is that the majority of the supply is managed via Operating Balance Agreements (OBA's) with the inter-connecting pipelines. (OBA's manage the differences between measurements and nominations by allowing the pipeline operators to adjust future business to match the cumulative nominations.) These agreements result in the customer getting what they nominate at pipeline inter-connects, eliminating any imbalance at these locations. The second difference is deliveries are managed to each delivery area or physical accounting location. The delivery area is a group of meter stations that are managed as a group, are assigned a single accounting location and have a single operator. The third difference is the services offered by the pipeline such as Short Term Firm Service and Park and Loan enable the operator to manage each location.

Operators are required to manage imbalances at each accounting location on a daily basis to a maximum +/- 2% of the location's throughput. The total cumulative imbalance must also not exceed +/- 4%. Failure of the operator to manage their imbalance results in an imbalance charge being assessed to their bill. These charges are not designed to generate revenue. Their intent is to encourage the operator to manage their imbalances with-out pipeline intervention.

Business Processes Require Measurement to Meet Their Demands for Timeliness and Accuracy

Market Conditions and Supply/Demand processes clearly identify the need for measurement to be accurate and available in "near time". TransCanada meets these demands through the use of Data Collection Systems and the Gas Measurement Systems. These systems provide validated volume, energy, pressure, temperature and gas composition information. The data is update hourly, with-in an hour after the EFM systems have completed their measurement transactions. The data is made available for use by all of TransCanada's business processes from a database that is commonly referred to as Best Station Data (BSD). This process operates 24 hours a day, 365 ¹/₄ days a year.

Hourly Data Collection and Estimation Provide Timely Measurement

The Data Collector Systems collect measurement on an hourly basis from approximately 99% (by Energy) of TransCanada's measurement facilities. These hourly measurement transaction records, along with any event and user change logs, are passed to the Gas Measurement System for processing and validation.

The Gas Measurement System also estimates all facilities to the end of the current gas day and for future gas days based on historical measurement and flow confirmations received from the Gas Measurement System. A side benefit of the estimation process is that any missing measurements, due to communication problems, facilities that are too small to justify communications or stations with major validation problems, automatically use these previously generated station estimates. The process ensures that timely measurement from all facilities is

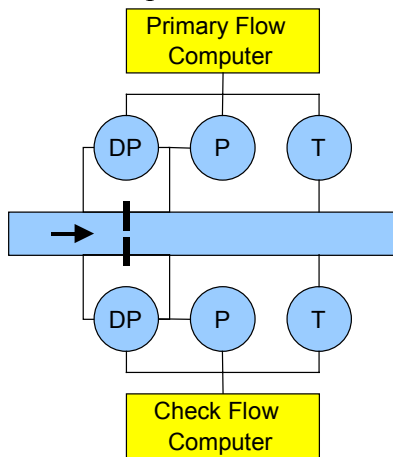
available to the Gas Management System for allocation to the customer accounts on an hourly basis.

Automated Validation - Accurate “Final” Measurement or “Needs Work” Identified

TransCanada’s Gas Measurement System performs station and run level validation checks on all of the measurement it receives. The results of this validation are indicated on all of the hourly measurement records which enables the state of the measurement to be displayed with the measurement. Problem reports are generated for any failed rule. All measurements that pass the validation process are considered final, with the remainder being prioritized and cued for action by the field technician.

Validation of Orifice Check Measurement Systems

TransCanada employs automated check measurement systems at its orifice meter stations. At these stations, one set of pressure transmitters is connected to each of

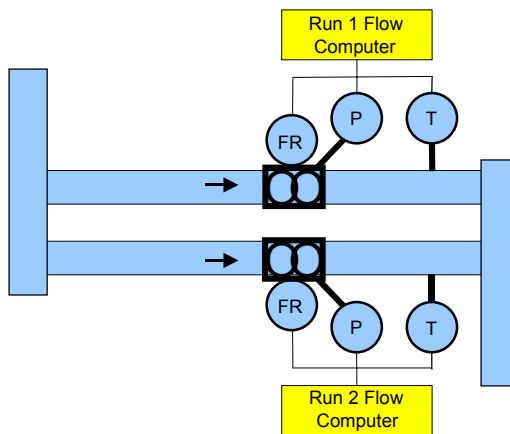


the two pressure taps located on each side of the orifice meter. The transmitters in turn are connected to their own flow computer to perform independent flow calculations. This information is communicated hourly to TransCanada’s central Gas Measurement System where

comparisons are performed to validate energy, volume, pressure, temperature and differential pressure values from the primary and check flow computers.



Validation Multi-run Check Measurement Systems



At multi-run Turbine and Ultrasonic meter stations, check measurement is based on automated Run to Base Run comparisons. One set of pressure and temperature transmitters is installed on each meter run. The transmitters and the pulse output from the meter are connected to a minimum of two independent flow computers. By maintaining a minimum of two runs in service, the flowing runs can be validated against the base run. The Gas Measurement System collects data from these facilities on an hourly basis and directly compares pressure and temperature readings. The volume,

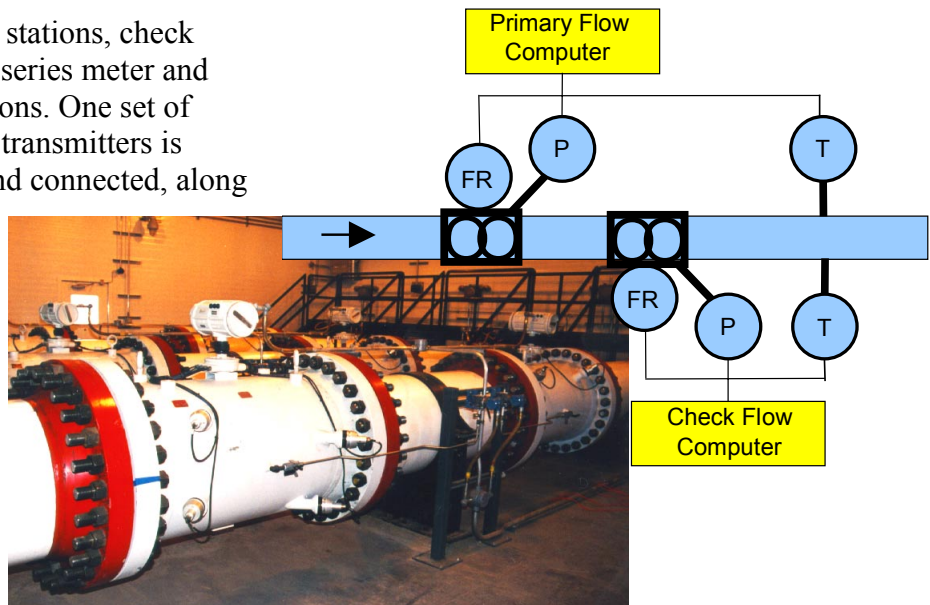
energy and frequency are compared between the flowing runs and the base run using the historical flow split for the meter station.

If one of the flow computers fails, the historical flow split is also used to estimate its flow. This practice increases the reliability of measurement for use in the “near time” business processes and provides for flexibility in scheduling equipment repair.



Validation Series Meter Check Measurement Systems

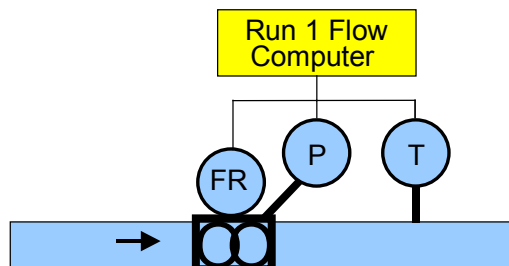
At large Ultrasonic meter stations, check measurement is based on series meter and instrumentation comparisons. One set of pressure and temperature transmitters is installed on each meter and connected, along with the pulse output from the meter, to two independent flow computers. The Gas Measurement System collects data from these facilities on an hourly basis and directly compares pressure, temperature, volume, energy and frequency.



Validation Single-run Previous Day Check Measurement Systems



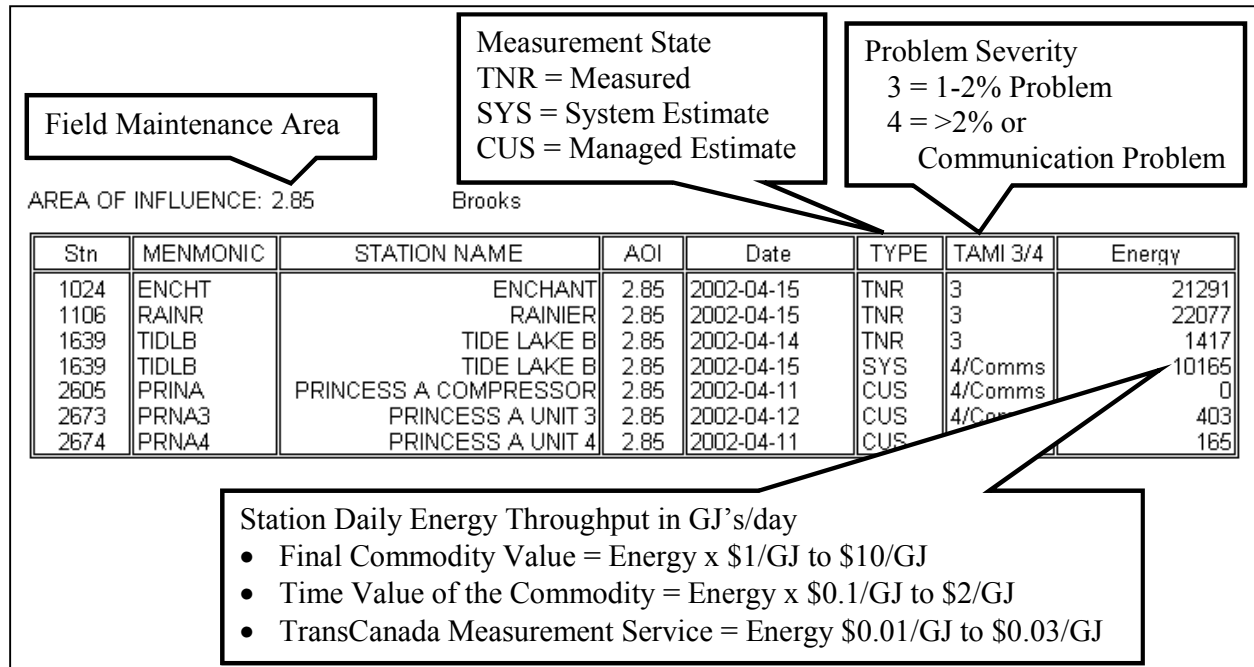
At small volume meter stations, the expense of additional transmitters and flow computers is not economical. Validation checks are still done based on comparison of the current hour and day pressure, temperature, volume, energy and frequency values to the previous hour and day values.



Management Provides "Near Time" Accuracy

Field technicians review the measurement state and validation information for their facilities at the start of each workday. They mitigate the impact of the identified measurement problems on the business process by selecting available redundant measurement to finalize it or managing the measurement estimate to an acceptable value until the measurement can be finalized.

Their next task is to prioritize and schedule any required corrective action. (ie as plate changes or transmitter calibration) This prioritization is based on the size of the facility (daily energy) and the severity of the validation problem.



Summary Report for One Maintenance Area, With Problem Type, Severity and Impact

Conclusion

Measurement plays a key role in TransCanada's daily operation. It's "near time" availability and accuracy enables the 350+ customers transporting gas on our system to move gas 24 hours/day 365¹/₄ days/year, to meet the demanding energy market needs.

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