

# ARGONNE NATIONAL LABORATORY

Infrastructure Assurance Center (IAC)

## NGtools — Natural Gas Infrastructure Toolset



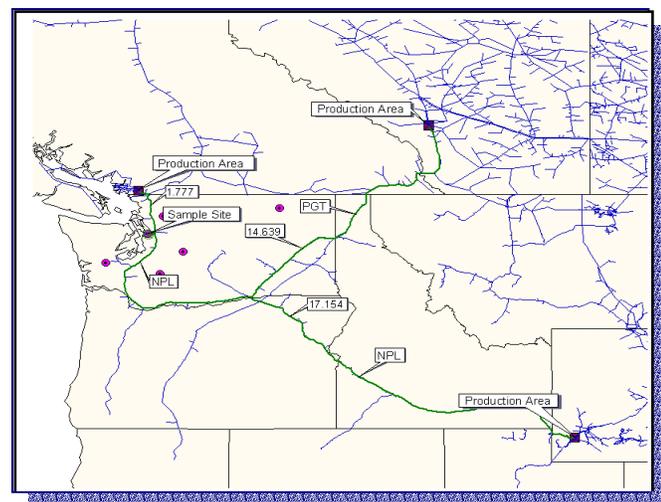
**Opportunity:** In 2000, natural gas accounted for 24% of the energy consumed and 27% of the energy produced in the United States. Natural gas is the largest energy source consumed in the residential sector and fastest growing energy source for electricity generation. The natural gas network is a complicated system with many players that interact through a complex system to ensure safe and reliable service. Interdependencies with other infrastructures, notably electric power generation, have resulted in the need to develop a better understanding of the overall system and its limitations and potential weaknesses.

**Argonne Approach:** The IAC has developed a suite of tools (NGtools) to represent the physical components of the natural gas network. NGtools allows the analyst to quickly access, review, and display components of the natural gas network. This versatile toolset also allows the analyst to perform varying levels of component and systems analysis and display analysis results. The toolset consists of four models:

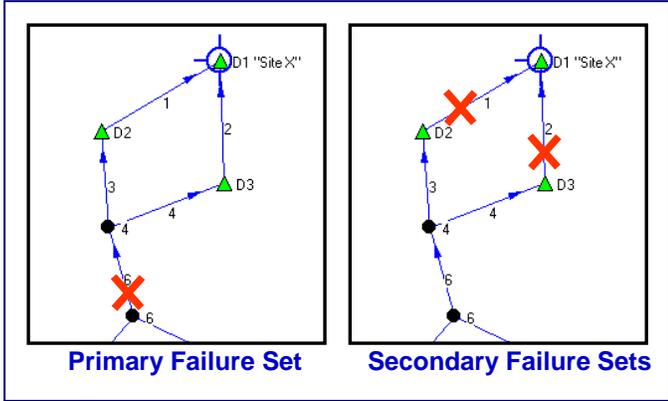
- NGANalyzer
- NGcut
- NGflow
- NGdepletion

**NGANalyzer:** NGANalyzer assists in analyzing gas system characteristics and vulnerabilities. Key considerations include the number of city gates, available storage, and pipeline capacity and interconnections. The figure below shows an example of the shortest path distance from major gas supply areas to a sample site as calculated by the model.

Once an area view has been assembled with either a geographic information system (GIS) or schematic view, an analyst can select other tools to identify critical components (NGcut), potential loss of pressure (NGflow) and estimated time for pipeline depletion (NGdepletion).



**NGcut:** NGcut identifies network component failure sets that could isolate a specific location or site from its supply sources. One of the primary benefits of using this model is that it significantly decreases the time needed to analyze site isolation issues by automating the construction of failure sets. The model also allows analysts to consider a larger number of failures and to broaden an analysis.



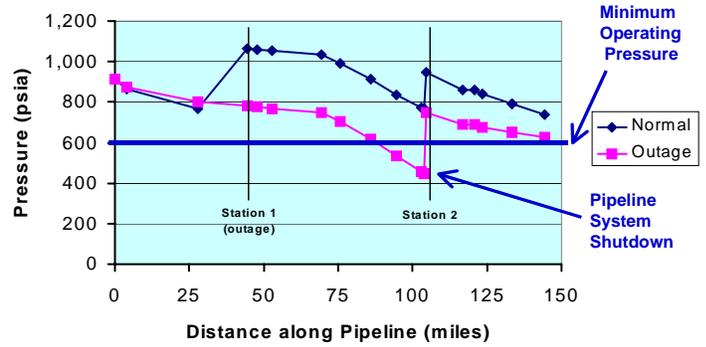
**NGflow:** Failure sets identified by NGcut provide an initial group of components that require closer examination. NGflow identifies critical links and nodes in a network topology. It also provides an alternative to using very detailed, data-intensive commercial flow simulation models.

NGflow simulates steady-state gas network flows and provides gas flow movements under various operating conditions based on gas flow balancing algorithms and available system flow data. The model also gives a unique snapshot of the gas transmission infrastructure that supports a certain location or site.

The model addresses central issues such as: Can the system continue to deliver natural gas to a certain location or site if a key city gate is disrupted under both average- and peak-day conditions? NGflow uses standardized industry equations and publicly available data sources

**NGdepletion:** NGdepletion addresses outage duration times and determines whether and

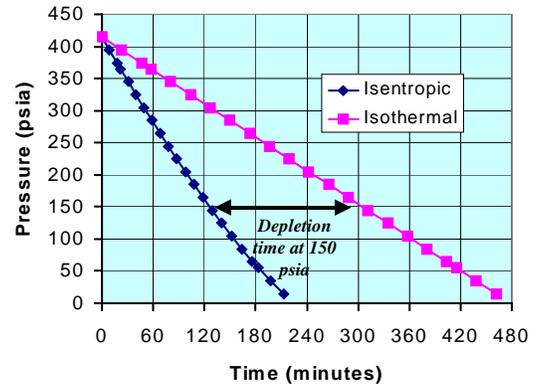
Pressure Along a Pipeline System  
Loss of a Compressor Station



when a component outage will affect a specific location or site. The model computes the amount of time that line pack can continue supplying gas to a site.

**Additional Applications:** NGtools are also used in studies of electric power-natural gas interdependency issues. As these infrastructures become increasingly dependent on one another, analysis of interdependencies becomes even more important.

Gas Depletion Analysis, Annual Average-Day Conditions



For further information, contact:

**James P. Peerenboom**  
Infrastructure Assurance Center  
Argonne National Laboratory  
9700 S. Cass Avenue, Bldg. 900  
Argonne, IL 60439, USA

phone: 630-252-8994  
fax: 630-252-6073  
email: jpeerenboom@anl.gov  
internet: dis.anl.gov

Argonne National Laboratory is a U.S. Department of Energy research center operated by the University of Chicago.