Natural Gas STAR 2009
Annual Implementation Workshop
October 19 to 21, 2009

Methane Emissions Reductions: Barriers, Opportunities and Possibilities for Oil & Natural Gas

Westin Riverwalk San Antonio, Texas

View more information and register at epa.gov/gasstar/workshops

Partner Profile: TransCanada's Approach to Pipeline Pumpdowns

Natural Gas STAR Partner TransCanada owns over 36,500 miles of pipeline with combined annual throughput of 11.8 trillion cubic feet of natural gas. When a segment of pipeline requires maintenance, gas must be evacuated from the segment to attain safe working conditions, and this gas commonly is released to the atmosphere. Each year, TransCanada must evacuate dozens of segments for pipeline maintenance which represented an opportunity to recover this energy resource, retrieve lost revenue, and reduce methane venting to the atmosphere.

As part of its larger effort to address methane emissions, TransCanada studied pipeline blowdowns for project opportunities. Pipeline pumpdowns capture emissions that would normally have been released before maintenance by evacuating gas from the pipeline segment before maintenance and routing it into an operating portion of the system. Challenges associated with pipeline pumpdowns include additional time required to evacuate gas from a pipe segment compared to blowdowns and acquiring, scheduling, and positioning portable compressors for each pumpdown event.

Given these challenges, pipeline pumpdown is economic and practical for a subset of the maintenance activities requiring blowdowns of natural gas. To identify the economic pumpdown opportunities, TransCanada uses its "Outage Decision Model". TransCanada enters data on key characteristics of the pipeline segment such as pipe diameter, length between segment isolation valves, pressure, and gas value. The model outputs include a determination of pumpdown economics for a given maintenance activity. As a result, TransCanada typically performs 30 pumpdowns per year. TransCanada found that pipeline pumpdown tends to be economical for large volume, high pressure gas line segments and pre-planned maintenance activities.

Once the decision has been made to implement a pumpdown, TransCanada can bring trailer-mounted portable compressors on site typically within a few weeks. TransCanada's portable compressors are a mix of centrifugal and reciprocating units with one or two stages of

compression; drivers range from 0.3 to 4 MegaWatts. By purchasing its own portable compressors, TransCanada rarely requires a third party to provide mobile compression and can recover the investment over multiple pumpdown implementations.

Exhibit 1 shows normal pipeline operations. TransCanada typically has parallel lines with interconnects and isolation valves every 20 to 30 miles. A typical line for TransCanada is 42 inches in diameter and operates at pressures up to 935 pounds per square inch gauge (psig).

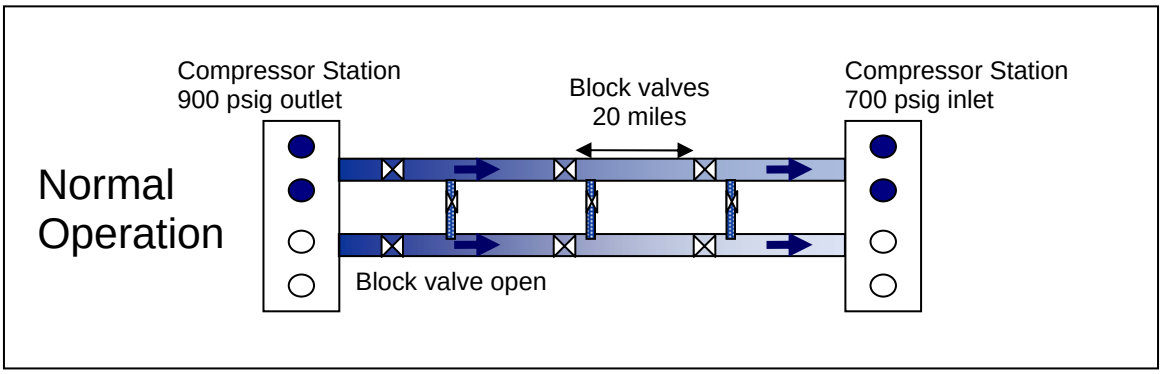


Exhibit 1: TransCanada Pipeline Diagram

The transition from normal operations to pipeline pumpdown operations is shown in Exhibit 2. To initiate a pumpdown, TransCanada blocks flow from entering a segment and draws down the pressure by continuing to run downstream inline compressors. Inline compressors can typically draw the line down to 700 psig. Next, TransCanada blocks the segment entirely by closing the downstream valve. A trailer-mounted portable compressor is attached to the isolated segment and further draws down the pressure to between 80 and 200 psig depending on the suction pressure limitations of the portable compressor. To fully depressurize the segment, the remaining gas at the lowest possible pressure is vented to the atmosphere.

The increased flow through a single line during the pumpdown requires an increase in downstream inline compression and therefore an increase in fuel gas consumption. The entire pumpdown process typically last ten hours, compared to two hours necessary for blowdown.

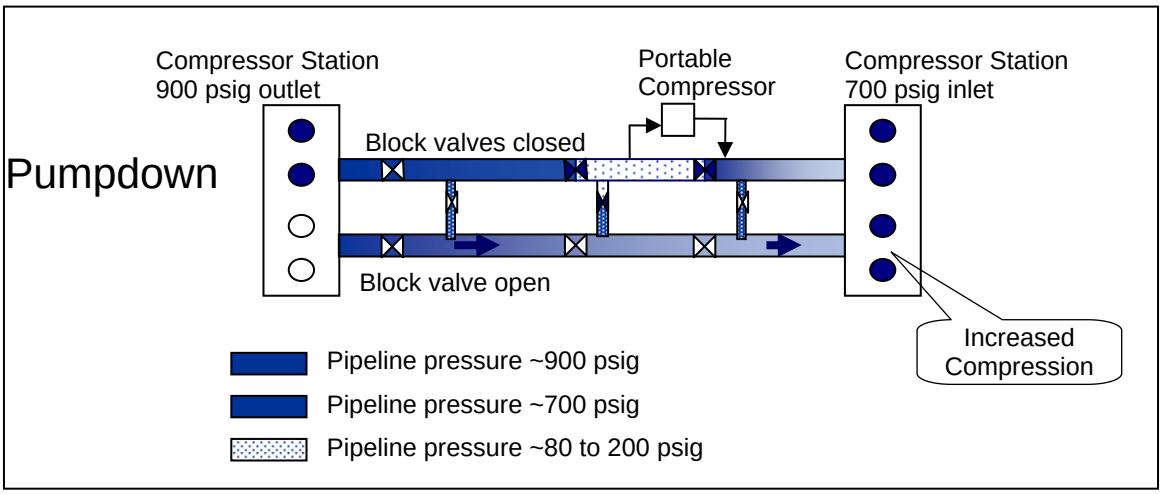


Exhibit 2: TransCanada Pipeline Pumpdown Diagram

To quantify the costs and benefits of a pumpdown, TransCanada values fuel gas and the saved pipeline gas equally. The net gas savings is therefore the recovered volume of pipeline gas less the fuel used for the portable compressor less the increased fuel required for inline compression.

One implementation on a 20-mile segment of pipeline as described above netted savings of over 49 million cubic feet of natural gas. The success of pumpdowns has resulted in TransCanada's purchase of 8 trailer-mounted, road-ready portable compressor units for use mainly on its high pressure lines in Canada. Future opportunities include expanding its fleet of portable units and implementing this practice company-wide, including the U.S. TransCanada has realized several benefits from this practice including increased revenue and decreased methane emissions.

Natural Gas STAR 2009 Emissions Reductions: Continuing Success

Natural Gas STAR Partners accelerated the pace of their methane emission reductions over the past year. As the 2009 reporting season closed, domestic U.S. Partners reported methane emission reductions of almost 115 Bcf in 2008. International Partners, in their second year of reporting, recorded over 51 Bcf of 2008 methane emission reductions. These voluntary emission reductions demonstrate the continued effectiveness of information sharing and technology transfer among worldwide Partners within the Program.

Natural Gas STAR Partners have operations in all of the major industry sectors—production, gathering and processing, transmission, and distribution—and represent 60 percent of the natural gas industry in the U. S. With the launch of international participation in 2006, the Program expanded to include companies worldwide, significantly increasing opportunities to reduce global methane emissions from oil and natural gas operations. Currently, the Program has over 130 domestic Partners, including 12 international Partners.

Natural Gas STAR Partners have implemented over 80 different technologies and practices since the inception of the program 16 years ago. Top technologies and practices implemented by Partners in 2008 include:

- Production: Reduced emissions completions
- Gathering & Processing: Aerial leak detection
- Transmission: Use of fixed/portable compressors for pipeline pumpdowns
- Distribution: Survey and repair leaks

More information on the overall achievements of Natural Gas STAR Partners will be posted on the Accomplishments page of the Gas STAR web site at epa.gov/gasstar/accomplishments/index.html.

Prospective Projects Spotlight: Potential Membrane Applications for Dehydration Can Reduce Methane Emissions

A U.S. Department of Energy funded study[1] can help producers and processors of natural gas consider membrane dehydration processes, which can operate with less product loss and vent less methane to the atmosphere than other established dehydration processes. One key finding of the study's economic evaluation was that membranes can viably compete with glycol dehydrators at lower throughputs, such as with gas feed rates less than 10 million cubic feet (MMcf) / day.

Dehydration is necessary to remove water vapor from produced gas to meet pipeline specifications. One common type is glycol dehydration which circulates glycol to absorb water from the gas stream. The water is released by regenerating the glycol with heat. Major losses from glycol dehydrators are the venting of methane absorbed along with water and the venting of methane from pneumatic glycol circulation pumps and pneumatic control valves. Natural gas glycol dehydrators in the U.S. production sector were estimated to emit 17 billion cubic feet in 2007[2], worth $119 million when valued at $7/Mcf. This represents a significant opportunity in terms of gas sales value or as a greenhouse gas emissions reduction value.

Membranes have been in service in other separation processes for decades, and their feasibility for replacing solvent-based natural gas dehydration processes is increasing due to advances in selectivity, low operating costs, and the value of reduced methane emissions. Advantages of membranes are that they:

- are capable of dehydrating natural gas high in water vapor content to pipeline quality.
- can often direct the permeate gas to the on-site fuel gas system.
- are mechanically simpler than a solvent process.
- have no direct continuous venting and have less expected methane losses to the atmosphere than with glycol dehydration.

Barriers to employing membrane separations are that they are not well-established for natural gas dehydration and require some pre-treatment of the gas to remove particles that can potentially foul the membrane. Further, the gas must be at high pressure as a driver for membrane separation of the water; however, that pressure is not lost in the dry product gas.

With these barriers in mind, the 2003 Department of Energy study developed high performance composite membranes and compared their performance against a traditional glycol dehydrator in a gas treatment facility. The study's economic evaluation compared costs of a membrane configuration to glycol dehydration. The membrane configuration consisted of a pretreatment, a membrane, and a permeate compressor. The pretreatment removed liquids to prevent degradation of membrane performance. The membrane took wet feed gas and outputted a

[1] DOE. *Novel Composite Membranes and Process for Natural Gas Sweetening*. March, 2003. DE-FC26-99FT40497.
[2] EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sink: 1990 – 2007*. April, 2009. <http://epa.gov/climatechange/emissions/usinventoryreport.html>.

product stream of dry gas and a permeate stream containing water. The permeate compressor recycles most of the permeate stream into the membrane inlet.

Comparisons to glycol dehydration were developed at 1, 5, 50, and 100 MMcf / day. The report's economic analysis of membrane performance compared to glycol dehydration concluded that the developed membrane process was competitive with glycol dehydration at feed rates less than 10 MMcf / day.

Membrane dehydration can be further investigated as a solution that enables reduced methane emissions and that may be well suited for remote locations with lower throughputs. We would like to hear from you on your implementation experiences. If your company has already implemented this project or wishes to further explore this concept further, please contact Jerome Blackman (blackman.jerome@epa.gov) or (202) 343-9630.

Climate Policy Update:

Climate Legislation Panel Discussion To Be Held at Annual Implementation Workshop

Natural Gas STAR strives to keep its stakeholders updated on climate change policy issues, and a portion of the October 19 to 21 Annual Implementation Workshop in San Antonio, Texas, will be devoted to a climate legislation update panel. The purpose of the panel is for the U.S. EPA to provide updates to current and recently proposed climate legislation including the Endangerment Finding published April 24 and whose public comment period ended on June 23. The panel will also discuss the proposed U.S. Mandatory Greenhouse Gas Reporting Rule status. Panel members participating in the discussion will include representatives from U.S. EPA's Climate Change Division, including the Climate Change director, a representative of the Climate Economics Branch, and the team leader of the Natural Gas STAR Program. A detailed question and answer session for participants will be included as part of the panel discussion, which will be held on Wednesday, October 21.

Mandatory Reporting Rule Update

The mandatory greenhouse gas reporting rule package is currently with the Office of Management and Budget. U.S. EPA is working to finalize the rule so that reporting entities would begin collecting data for reporting on January 1, 2010. After rule finalization, an extensive outreach and training effort will occur. Additional information on the rule will be available at epa.gov/climatechange/emissions/ghgrulemaking.html.

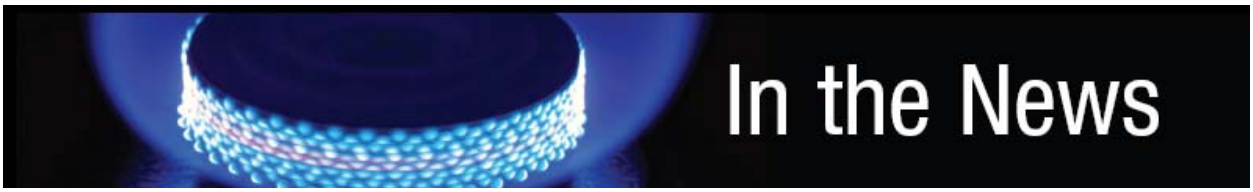
New Partners

Empresa Nacional del Petroleo (ENAP), ENAP Sipetrol S.A. & ENAP Sipetrol Argentina SA

State-owned Chilean company Empresa Nacional del Petroleo (ENAP) & ENAP Sipetrol S.A. (international affiliate of ENAP) are the newest Natural Gas STAR International Partners. ENAP carries out activities throughout the value chain in the oil industry, from exploration to end use consumption. ENAP and ENAP Sipetrol's total production averages 17,852 barrels of oil per day and 206.8 million cubic feet of gas per day.

ENAP Sipetrol S.A., the international subsidiary of ENAP, was founded in 1990, for exploration and production activities outside of Chile. At present, this subsidiary carries out production activities in Argentina, Ecuador and Egypt.

Created in 1991, ENAP Sipetrol Argentina S.A. is the Argentine affiliate of ENAP Sipetrol S.A and is the main offshore operator of the country. ENAP Sipetrol Argentina S.A. has built, installed, and now operates six oil and gas platforms in the outlet of the Magellan Straight. Its operating interests are in the Magallanes, CAM 2/A Sur, Austral Basin E2, and Pampa del Castillo-La Guitarra areas of Argentina. ENAP Sipetrol Argentina S.A. is also a non-operating partner in development of the Campamento Central-Cañadón Perdido area.



Georgia Joins Methane to Markets

Since the Partnership's founding in 2004, Methane to Markets has expanded to include 30 national governments, as well as the European Commission. The Partnership welcomed its newest member, Georgia, in August. As the Partnership continues to grow, so does its potential annual methane emission reductions. The U. S. estimates that within 10 years, the Partnership has the potential to deliver estimated annual methane emission reductions of more than 180 million metric tons of CO_2 equivalent.

2009 Annual Implementation Workshop Information

Workshop Exhibitors

2009 Natural Gas STAR Annual Implementation Workshop

The 2009 Natural Gas STAR Annual Implementation Workshop will feature exhibits from over a dozen vendors and service providers this year. The exhibit area will be set up outside of the Navarro Ballroom in the Westin Riverwalk for both full days on October 20 and 21, 2009. The following exhibitors will have booths at this year's workshop:

- Chicago Climate Exchange
- COMM Engineering
- Compressor Engineering Corporation (CECO)
- Cook Compression
- Emission Reduction Systems
- FLIR Infrared Cameras
- Fluenta, Inc.
- Gulf Coast Helicopters, Inc.
- Hy-Bon Engineering, Inc.
- ITT – ANGEL Services
- NDTrak
- Pergam Technical Services
- Questor Technology, Inc.
- TXAM Pumps, LLC
- Weatherford International

2009 Natural Gas STAR Annual Implementation Workshop Sponsorship Organizations

Sponsorship allows us to keep our meal fee affordable while providing attendees with coffee breaks, great food and beverage, and fantastic networking receptions.

Thank you to the following organizations who have currently pledged their sponsorship for the 2009 Annual Implementation Workshop.

- **Platinum Sponsor**
  - Interstate Natural Gas Association of America
  - NDTrak
- **Gold Sponsor**
  - ITT – ANGEL Services
- **Silver Sponsor**
  - American Petroleum Institute
  - Devon Energy
- **Bronze Sponsor**
  - TXAM Pumps

If you are interested in sponsoring the workshop or have any questions, please contact Mark Grady (meetings@erg.com) or call (781)-674-7313.

http://www.epa.gov/gasstar/workshops/annualimplementation/2009.html

Technology Spotlight: Upcoming Natural Gas STAR Publications

Natural Gas STAR is developing several pieces for publication or exhibition at upcoming venues.

- Pipeline & Gas Journal. New Measurement Data Has Implications For Quantifying Natural Gas Losses From Cast Iron Distribution Mains. An upcoming article discusses fugitive emissions from cast iron distribution lines and new measurement data on leak rates.
- World Gas Conference October 5 to 9, Buenos Aires, Argentina. Methane's role in promoting sustainable development in the oil and natural gas industry. Natural Gas STAR will be exhibiting a paper reporting on proven methods to reduce methane emissions and increase sales revenues. Case studies will be provided on Pemex, Encana, Pluspetrol, and Gazprom.
- The SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, April 12 to 14, 2010, Rio de Janeiro, Brazil. Natural Gas STAR will be presenting a paper on ideal offshore facility design to minimize methane emissions and maximize gas capture and sales opportunities.

Upcoming Events Map

Below are scheduled Natural Gas STAR Program events. For updates and further information, visit epa.gov/gasstar/workshops. Additionally, are you a Natural Gas STAR endorser and have an event you would like listed here? Please notify Jerome Blackman (blackman.jerome@epa.gov).

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