Gas & Electric Coordination: The need for information sharing

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Power generation now accounts for the majority of the natural gas consumed in the United States. However, the structure of the gas and electric markets do not align. Differences in market timing between the gas day nomination schedule and the electric day scheduling process make it difficult for generators to bid with certainty about the price of their fuel, on the electric side, and to nominate with certainty about the quantity of fuel they will need, on the gas side.

In addition, long-term natural gas transportation contracts have been designed around the idea that gas coming from the interstate pipelines will be shipped to local gas distribution companies (LDCs), mostly to serve the needs of residential and commercial end-use consumers. As we shall see, these long-term contracts play an important role in the construction financing for new pipeline capacity. So, while there appear to be more than adequate natural gas supplies to meet expected demand, ensuring sufficient pipeline capacity for electric generators remains a challenge.

The need for information sharing arises because of reliability concerns on both the gas and electric systems. The physical flow of gas molecules through the pipeline system requires strict pressure balancing. While pipelines can accommodate nomination changes and have balancing agreements in place to handle gas either left on the system or gas taken off the system outside of what was scheduled, pipeline system pressure drives any potential flexibility on the pipeline system. When generators operate outside of their nominated schedule, they can limit pipeline flexibility, and impact pipeline system reliability.

This paper seeks to answer two questions related to gas and electric coordination. First, what drives the need for information sharing? Second, what kind of information or coordination is needed? Both day-ahead and real-time electric scheduling practices assume fuel availability. Generation is scheduled to meet expected next-day load (demand) through day-ahead markets. In real-time, however, system conditions change. There may have been more or less load than expected, a transmission line may be out, or a generator might trip. Each of these situations requires a system operator to respond, and may require the re-dispatch of a previously scheduled unit, or the dispatch of a unit not scheduled previously. The ability of a gas-fired generator to respond to these signals could depend on how much gas a generator nominated, already burned, and/or depending on the pipeline system conditions at the time. As more natural gas-fired units make up the pool of generators available to meet electric load, coordination and information sharing between the pipeline system and the electric system becomes more important.
The New York State Gas and Electric Markets

On average, New York consumes about 3.3 billion cubic feet (Bcf) of natural gas per day, with peak gas demand around 5.0 Bcf/day in the winter.¹ For the past ten years, the electric sector has accounted for around 30-35% of the total natural gas consumed in New York State, about the same as the total gas consumed by the residential sector. In 2012, however, the electric sector accounted for 42% of the total natural gas consumed in New York State, the highest gas consumption by the power sector in the past ten years. This represents a nearly 30% increase in natural gas consumption by the electric sector since 2008.

The following figures highlight current and expected gas-fired generation across New York State, as well as current gas supplies into New York State. Natural gas-fired generation accounts for more than half of the total generation capacity in New York. The majority of natural gas units in New York are dual-fuel units; currently, less than 20% of New York’s entire gas-fired capacity relies on natural gas only.² Of the new generation proposed in New York, natural gas units account for nearly half.

¹ All natural gas consumption data from: U.S. Energy Information Administration, New York Natural Gas Consumption by End Use.
² As we shall see, there are reliability rules associated with much of this dual-fuel capacity.
While current natural gas supplies into New York State are enough to offset expected demand in the electric generation sector, getting the gas to electric generators during the coldest winter months when pipelines are operating at or near capacity remains a challenge. The next sections address some of these challenges, and the related information sharing and communication needed.

<table>
<thead>
<tr>
<th>Current and Expected Gas Demand and Supply in New York State (Bcf)</th>
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<tbody>
<tr>
<td>Total Gas Generator Winter Usage (2012)</td>
<td>6.9</td>
</tr>
<tr>
<td>Total Gas Generator Summer Usage (2012)</td>
<td>9.9</td>
</tr>
<tr>
<td>Total Gas Generator Usage (2012)</td>
<td>16.8</td>
</tr>
<tr>
<td>Total Gas Winter Capacity (MW)</td>
<td>22,447</td>
</tr>
<tr>
<td>Total Gas Summer Capacity (MW)</td>
<td>20,489</td>
</tr>
<tr>
<td>Total Expected Winter Gas Generation Capacity (Interconnection Queue)</td>
<td>5,920</td>
</tr>
<tr>
<td>Total Expected Summer Generation Capacity (Interconnection Queue)</td>
<td>5,490</td>
</tr>
<tr>
<td>Total Winter Gas Usage Expected (2012 usage + interconnection queue)</td>
<td>8.9</td>
</tr>
<tr>
<td>Total Winter Gas Usage 2012 (Res/Commercial/Industrial)</td>
<td>17.0</td>
</tr>
<tr>
<td><strong>Total Winter Supply into NY @ 5.9 Bcf/day in 2012</strong></td>
<td>35.4</td>
</tr>
<tr>
<td>Total Expected Winter Demand (All Sectors)</td>
<td>25.9</td>
</tr>
</tbody>
</table>

3 Consumption data from the U.S. Energy Information Administration: Consumption by End Use and Movements of Natural Gas by State. Total daily gas supply includes all New York International and Interstate Receipts coming into New York. The above chart does not take any expected residential, commercial, or industrial growth into account, and only looks at increased gas-fired electric generation already in the NYISO interconnection queue. New York City’s plan to switch residential units from heating oil to natural gas will add considerable residential gas demand during winter months, as well as the New York Department of Public Service focus on expanding natural gas heating use. NYISO Interconnection queue as of March 2012. Summer and Winter Capacity reflect the 2012 NYISO Load and Capacity Data Report.

4 The average monthly supply into New York in 2012 was 5.9 Bcf/day. The winter operating period runs from November-April. Note that this is the average monthly total of all international and interstate receipts coming into New York, and does not capture days when the pipelines are operating at full capacity, particularly during the winter.
**The need for information sharing**

Reliability concerns on both the gas and electric systems are driven by: (1) market timing differences between the two sectors; (2) the market structure of the gas system; and (3) the physical reality of the way gas moves through the pipeline system.

(1) Differences in market timing

The timing of the electric and gas markets are not aligned. Not only does the gas day, which runs from 10 a.m.-10 a.m. (Eastern Standard Time), not match up with the electric day, which runs from 12 a.m.-12 a.m., but the scheduling times in each market differ. As a result, in ISO/RTO markets, generators either bid their energy offers before knowing what the price of gas will be and/or nominate gas prior to receiving a firm operating commitment. Moreover, the gas market is most liquid between 8 a.m. – 9 a.m., prior to the release of day-ahead energy schedules in any electric market.

The NYISO requires generators to bid offers by 5:00 a.m. and posts its Day Ahead schedule by 11 a.m. In other words, a generator in New York must bid without knowing the price of gas, and then purchase and schedule that gas before it knows its operating schedule. While the NYISO is the only ISO/RTO that releases its day-ahead market commitments prior to the 12:30 p.m. (ET) timely nomination cycle close of the gas market, most generators within the NYISO market nominate gas prior to receiving a day-ahead commitment, in order to ensure gas is procured while the gas market is most liquid, or, on some LDC pipeline systems, to ensure capacity is reserved.

Further, day-ahead gas nominations are made Monday-Friday, and there is often no day-ahead weekend or holiday gas scheduling. Generators typically purchase a weekend gas package, which bundles gas supply with the gas transportation contract. This means that on any given weekend, gas generators must purchase and nominate on Friday the gas they think they will need for Saturday, Sunday, and Monday. Complicating this even more, generators often must nominate the same amount of gas for each day. So, going into a Holiday weekend, generators are purchasing and scheduling the same quantity of gas for Saturday, Sunday, Monday, and Tuesday. If (when) system conditions change over the weekend period, it could be difficult for gas-fired generators to adapt to changing real-time system condition needs by making changes to their nomination schedule.

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5 The NYISO has a mechanism in place to allow generators to manage some of the risk of purchasing gas intra-day: increasing bids in real-time (IBRT). This is an important market design that at least allows generators the opportunity to bid costs associated with purchasing (more expensive) spot market gas in real-time.

6 See appendix A for an overview of ISO/RTO market closing times.

7 These scheduling limitations are often imposed by the marketers through whom generators purchase and nominate gas, not necessarily the interstate pipelines or LDCs.
(2) The market structure of the gas system

The gas pipeline system – as it exists today – was not designed to serve a mostly gas-fired electric system. Pipelines were built to serve the needs of local gas distribution companies (LDCs), who buy long-term firm transportation contracts on one or more interstate pipelines in order to meet customer demand on a peak winter day. Just like on the electric system, while there are sufficient resources available to meet a peak demand day, not all of these gas resources are needed every day. Most LDCs rely on some combination of interstate pipeline gas, storage gas, and/or liquefied natural gas (LNG) to meet peak demand. Thus, even though the interstate pipelines are fully subscribed, they are not always fully utilized.

To manage the efficient use of their pipeline transportation contracts, most LDCs sell any capacity not needed in a secondary market, called the capacity release market. On the pipeline system, the transportation contracts held by LDCs (or other long-term anchor shippers) are known as primary firm. Transportation contracts purchased via the capacity release markets are known as secondary firm.

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There can be other long-term anchor shippers holding primary firm transportation contracts. In fact, in recent years, some shale gas developers began purchasing long-term primary firm contracts on the interstate pipelines. For the purposes of this paper, I refer to LDC primary firm contract holders.

Details on the restructuring of the interstate pipeline system are outside the scope of this paper. However, an important part of the capacity release market story is the unbundling of the gas commodity from the transportation of that gas. By recognizing that transportation contracts on the pipeline system are a property right, the Federal Energy Regulatory Commission set up the possibility for a robust capacity release market. For a detailed history of the United States pipeline systems see: Makholm, Jeff D. 2012. The Political Economy of Pipelines: A Century of Comparative Institutional Development. University of Chicago Press. Combined with the revolution in shale gas supply, the development of the capacity release market has played an important role in incenting greater gas-fired generation.
On any given day, the interstate pipelines ship gas under primary firm contracts to their long-term, anchor shippers (typically, LDCs), under secondary firm contracts that are bought and sold in the capacity release markets, and any remaining pipeline capacity is filled with various forms of interruptible contracts. Most gas-fired generators are purchasing either secondary firm transportation contracts, or some type of interruptible transportation contracts.

While this purchasing strategy works most of the time, on the coldest winter days, generators receiving gas directly from the interstate pipelines or an LDC10 are at risk of not receiving their gas supply. This is because interstate pipelines are obligated to ensure that their primary firm contract holders are supplied before shippers holding any other contracts. In other words, even though, theoretically, there is plenty of North American gas supply to meet the needs of gas generators and other gas users, on peak gas demand days, there may not be enough pipeline capacity to meet the needs of shippers holding anything but primary firm transportation contracts.

Since existing pipelines are fully subscribed, the only way for gas-fired generators to purchase primary firm transportation contracts is to build new pipelines or add more loops to existing pipelines.11 However, pipelines are not allowed to charge their existing customer base for the costs of new pipeline capacity, so new pipelines are constructed only when pipeline operators can demonstrate that the pipeline is in the public interest. The most common method of demonstrating that a project is in the public interest is through long-term transportation contracts. This financing model has worked when the largest consumer of natural gas has been residential and commercial loads: The LDC can finance the construction of a new pipeline through the purchase of firm transportation rights associated with the pipeline capacity, and then can recover these long-term costs through their regulated rates. By lining up these long-term anchor shippers, the pipeline is able to demonstrate that the new project is in the public interest.

Generators in competitive wholesale markets, however, generally have little incentive to purchase long-term primary firm transportation contracts. A long-term primary firm transportation contract includes a fixed monthly charge to reserve the pipeline capacity. Peaking plants likely would not run enough to recover this fixed cost. Even if a gas generator ran as a base load plant, generators are allowed to bid only their incremental variable costs. This means that even though the largest natural gas consuming sector in the United States is now the electric sector, electric generators selling energy in competitive wholesale markets have little incentive to support the construction of additional pipelines via primary firm transportation contracts.

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10 As will be discussed, not all generators are directly connected to the interstate pipelines. In fact, in New York State, much of the gas-fired generation is behind the city-gate, i.e. gas is received through the local gas distribution company. Generators on the New York Facilities System (in New York City and Long Island) are generally considered interruptible.

11 Looping entails adding capacity to an existing pipeline by expanding an existing right of way. There may also be some primary firm contracts available when a long-term anchor shipper contract expires. Some generators hold primary firm transportation contracts.
(3) **The physical reality of the pipeline system**

Just because a generator has a transportation contract, this does not mean they automatically have gas available. They are still required to purchase and nominate the gas flow. The NAESB grid-wide Gas Day consists of four separate scheduling cycles for nominating gas: two day-ahead cycles and two intra-day cycles. However, most gas is scheduled during the first day-ahead cycle, known as the “timely” cycle. This is when the gas market is most liquid, and secondary firm transportation contracts, once scheduled, cannot be bumped.

<table>
<thead>
<tr>
<th>NYISO Day Ahead Electric</th>
<th>Day Ahead Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>05:00</td>
<td>12:30</td>
</tr>
<tr>
<td>5CUC</td>
<td>TIMELY Nomination Cycle Close</td>
</tr>
<tr>
<td>11:00</td>
<td>Final Confirmation of Timely Nomination</td>
</tr>
<tr>
<td>ISO or NY TO Supplemental Resource Evaluation (SRE)</td>
<td>EVENING Nomination Cycle Close</td>
</tr>
<tr>
<td>16:00</td>
<td>Final Confirmation of Evening Nomination</td>
</tr>
</tbody>
</table>

Each pipeline has a minimum required operating pressure, and line pack, the quantity of gas stored in the pipeline above that minimum, is used to balance pressure throughout the pipeline system. As gas moves through the pipeline system, pressure declines. Compressor stations are used to offset this decrease in pressure. Gas can be fed into the pipeline system from gas wells, storage tanks, as LNG, or at an interconnection point where two pipelines meet. Day-to-day gas usage is managed by balancing pressure through line pack, compressor stations, and gas injections.

There is some flexibility built into the pipeline scheduling process through balancing agreements. In particular, shippers may leave gas on the system at the end of the gas day (“undertake”), or may use slightly more than scheduled (“overtake”), as long as it is within an amount specified by the pipeline’s tariff. These variations are tracked daily, and there are usually fees associated with these imbalances. As long as the pipelines can handle the imbalance – for example, because there is sufficient line pack remaining on the system or because a shipper scheduled an additional injection later in the day at some point on the system that can offset the pressure decline – then the pipelines are generally able to handle over/under takes.

In addition, there is some flexibility on the timing of the gas taken throughout the day. That is, non-ratable takes, or gas taken at different times during the operating day, are allowed; again, as long as the pipeline can manage the pressure and balancing throughout the system. Some pipelines offer hourly

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12 As explained, marketers sometimes bundle gas supply with the transportation contract.
nomination schedules, and some offer various types of flexible transportation contracts. Not all pipelines offer these flexible transportation contracts, and even those that do limit the availability of these contracts until after all primary firm shippers are served.

Restrictions on this flexibility occur when pipelines are experiencing, or anticipate experiencing, difficulty maintaining pressure. A system alert, for example, communicates that shippers must stay within their scheduled quantities. Shippers may be restricted to overtaking or undertaking within a specified range, or may be asked to operate within a ratable take. In the latter case, this could limit shippers to taking gas within 1/24 th increments, so a strict hourly flow. If an alert is issued, taking more or less than scheduled could lead to a pressure problem on the pipeline.

If these system alerts are not followed, the pipelines could issue an operational flow order (OFO). Though rare, an OFO is issued when the pipeline is experiencing significant pressure issues. If over or undertaking gas is allowed at all during an OFO, shippers could pay penalty charges in addition to any imbalance charges.

Just like transmission lines in the electric sector, the gas pipelines can be congested, or “over-nominated,” at particular points on the pipeline system. Day-to-day congestion (over-nomination) is managed by priority, according to the type of transportation contract a shipper has with the pipeline. Shippers holding primary firm contracts, with nominated and scheduled gas transportation, always have priority. On peak days it can be difficult to schedule any additional gas, during the gas day, through particular congestion points without a primary firm contract. Secondary firm capacity, once nominated and scheduled, though not as high priority as primary firm, is a type of firm transportation contract. Once confirmed, secondary firm could prevent primary firm nominations submitted in a later cycle (e.g. the evening cycle) from being scheduled. On a peak day, this means that secondary firm contracts not scheduled during the timely cycle could have difficulty being scheduled at all. Interruptible capacity is only available after all firm requests have nominated and scheduled gas. Once scheduled after the first intra-day cycle, however, interruptible capacity cannot be bumped.

Potential Reliability Concerns on the Electric System

Despite the fact that gas pipelines have some flexibility built into gas transportation scheduling and offer balancing services, there are still day-to-day operational conditions that could impact electric system reliability.

As explained, generators in NYISO markets are committed through a financially binding day-ahead market. Results are posted by 11 a.m. the day-before the actual dispatch day. The day-ahead market

\[ \text{In this situation, a gas generator would need to nominate over and above what is required to operate on a normal day, since they will only receive } 1/24 \text{ of what they nominate per hour. Even without any electric dispatch changes on a day when pipelines are operating a full capacity, a ratable take restriction leaves generators with excess gas to be sold intra-day (typically, at the wellhead price, not the spot market price), as well as an imbalance on the pipeline system.} \]

\[ \text{See Appendix C for a discussion of the NAESB grid-wide transportation contract priority levels.} \]

\[ \text{Gas generators not directly connected to the pipeline manage imbalances through their LDC.} \]
ensures that enough generation is committed to meet expected load, as well as to meet all operational reserves and regulation requirements.\footnote{The NYISO is responsible for the reliable operation of the New York Control Area power system, according to all applicable North American Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and New York State Reliability Council (NYSRC) reliability rules and standards. Regulation services support load balancing and the maintenance of frequency at 60 Hz. Reserves provide back-up generation during system contingencies.}

In real-time, however, system conditions may differ from what was assumed when scheduling generator commitments day-ahead. There may have been more or less load than expected, a transmission line may be out, or a generator might trip. Planning for these types of contingencies ensures that the loss of the largest generator, or the loss of particular transmission lines, do not impact overall system stability. However, each of these situations requires a system operator to respond in order to keep the system within these contingency limits and prevent an emergency situation. To that end, electric system operators may require the re-dispatch of a scheduled unit, or the dispatch of a unit not scheduled previously.

The difference between the time generators bid and then purchase gas makes it difficult for generators to nominate with certainty the quantity of gas they will need to meet an operating commitment. The challenge comes when gas generators nominate a particular amount of gas, and then are called upon by the system operator to run more or less than what was nominated. Depending on how much gas a generator nominated, already burned, or depending on the pipeline system conditions at the time, a gas-fired generator may or may not be able to respond to dispatch signals in real-time. Thus, not only do over/under takes create headaches for pipeline system operators trying to manage sufficient line pack to meet the needs of all its transportation customers (especially its primary firm shippers), but if generators cannot respond, then electric system reliability could be at risk.

Moreover, gas is not easily purchased and scheduled on peak usage days, holidays, during the overnight hours, or during the early morning hours. Even though some ISO/RTO markets (for example, NYISO) allow bids to be increased in real-time to reflect the higher gas procurement costs in the intra-day gas spot markets, depending on the time of day, there may not be the possibility to procure additional gas. Thus, there could be a situation where a generator is called on outside of the day-ahead dispatch schedule, and the pipeline could manage the imbalance, but there is no gas marketer available to arrange the gas purchase.

**Directly connected generators vs. Generators located behind the city-gate**

In some ISO/RTO markets, the majority of gas-fired generators are directly connected to the pipeline system. Directly-connected generators have a dedicated meter point off of the interstate system, share their estimated hourly burn profiles with the pipeline (when required), and manage imbalances with the interstate pipeline. In other ISO/RTO markets, for example in NYISO, many gas-fired generators are located behind the city-gate. These generators nominate gas to their local gas distribution company (LDC), manage imbalances with the LDC, and in some cases, may see additional restrictions, depending on LDC pipeline system conditions.
LDCs have an obligation to serve and are responsible for ensuring that the gas on their system is in balance on both an hourly and daily basis. On the New York Facilities System, which is managed by two gas LDCs serving New York City and Long Island customers (Consolidated Edison and National Grid), generators, by definition, are considered an interruptible customer. This means that even if a New York City generator had primary firm transportation on the interstate system, at the local-level, where they receive their scheduled gas, they run the risk of being interrupted when the pipeline system is stressed.\(^{18}\) Moreover, pipeline capacity on the New York City and Long Island LDC system is reserved daily by 9:30 a.m., prior to the posting of the NYISO day-ahead operating commitment.

Some of this fuel uncertainty is managed by a dual-fuel requirement. New York State Reliability Council (NYSRC) rules require that the New York bulk power system operates such that the loss of a single gas facility does not result in the loss of electric load within the New York City or Long Island zones. Since the loss of a single gas line on the NYFS could result in the loss of multiple generators, there are additional operating requirements for generators within the Consolidated Edison and National Grid system. Upon a loss of gas pressure, or when electric load is predicted to be above a certain level, either the minimum oil burn\(^{19}\) or the automatic fuel swap\(^{20}\) rules require generators to operate on an alternate fuel source. However, just because these units have dual-fuel capability does not mean they can easily make the switch to their alternate fuel, and some units require start-up gas to make the switch.

Finally, given an increased focus on safety on local gas distribution pipelines, some pipelines on local gas systems may see requirements to reduce the maximum allowable operating pressure on some lines. More testing of pipelines at the local distribution level could reveal that pipeline operating pressures must be reduced for safety reasons. These reduced pressures could impact gas-fired generators behind the city-gate.

### Opportunities for Improved Coordination and Information Sharing

Given market timing differences, the structural reality of the gas market, and the physical reality of the way gas moves through the pipeline system, the reliable operating of the electric system depends on improved coordination and information sharing with the gas pipelines, gas LDCs, gas generators, and ISO/RTOs. While there may be room for improved market design on both systems, increased day-to-day communication between pipeline operators, LDCs, gas-fired generators, and the ISO/RTO may also be needed. Certainly, communication when either system is stressed, is crucial.

The information needed will depend on system conditions on both the pipeline/LDC system and the electric system. In particular, there are two types of system conditions that would require coordination:

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\(^{18}\) Generators located behind the city-gate in other regions may also have tariff agreements with their LDC that limit their gas supply during particular system conditions, or when the temperatures are below a certain level. For a discussion on some of the impact of gas-fired generation behind the city-gate, see: NAESB Gas Electric Coordination Task Force – LDC Presentation, January 2004.

\(^{19}\) Minimum oil burn applies to generators with the ability to simultaneously burn gas and oil.

\(^{20}\) New or re-powered gas units (combined cycle units) are required to be operated with the ability to switch automatically to an alternate fuel.
(1) Day-to-day conditions on the electric system that require a change in the scheduled dispatch of gas-fired generators.
(2) An emergency, as defined by either system.

The type of communication required would differ in each of these situations. In addition, who is actually doing the communicating could differ.

Day-to-day changes in the scheduled dispatch of generators occur in real-time, in response to electric system conditions. There are procedures in place for generators to communicate any unavailability, both prior to the day-ahead scheduling process and in real-time. Given that changes on the electric system could require a generator to overtake outside of their scheduled amount, there may be a need for additional communication/coordination between the LDCs and pipelines in order to manage possible imbalances and prevent reliability concerns on the pipeline system.

For example, the pipelines or LDCs could request additional information from generators. FERC Order 698 already allows pipelines to request hourly burn profiles from generators directly connected to their system. This kind of communication could be requested from generators located on LDC systems, could be modified such that generators communicate changes to this profile throughout the day, and/or could include detail on how generators and pipelines/LDCs can manage the imbalance, if it can be managed.

Keeping in mind that actions by system operators to maintain reliability are an attempt to prevent an emergency situation, additional communication procedures could be put in place whereby generators communicate this information to the ISO/RTO during specific system conditions. During expected cold weather snaps, for example, generators could communicate their next-hour fuel availability. This would allow electric system operators to know how much gas a generator has nominated, how much gas a generator has already burned, and how much alternate fuel is available. This is not information that would be required at all times, but during these identified system conditions, knowing next-hour generator capability could enhance reliability.

During an emergency – as defined by either system – direct communication procedures between the ISO/RTOs, pipelines, and LDCs are already outlined. If a generator is identified as being critical to maintaining reliability, there is an effort to communicate with the pipelines and LDCs to determine if there is capacity to transport gas. Even in this case, however, gas may not be available. Furthermore, interstate pipelines have a requirement to serve their primary firm transportation holders, and LDCs have a requirement to serve their “human needs” customers first. Generators often do not fall into either category.

Beyond the type of information needed, there are market implications for acting on this information. What if a generator has overtaken gas from the pipeline, but is certain they can work around any imbalances? At what point do pipeline operators notify system operators that a generator’s actions cannot be accommodated? Requiring generators to manage their fuel requirements and notify the ISO/RTO of any limitations – as is done now – could help to avoid some of these uncertainties. But what if a generator is assuring the ISO/RTO they will have gas, yet the pipeline or LDC is anticipating that they cannot handle the current imbalance, and has notified the system operator. Perhaps the generator is working with a marketer to schedule gas, but has not yet placed the nomination, so the pipeline or LDC
is unaware that the expected imbalance may not occur. Moreover, what happens when the anticipated reliability concern does not occur, but generator profits were impacted because of ISO/RTO or pipeline actions? Clear “checkpoints” must be in place to define appropriate actions to be taken to maintain system reliability.

**Conclusion**

The most important issues related to the need for information sharing between the gas and electric systems are: (1) the differences in the timing of gas and electric scheduling, and (2) the market structure of the gas pipeline system; and (3) the physical reality of the way gas moves through the pipeline system. Firm contracts are necessary for ensuring gas supply, but they are not sufficient to guarantee supply; generators must also nominate the gas they need. Given differences in the timing of gas and electric markets, it may be difficult for gas generators to nominate enough gas supply to meet real-time electric system needs, leading to reliability concerns on both systems.

Since the pipeline system was not designed to serve a mostly gas-fired electric system, understanding the current pipeline financing model is an important part of the gas-electric coordination process. Even with the abundance of natural gas, there are still transportation congestion issues on peak demand days. Additional pipelines may be needed, but it is difficult for the largest – and fastest growing – natural gas consumer to finance the construction of pipeline infrastructure, especially if the need for additional capacity occurs only a few days of the year.

Furthermore, the ability of generators to respond to changing electric system conditions depends on pipeline system conditions. Generators typically do not hold primary firm contracts, and even if they did, most pipelines do not offer “no-notice” transportation service. This means that generators may not easily make changes to their scheduled nominations in real-time. Thus, even without a pipeline or gas LDC system alert or OFO in effect, the real-time availability of a gas-fired generator could be limited. There may not be capacity available on the pipeline system, or the gas system may be unable to accommodate large swings in gas usage at that particular moment.

There may be a need for communications and market design changes in both markets in order to ensure that reliability on either system is not threatened, to supply electricity on the coldest winter day, or even to ensure system reliability during normal operating days. Even then, enhanced planning and communication will be required on both the gas and electric sides for both emergency situations, as well as for every day system fluctuations.

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21 Gas prices reflect congestion patterns on the pipeline system, and gas prices during January and February of 2013 were almost twice as high as the price of oil on some very cold days.
Appendix A

Market timing across ISO/RTOs

<table>
<thead>
<tr>
<th>ISO/RTO</th>
<th>Bids Due</th>
<th>DA Market Posted</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>11 am (ET)</td>
<td>4 pm (ET)</td>
</tr>
<tr>
<td>ISO-NE</td>
<td>12 pm (ET)</td>
<td>4 pm (ET)</td>
</tr>
<tr>
<td>MISO</td>
<td>11 am (ET)</td>
<td>3 pm (ET)</td>
</tr>
<tr>
<td>CAISO</td>
<td>7 am (ET)</td>
<td>4 pm (ET)</td>
</tr>
<tr>
<td>ERCOT</td>
<td>11 am (ET)</td>
<td>2:30 pm (ET)</td>
</tr>
<tr>
<td>NYISO</td>
<td>5 am (ET)</td>
<td>11 am (ET)</td>
</tr>
</tbody>
</table>
Appendix B

North American Energy Standards Board (NAESB)

Wholesale Gas Quadrant (WGQ) Nomination and Scheduling Standards and Procedures

*Eastern Standard Time

1. The Timely Nomination Cycle: Deadline 12:30 p.m.
   - Made the day prior to the gas flow day
   - No scheduled quantities are carried over from the previous gas day
   - If nominated quantities exceed available pipeline capacity, reductions are made, following the scheduling priorities
   - Final confirmation: 4:30 p.m.
   - Scheduled quantity reports available to shippers and interconnected operators by 5:30 p.m. These reports also indicate quantities scheduled to flow the next gas day, as well as reasons for any reductions to originally nominated quantities.

2. The Evening Nomination Cycle: Deadline 7:00 p.m.
   - Made the day prior to the gas flow day
   - Scheduled quantities are carried over from the Timely Cycle
   - Previously scheduled interruptible (IT) nominations may be bumped at this cycle to accommodate new firm requests
   - If nominated quantities exceed available pipeline capacity, reductions are made, following the scheduling priorities
   - Final confirmation: 10:00 p.m.
   - Scheduled quantity reports available to shippers and interconnected operators by 11:00 p.m. These reports also indicate reasons for any reductions to originally nominated or previously scheduled quantities

3. The Intraday 1 (ID1) Nomination Cycle: Deadline 11:00 a.m.
   - The first opportunity to modify previously scheduled quantities during the Gas Day
   - ID1 nominations effective at 6:00 p.m. (8 hours after the start of the Gas Day)
   - Scheduled quantities are carried over from the Evening Cycle
   - Previously scheduled interruptible (IT) nominations may be bumped to accommodate new firm requests
   - Because gas is already flowing based on previously scheduled nominations, reductions to remaining nominations are limited to the amount that would have flowed up to the effective time of the changes (i.e. 6:00 p.m.), called the Elapsed Prorated Scheduled Quantity Process (EPSQ)
   - Final Confirmation: 2:00 p.m.
• Scheduled quantity reports available to shippers and interconnected operators by 3:00 p.m. These reports also indicate reasons for any reductions to originally nominated or previously scheduled quantities

4. **The Intraday 2 (ID2) Nomination Cycle:** Deadline 6:00 p.m.
   • The final opportunity to modify previously scheduled quantities during the Gas Day
   • No bumping permitted: All ID2 nominations compete for available capacity remaining after the ID1 Cycle
   • As with reductions in the ID1 Cycle, ID2 reductions are limited by EPSQ. However the EPSQ calculation for ID2 includes an adjustment for the additional four hours of effective flow after ID1
   • **Final confirmation:** 9:00 p.m.
   • Scheduled quantity reports available to shippers and interconnected operators by 10:00 p.m. These reports also indicate reasons for any reductions to originally nominated or previously scheduled quantities
Appendix C

North American Energy Standards Board (NAESB)

Wholesale Gas Quadrant (WGQ) Nomination and Scheduling Standards and Procedures

Transportation Service Provider Scheduling Priorities

1. *Primary Firm Capacity:* Once scheduled, cannot be bumped
2. *Secondary Capacity:* In most cases, cannot be bumped, so may prevent nominations for primary capacity from being scheduled if submitted in a later cycle
3. *Interruptible Capacity:* Only paid for when actually used. Have no entitlement or right to transport gas, only able to use system capacity when it is available after all firm requests
4. *Other Priorities:*
   a. *Authorized Overrun:* Nominated firm that exceed the firm contract’s entitlement. Only scheduled after all firm and interruptible nominations served.
   b. *Imbalance:* Nominated to clear up over- or under-supply situations.