Argonne NATIONAL LABORATORY

Infrastructure Assurance Center

NGFast: rapid assessment of impacts of natural gas pipeline breaks at U.S. borders and import points

Challenge

Our nation relies on natural gas to meet about 22% of its energy needs. Within the next 10 years, the use of natural gas is projected to grow by 50% — making security of this resource increasingly important.

Natural gas is transported from production fields and import points to consumers nationwide via high-pressure interstate pipelines. In an emergency involving a pipeline disruption, whether it be natural or man-made, quick response is necessary to limit the impact of the event. Existing modeling systems take days to provide essential assessment data following an event like a pipeline break or a reduction in pipeline flow (resulting from either compressor damage or a low-output condition in production fields brought about by hurricanes or freezing rain).

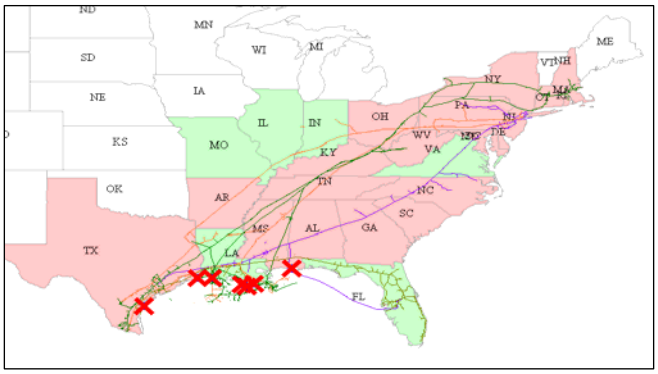

Figure 1 – Actual graphic NGFast output (× indicates the location of a pipeline break; affected states are in pink)

Solution

NGFast is a new simulation and impact-analysis tool developed by Argonne National Laboratory. This powerful tool allows for rapid, first-stage assessment of the impacts of major pipeline breaks and reductions in flow from import points and production fields. Within minutes of a break, NGFast can generate HTML-formatted graphics and tabular reports to supplement briefing materials for state and federal emergency responders. The model provides summaries, as well as detailed reports (pre-and post-disruption conditions).

This new application is a linear, steady-state model that can handle multiple disruption points across many pipelines in several states (Figure 1). NGFast maximizes the use of publicly available information to perform relatively straightforward, but insightful, analyses of pipeline disruptions. The model has the flexibility to modify flow and load patterns and to reorder mitigation and load-shedding implementation strategies.

Capabilities

An Analysis Tool

For a postulated flow disruption in a specific border point and month of year, NGFast assesses:

- States affected (uncompensated and compensated)
- Local distribution centers (LDCs) affected in each state
- Load shed per customer class per LDC
- Number of customers per class type
- Megawatts of electric power plants affected
- Actions taken to minimize impacts

An Information Retrieval Tool

For selected pipelines and months of the year, NGFast provides:

- Information on normal systems operations
- Pipeline structure and load connectivity
- Spare mitigating capacity information (including underground storage tanks and liquefied natural gas [LNG] production facilities) for each state served by pipelines

Benefits

NGFast can be used to understand the interdependency implications of a scenario, particularly the impacts on the electric infrastructure. Further, it is useful for assessing the adequacy of mitigating measures taken to address a specific disruption event. It can also be used to study policies that govern the prioritization of these mitigating measures, as well as to evaluate load-shedding schemes. Finally, it is useful in quantifying the impacts of impending disasters, providing the basis for evacuation decisions and early warning actions.

NGFast – A National Model

The NGFast database includes:

- 80 interstate pipelines
- 1,800 local distribution companies
- 800 U.S. state border points
- 5,720 underground storage facilities
- 105 liquefied natural gas storage facilities

The data set represents about 95% of existing interstate pipelines, about 90% of existing utilities, and 100% of pipeline state border points, underground storage facilities, and LNG facilities.

Applications

NGFast has been applied to a number of studies, including (1) a study that addressed the impact of a postulated earthquake event along the New Madrid fault (Figures 2 and 3), and (2) analysis of a 2007 exercise scenario in which flooding of the Savannah River along the South Carolina/Georgia border caused a 25% reduction in flow through a major pipeline (Figures 4 and 5).

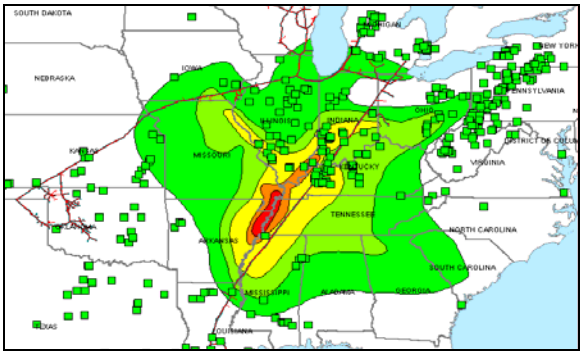

Figure 2 – New Madrid seismic zone

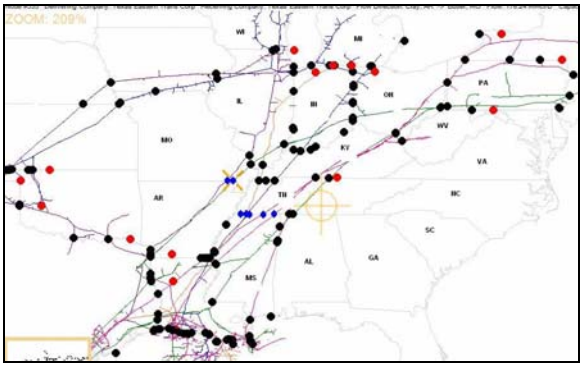

Figure 3 – Pipeline breaks (blue dots) resulting from the earthquake, which simultaneously affected six major pipeline systems

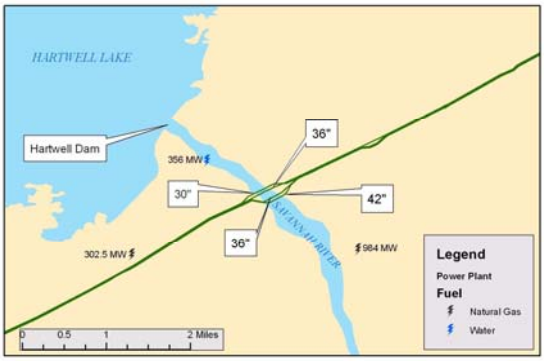

Figure 4 – Savannah River flooding and affected pipeline

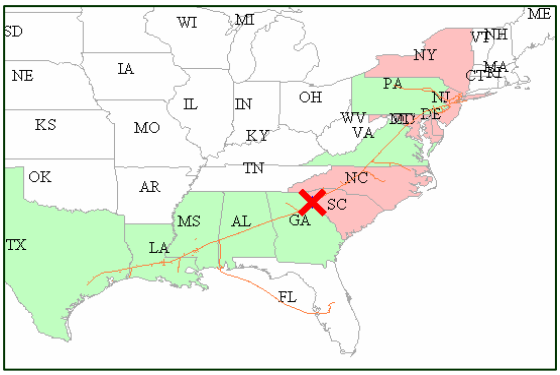

Figure 5 – Graphic output from NGFast simulation showing pipeline and point of disruption

Future Developments

Argonne's Infrastructure Assurance Center plans to continue to improve the NGFast model. Future developments include the following:

- Port NGFast to "real-time" data sources by using web-based electronic bulletin boards published by interstate pipeline companies
- Incorporate full capability to identify individual electric power plants at risk from natural gas outages caused by a postulated pipeline break
- Develop a universal test system using real historic incidents
- Incorporate capability to perform detailed link-node level simulations within each U.S. state

For more information, contact:

Stephen M. Folga (sfolga@anl.gov) or
Edgar Portante (ecportante@anl.gov)
Decision and Information Sciences Division
Infrastructure Assurance Center
Argonne National Laboratory
9700 S. Cass Avenue, Bldg. 900
Argonne, IL 60439, USA

Learn more about NGFast and other Argonne-developed models at:
http://www.dis.anl.gov/

A U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC