KEYSTONE ENERGY FORUM

Unconventional Natural Gas Infrastructure Development in Pennsylvania

There are four basic components to the natural gas business: (1) exploration and production (E&P), or "upstream" operations; (2) natural gas gathering, treating and processing, or "midstream" operations and services; (3) natural gas transportation, or "downstream" services; and (4) local distribution services.

The process of connecting an unconventional, or shale, natural gas well to pipelines to deliver the gas to businesses and homes includes several intermediate steps to gather the natural gas from a number of wells in an area, treat and process the gas as needed (to remove moisture, contaminants and natural gas liquids such as ethane, propane and butane), and transfer it to an interstate transmission pipeline. From there, natural gas can be delivered to local distribution companies that supply it to consumers.

Drilling activity in the Marcellus Shale began a steady climb in 2008, with 6,100 wells drilled between then and the end of 2012. Infrastructure development is now catching up to this initial development, connecting more wells to consumers.

From Production Operations: Gathering Lines

The first phase in moving unconventional natural gas from production operations to market is the completion of gathering lines that collect the gas from a number of individual well locations. Unconventional gas gathering lines may be from 4-30 inches in diameter, and are placed in the ground, like other pipelines. Rights of way for these lines must be negotiated between natural gas producers and property owners prior to their construction. A number of wells completed early in the development of the Marcellus Shale needed to await gathering lines, with an estimated 600 completed but "shut-in" wells coming into production in the last six months of 2012.

Companies that build gathering (or midstream) lines construct them to federal Pipeline and Hazardous Materials Safety Administration (PHMSA) standards and must meet be meet specific pressure testing and standards based on the type of pipeline material (steel, copper, plastic) and pressure of gas flowing through the lines. Except in the most rural areas, these lines are subject to regular inspections by federal and state regulators to ensure long-term integrity and safety. Meters are used to track the amount of gas entering a midstream system from each production operation.

Midstream Treatment and Processing

In some cases, "raw" natural gas off the wellhead can be placed into an interstate transmission line with minimal treatment (compression and dehydration, or drying) for distribution to end users, but most natural gas must undergo some processing through midstream operations and facilities to be suitable for consumption by end users.

In Pennsylvania, midstream pipeline companies and services are not regulated as public utilities or public utility services, but the facilities are subject to stringent EPA air emissions standards. Midstream companies have an excellent record of safety, based on rigorous testing of equipment and adherence to independent quality standards that are the most advanced in the world.

FAST FACTS

- Approximately 1,200 shale wells in Pennsylvania were connected to pipelines and put into production in 2012, bringing the total number of wells online in the Commonwealth to 6,100.
- On average, the construction of a single mile of natural gas pipeline requires the investment of $1 million.
- There are approximately 190,000 miles of gathering lines currently in operation around the United States, which are maintained according to industry and federal standards.

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The second phase of midstream operations involves processing the natural gas at centralized facilities, as necessary. The amount of processing required is dictated by the makeup of the gas, including the heavier hydrocarbons (natural gas liquids (NGLs), such as butane, propane and ethane) it contains. This is often called "wet" gas.

A cryogenic processing facility first "strips" (or separates) the NGLs from the natural gas and removes other potential impurities, such as carbon dioxide, that may be found in the raw gas. These facilities subject the gas to temperatures as low as -150°F to recover over 90% of the NGLs present. The natural gas can then be placed into transmission lines, one step closer to the burner tip in homes and businesses.

There are approximately 570 natural gas processing facilities in the United States, with more being built to support the increase in production from areas such as Pennsylvania.

The NGLs require further processing to separate them, a process known as fractionation. Fractionation has nothing to do with hydraulic fracturing or well stimulation. It is a process that uses heat to separate a raw NGL stream into pure NGL products. Raw NGLs contain ethane, propane, butanes and natural gasolines, all mixed together.

Through the fractionation process, the ethane, propane, butane and natural gasolines are separated from one another so that they may be sold to end users. Ethane is used to make petrochemicals, propane to heat homes and also to make petrochemicals, while butanes and natural gasolines are used in the gasoline refining process and as diluents for heavy Canadian crude oil.

Natural gas from the Marcellus Shale in the northcentral part of Pennsylvania typically requires less midstream processing than that found in southwestern Pennsylvania counties, which contains marketable levels of NGLs. The Utica Shale, extending from Pennsylvania's western counties into eastern Ohio, also contains valuable amounts of oil and NGLs.

Interstate Transmission Pipelines and Storage

The next phase of infrastructure to move natural gas to end users is the system of interstate transmission lines and natural gas storage fields operated by federally regulated companies. Transmission lines extend across the country, including a number of lines in Pennsylvania that had connected northeastern population centers to traditional large natural gas producing states in the southern and western United States.

Those transmission lines are now receiving significant volumes of natural gas from Marcellus Shale wells, with many undergoing expansion to supply gas from Pennsylvania to other states. Authorization for interstate lines lies with the Federal Energy Regulatory Commission (FERC). Companies seeking to build new lines or improve existing transmission lines must follow a regimented process under FERC's regulations to undertake construction of those lines. The U.S. Department of Transportation (through PHMSA) oversees the long-term safety of interstate transmission lines once they are built.

Interstate transmission companies also operate nearly 400 underground natural gas storage fields around the country, which have been in place for decades and are used to store gas during periods of the year when usage is low. Large quantities of natural gas can pumped into these old, formerly producing formations under controlled conditions and held in place for several months, then extracted when needed to meet periods of peak demand. A total of 40 storage fields are in use in Pennsylvania today.

Local Distribution

The final phase of infrastructure to move natural gas to end users is the system of distribution pipelines and customer services lines operated by public utilities and regulated by the Pennsylvania Public Utility Commission.

Safety and Environmental Protection as a First Priority

Every part of extracting natural gas from geologic formations and delivering that energy to the burner tip is driven by a culture focused on safety and the protection of the environment and natural resources. Gathering and transmission lines are built according to safety standards established by both industry organizations and regulatory agencies, and rights of way are inspected and maintained to ensure pipelines are not compromised by vegetation growth or unpermitted structures. Operators also maintain regular communication with property owners along their rights of way regarding the safety of pipelines and facilities.

Treatment and processing facilities are engineered and constructed with redundant safety systems, and personnel working at those facilities keep current with all safety training requirements for the industry.

Pipeline rights of way are marked, maintained and regularly inspected by midstream operators to ensure the safety of the line.