

Power Generation and Fuel Diversity in New England: Ensuring Power System Reliability

Dependence on Natural Gas

As demand for both electricity and natural gas continues to grow in New England, the region will need to implement strategies to increase gas supplies through pipeline and liquefied natural gas (LNG) infrastructure and manage electric and gas peak demand through conservation, demand response and switching to alternative fuels. The success of these strategies will have significant impacts on the reliability of the power system, especially during extreme cold weather conditions. Effective wholesale electricity market rules play an important role in achieving these goals.

The addition of approximately 10,000 MW of gas-fired generation since 1999 has contributed significantly to the region's growing dependence on natural gas. Consider that approximately 40 percent of the region's installed generating capacity burns gas as a primary fuel, up from approximately 17% in 1999. Similarly, 30% of total electricity produced in New England in 2004 was produced by generators using natural gas as a primary fuel, up from 15% only five years ago. This trend is expected to continue with the commercialization of additional gas-fired generators, the conversion of existing generators to gas, and the deactivation or retirement of existing oil- or coal-fired generators.

More than 40% of New England's total annual natural gas demand goes toward the production of electricity, which has implications for wholesale electricity prices. In 2004, generating units that burn only natural gas set the price in the wholesale electricity market 55% of the time, and units that can burn gas or oil set the price 85% of the time. In 2004, natural gas prices were up 82% from 2002 levels, which drove wholesale electricity prices higher.

Interstate natural gas pipelines meet the majority of the region's annual gas demand, however, New England sits at the "end of the pipeline." LNG is a critical supplement to traditional natural gas pipeline supply since it allows for the direct injection of natural gas into the growing New England gas market. Approximately 20% of New England's annual gas supply comes from LNG, and LNG supplies approximately 30% of the New England's peak day requirements in winter.

Additionally, more than 60% of the region's electricity supply is derived from either gas or oil. New England's limited ability to import electricity over the transmission system and its lack of indigenous fuel supplies make the region especially vulnerable to fuel supply disruptions and price volatility.

Recent Analysis, Projections and Operating Experience

The U.S. Department of Energy projects that natural gas consumption in New England will grow at an annual average rate of 1.38% between 2004 and 2024 and demand for natural gas in the power generation sector is projected to grow by 1.48% annually over the same period. At the same time, producers in the Gulf Coast, western Canada and Atlantic Canada have encountered

accelerated depletion trends in traditional gas-producing basins and lackluster production off the coast of Nova Scotia, relative to producers' initial expectations.

Recent reports by state and federal governments and business groups project that 2010 will be a pivotal year for gas supply in New England. The region is generally expected to have adequate, although tight, gas supplies through 2010, assuming full availability of the region's existing natural gas infrastructure. Yet, additional infrastructure will need to be in place by 2010 to meet future natural gas demand. Some analyses are less optimistic and project shortfalls by 2007 without additional infrastructure.

Additionally, more than 9,000 MW of new gas-fired generation is projected to be commercialized in New York, Ontario and Quebec by 2008, which will directly impact the availability and price of gas for power plants in New England.

ISO Analysis and Operating Experience

New England's January 2004 Cold Snap demonstrated the interdependencies in the wholesale electricity and gas markets and identified the limitation of serving coincident natural gas demand from traditional local gas distribution companies (LDC) and gas-fired electric generators under extreme winter conditions. Wholesale electricity spot market prices were generally below the variable cost levels needed to encourage gas-fired generators to buy gas in the gas spot market, which prompted significant outages of gas-fired units. Nearly 9,000 MW of generation was unavailable during the electric system peak, including more than 7,000 MW of gas-fired generation, resulting in a deficiency in operating reserves. The event demonstrated that the availability of natural gas for generation customers without firm gas arrangements is at risk under heavy demand conditions. Additionally, it was observed that the wholesale markets for gas and electricity are not well aligned, further increasing financial risk for generator availability.

Remedial Actions

ISO responded to the Cold Snap Event by instituting a new operating procedure to provide additional information on the need for specific gas-fired generators to enable those resources to obtain gas or, in the case of a dual-fuel power plant, to switch to an alternative fuel. The ISO has worked with state air regulators to relieve fuel-switching constraints on certain generators, which are subject to air permit limitations. The ISO has enhanced communications with the regional gas industry to improve ISO's ability to detect conditions on the gas system that could affect the availability of gas-fired generators. These actions are intended to bridge a short-term gap until new gas supplies can be brought to market and market enhancements can be implemented.

Constraints on Gas Units

The 40% of installed generating capacity in New England that burns natural gas as a primary fuel can be broken down into two subcategories, both of which have operating constraints. Of the total installed capacity in New England, 21% can only burn natural gas and 19% has dual-fuel capability. However, ISO has determined that half of these dual-fuel units are limited to burning fuel oil for 30 days or less per year, or when gas is unavailable, based on the conditions in their operating permits. Additionally, about half of these dual-fuel units have oil storage capability for less than a two-day run. While historically, most dual-fuel units have used little of the oil allowed under their permits, oil burning increased significantly in the first quarter of 2004 (when the January 2004 Cold Snap occurred) compared to all of 2003. If increased oil firing continues and dual-fuel units exhaust the allowable hours of oil burning under their permits, these units could be

constrained during an extreme cold weather event when ISO requests that they switch to a secondary fuel. If the dual-fuel units in New England were to reach their permitted limits on burning oil, and if these resources were not able to operate using natural gas, it could reduce the region's generating capacity during the winter by approximately 20% (6,000 MW).

The ISO's 2005 regional system planning process has identified the lack of dual-fuel capability, during extreme cold weather or during abnormal gas supply or delivery conditions, as a top concern for the short term. The ever-increasing reliance on gas as the sole fuel for power generation in New England and other North American regions is a concern for the longer term.

If the region's projected increase in electricity consumption over the next decade were to be met exclusively with gas-fired generation, it would require an additional 140 Bcf of natural gas each year, which is equivalent to an 18% increase in the capacity of the region's natural gas pipelines.

Competitive Markets Can Promote Fuel Supply Planning

Competitive wholesale electricity markets have improved the efficiency of the New England power system over the past five years including by providing incentives to promote increased generator availability. As an example, the percentage of time that generating units are available has increased from 81% in 2000 to 88% in 2004. This suggests that market participants are responding to economic signals to make their generators available to the ISO during time of need.

Proposed enhancements to the capacity and reserves markets provide incentives for improved generator availability and can be expected to motivate generators to secure adequate fuel supplies to ensure their availability when called upon by the ISO. Generators who do not have firm fuel supply arrangements for their primary fuel (i.e. natural gas) or the ability to switch to alternative fuels (i.e. oil) during shortage hours will be at risk of severe financial penalties.

Recommendations

As the percentage of electricity produced using natural gas increases, New England is becoming increasingly vulnerable to natural gas supply and/or delivery constraints, which results in increased natural gas price volatility, with a consequent negative impact on both electric system reliability and the cost of electricity production.

Recommendation: New England should diversify its fuel mix for power generation by developing resources that use alternative fuels (e.g. renewable energy sources, which now produce less than 10% of New England's electricity.) States should consider the impact on fuel diversity when permitting new generating facilities and allow for facilities to operate on secondary fuels during power system emergencies. States should also increase deployment of demand response, conservation and energy efficiency measures.

New England's growing demand for natural gas will exceed the capacity of existing infrastructure in the near term.

Recommendation: New England should develop additional gas infrastructure including expanding pipeline capacity and LNG import and storage capability. Additional LNG import and storage capability should be approved to diversify the sources of gas supply.

For the short term, the region should maximize use of already permitted dual-fuel generating capacity and promote expansion of new dual-fuel capability at gas-only power

plants, including appropriate incentives for these units to maintain and be ready to utilize this operational flexibility when called upon by the ISO during power system emergencies.

Gas-fired generators that have dual-fuel capability can be constrained in their ability to respond to ISO dispatch instructions due to air permit limitations on use of oil.

Recommendation: States should ensure that air permits allow dual-fuel generators to run on secondary fuels during power system emergencies to avert reliability problems especially during extreme cold weather conditions if necessary. States can use the ISO's implementation of the procedure for Cold Weather Event Operations as a trigger for allowing gas-fired generators to burn limited amounts of fuel oil.

Gas-fired generators without contracts for firm gas supply and transportation service may be constrained in their ability to respond to ISO dispatch instructions due to constraints on the natural gas system.

Recommendation: Gas-fired generators should firm-up gas and transportation arrangements or develop dual-fuel capability to ensure continued availability when natural gas is curtailed. Market enhancements are necessary to provide appropriate incentives.

Availability of generators is of particular concern in transmission-constrained areas.

Recommendation: Existing gas-only capacity in constrained areas of the transmission system should be converted to dual-fuel (or enter into firm gas arrangements) to mitigate electric system reliability concerns associated with current interruptible gas arrangements. Market enhancements are necessary to provide appropriate incentives.

Existing wholesale electricity market rules do not provide adequate price signals for generators to be available during hours of greatest need.

Recommendation: Implement a locational capacity market that compensates generators based on their availability and performance during hours of greatest need, especially during extreme cold weather conditions. Enhancements to New England's wholesale electricity market rules are required to ensure appropriate incentives for dual-fuel capability and firm gas arrangements, and for more flexible generating resources (i.e. dual-fuel peaking capacity).

Conclusion

It is critical for stakeholders in New England's wholesale electric and gas markets to identify resource needs in a timely manner and chart a course to ensure the reliability of these interdependent systems and to secure the region's energy future. Ensuring power system reliability, especially during extreme cold weather conditions, will require short- and long-term actions including enhancements to wholesale electricity market rules to provide appropriate incentives for these actions.