Reliability Guideline
Gas and Electrical Operational Coordination Considerations

Applicability:
Reliability Coordinators (RCs), Balancing Authorities (BAs), Transmission Operators (TOPs)
Generator Owners (GOs), and Generator Operators (GOPs)

Preamble
It is in the public interest for the North American Electric Reliability Corporation (NERC) to develop
guidelines that are useful for maintaining or enhancing the reliability of the Bulk Electric System (BES). The
Technical Committees of NERC- the Operating Committee (OC), the Planning Committee (PC) and the
Critical Infrastructure Protection Committee (CIPC) – are, per their charters authorized by the NERC Board
of Trustees (Board) to develop Reliability (OC and PC) and Security (CIPC) Guidelines. Guidelines establish
voluntary codes of practice for consideration and use by BES users, owners, and operators. These guidelines
are developed by the technical committees and include the collective experience, expertise and judgment
of the industry. Reliability guidelines do not provide binding norms or create parameters by which
compliance to standards is monitored or enforced. While the incorporation and use of guideline practices
is strictly voluntary, the review, revision, and development of a program using these practices is strongly
encouraged to promote and achieve the highest levels of reliability for the BES. Nothing in this guideline
negates obligations or requirements under an entity’s regulatory framework (local, state or federal) and all
parties must take those requirements into consideration when developing any of the guidance detailed
herein.

Background and Purpose
Coordination of operations between the gas and electric industries has become increasingly important over
the course of the last decade. The electric power sector’s use of gas, specifically natural gas-fired
generation, has grown exponentially in many areas of North America due to increased availability of gas,
potentially more competitive costs in relation to other fuels and a move throughout the industry to lower
emissions to meet environmental goals. With increased growth in gas usage comes greater reliance and
associated risk due to the dependency that each industry now has on the other. The operational impact of
these dependencies requires gas and electric system operators to actively coordinate planning and
operations. The goal of the coordination is to ensure that both the gas and electric systems remain secure
and reliable during normal, abnormal and emergency conditions. This guideline attempts to provide a set
of principles and strategies that may be adopted should the region in which you operate require close
coordination due to increased dependency. This guideline does not apply universally, and an evaluation of
your area’s unique needs is essential to determine which principles and strategies you apply. The guideline
principles and strategies may be applied by RCs, BAs, TOPs, GOs and GOPs in order to ensure reliable
coordination with the gas industry. Finally, the document focuses on the areas of preparation, coordination,
communication and intelligence that may be applied in order to coordinate gas-electric utility operations
and minimize reliability-related risk.
Guideline Content:

A. Establish Gas and Electric Industry Coordination Mechanisms

B. Preparation, Supply Rights, Training and Testing

C. Establish and Maintain Open Communication Channels

D. Intelligence and Situational Awareness

E. Summary

A. Establish Gas and Electric Industry Coordination Mechanisms

- Establish Contacts
  
  - An essential part of any coordination activity is the identification of participants. For gas and electric coordination, this could involve the identification of the natural gas pipeline, gas suppliers and Local Distribution Companies (LDC) gas entities as well as gas industry operations staff within the electric footprint boundaries and in some instances beyond those boundaries. Once contacts among these participants are established, additional coordination activities can begin. Gas industry trade organizations, such as the Interstate Natural Gas Association of America, Natural Gas Supply Association, American Gas Association or a regional entity such as the Northeast Gas Association may be able to aid in development of operational contacts and the establishment of coordination protocols. These contacts should be developed for long and short term planning/outage coordination as well as near term and real-time operations. The contacts should include both control room operating staff contacts as well as management. Establishing and maintaining these contacts is the most important aspect of gas and electric coordination. Past lessons learned have taught the industry that the first call you make to a gas transmission pipeline or LDC should not be during abnormal or emergency conditions.

- Communication Protocols
  
  - Once counterparts are identified in the gas industry, communications protocols will need to be established within the regulatory framework of both energy sectors looking to coordinate and share information. The Federal Energy Regulatory Commission issued a Final Rule under Order No. 787 allowing interstate natural gas pipelines and electric transmission operators to share non-public operational information to promote the reliability and integrity of their systems. Since the inception of this rule and the subsequent incorporation of those rules into the associated tariffs, followed by the appropriate confidentiality agreements, gas and electric entities have been able to freely share operational data. Data that could be shared to improve operational coordination may include but is not necessarily limited to the following:
    
    - Providing detailed operational reports to the gas pipeline operators by specific generating assets, operating on specific pipelines, which specify expected fuel burn by asset, by hour over the dispatch period under review. It is important to convert dispatch plans from electric power (MWh) to gas demand (dekatherms/day) when conveying that information to gas system operators.
Combining the expected fuel to be used by asset on each pipeline in aggregate to provide an expected draw on the pipeline by generation connected to that pipeline on an hourly basis and on a gas and electric day basis.

- Exchanging real-time operating information in both verbal and electronic forms (e.g., pipeline company informational postings) of actual operating conditions on specific assets on specific pipelines.

- Outage planning for elements of significance to include sharing detailed electric and gas asset scheduling information on all time horizons and coordinating outages of those assets to ensure reliability on both the gas and electric systems. This coordination should include if possible face-to-face coordination meetings.

- Sharing normal, abnormal and emergency conditions in real-time and ensuring each entity understands the implications to their respective systems. This should include gas and electric entities proactively reaching out to the operators of stressed gas systems to discuss the impacts, adverse or otherwise, of their expected or available actions. Under extreme gas system operating conditions, understand the direct impacts to electric generation assets when gas pipelines are directed under force majeure conditions.

- The sharing of non-public operating information between the electric operating entity and LDC, intrastate pipelines, and gathering pipelines is not covered under FERC Order 787. For this reason, individual communication and coordination protocols should be considered with each LDC and intrastate pipelines within the footprint of the operating entity. Understanding the conditions under which an LDC or intrastate pipeline would interrupt gas-fired generation is of particular importance and incorporating this information into operational planning will assist in identification of potential at-risk generation. Setting up electronic/email alerts from each LDC or intrastate pipeline as to the potential declaration of interruptions is one key means of real time identification of potential loss of generation behind the LDC city gate or meter station on an intrastate pipeline.

- Coordinating Procurement Time Lines

- Operating entities may want to consider changing next day operating plan scheduling practices to align more efficiently with gas day procurement cycles. The gas and electric industries operate on differing timelines for the Day Ahead planning processes and in real-time, with the electric day on a local midnight to midnight cycle. The gas industry process operates on a differing timeline with the operating day beginning at 9 a.m. Central Clock Time and uniform throughout North America. This difference in operating days can lead to inefficient scheduling of natural gas to meet the electric day demands. In many instances throughout North America, the electric industry has moved the development and publishing of unit commitments and next day operating plans in order to ensure that generation resources have the ability to procure and nominate natural gas more efficiently to better meet the scheduling timelines of the gas industry. In addition, the gas industry has adjusted some of its nomination and scheduling practices to allow for more efficient scheduling that meets the needs of the electric system. Coordinating and modifying scheduling practices using more effective time periods may allow
for a higher level of pipeline utilization, but more importantly, may provide the early identification of constraints that could require starting gas generation with alternate fuels, or using non-gas-fired facilities for fuel diversity to meet the energy and reserve needs of the electric system.

- Identification of Critical Gas System Components and Dual-fuel Supplier Components
  
  o It is essential gas and electric operating entities coordinate to ensure that critical natural gas pipelines, compressor stations, LNG, storage, natural gas processing plants, and other critical gas system components should not be subject to electric utility load shedding in general but more specifically Under Frequency and or Manual Load shedding programs.

  - Electric transmission and distribution owners are capable of interrupting electrical load either automatically through under frequency load shedding relays installed in substations throughout North America or via manual load shedding ordered by RCs, BAs and or TOPs via SCADA. These manual and automatic load shedding protocols are part of every entity’s emergency procedures. Entities should try to ensure critical gas sector infrastructure is not located on electrical circuits that are subject to the load shedding described above. Electric operators should establish contact with the gas companies operating within its jurisdiction to compile a list of critical gas and other fuel facilities which are dependent upon electric service for operations. This list should also consider the availability of backup generation at critical gas facilities. Once the list is compiled, a comprehensive review of load shedding procedures/schemas/circuits should be done to verify that critical infrastructure is not connected to or located on any of those predefined circuits. This review should be considered for evaluation at least annually. The best practice in this area is to try and ensure that these facilities are not included in the initial under frequency or manual load shedding protocols at the outset.

  o In a similar manner, it may be appropriate to coordinate with secondary fuel (e.g., diesel or fuel oil, onsite LNG) suppliers to ensure that any necessary critical terminals, pump stations, and other critical components are not subject to electric utility load shedding programs in general and more specifically Under Frequency and or Manual Load shedding programs. This is especially appropriate if adequate on-site fuel reserves are not guaranteed and just-in-time fuel delivery practices are required.

- Operating Reserves

  ▪ The electric industry may want to consider adjustments to operating reserve or capacity requirements to better reflect the increased reliance on natural gas for the generation fleet. For instance, if the loss of a fuel forwarding facility has the ability to result in an instantaneous or near instantaneous electric energy loss, that contingency should be reflected in the reserve or capacity procurement for the operating day. In addition, some electric operators are considering the implementation of a risk-based operating reserve protocol that increases or decreases the amount of operating reserve procured based upon the risks identified to both the gas and electric system.
B. Preparation, Supply Rights, Training and Testing

- **Assessments**
  - Preparing the gas and electric system for coordinated operations benefits from up front assessments and activities to ensure that when real-time events occur, the system operators are prepared for and can effectively react. Preparation activities that may be considered include the following:
    - Developing a detailed understanding of where and how the gas infrastructure interfaces with the electric industry including:
      - Identifying each pipeline (interstate and intrastate) that operates within the electric footprint and mapping the associated electric resources that are dependent upon those pipelines.
      - Identifying the level and quantity of pipeline capacity service (firm or interruptible; primary/secondary) and any additional pipeline services (storage, no-notice, etc.) being utilized by each gas-fired generator.
      - Developing a model of and understanding the non-electric generation load that those pipelines and LDCs serve and will protect when gas curtailments are needed.
      - Identifying gas single element contingencies and how those contingencies will impact the electric infrastructure. For instance, although most gas side contingencies will not impact the electric grid instantaneously, they can be far more severe than electric side contingencies over time because gas side contingencies may impact several generation facilities. When identifying gas system contingencies, the electric entity should consider what the gas operator will do to secure its firm customers. This could include the potential that the gas system will invoke mutual aid agreements with other interconnected pipelines and this may involve curtailment of non-firm electrical generation from the non-impacted pipeline to aid the other.
      - Understanding how gas contingencies may interact with electric contingencies during a system restoration effort.
      - An additional example of appropriate actions to consider as part of the assessment phase of preparation is provided as a Natural Gas Risk Matrix¹.
  
- **Emergency Procedure Testing and Training**
  - Consider the development of testing and training activities to recognize abnormal gas system operating conditions and to support extreme gas contingencies such as loss of compressor stations, pipelines, pipeline interconnections, large LNG facilities, which can result in multiple generator losses over time. Particular attention should be focused on any gas related contingency that may result in an instantaneous generation loss.

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¹ [https://www.misoenergy.org/StakeholderCenter/CommitteesWorkGroupsTaskForces/ENGCTF/Pages/home.aspx](https://www.misoenergy.org/StakeholderCenter/CommitteesWorkGroupsTaskForces/ENGCTF/Pages/home.aspx)
Consider the addition of electric and natural gas coordination and interdependencies training to educate and exercise RCs, BAs, TOPs, and GOPs during potentially adverse natural gas supply disruptions.

If voltage reduction capability exists within your area, practical testing and training should be considered as part of seasonal or annual work plans.

The use of manual firm load shedding may be required for beyond criteria extreme gas and or electric contingencies. Consideration should be given to practicing the use of manual load-shedding in a simulated environment. These simulations should also be used as part of recurring system operator training at a minimum. The use of tabletop exercises can be a valuable training aid, but wherever possible, consideration should be given to using an advanced training simulator that employs the same tools the operators would use to accomplish the load shedding tasks.

Consider the development of and drill on internal communication protocols specific to potential natural gas interruptions.

Generator Testing

Consideration should be given to adopting generator testing requirements for dual fuel auditing. Some items to consider when establishing a dual fuel audit program are:

- How often should the audits be conducted and under what weather and temperature conditions.
- Verify sufficient alternate fuel (e.g., fuel oil) inventory to ensure required generation response and output. As part of this assessment, ensure that the stored fuel is fully burnable as well since the full volume of the tank may not be pumpable at very low inventories.
- Capacity reductions on alternate fuels.
- Understanding the exact time it takes to startup, switch to alternate fuel, ramp to and operate at full capacity, ramp down and resource shut down. Additional consideration should be given for those assets which require a shutdown in order to swap to an alternate fuel source.
- The operating entity should consider any environmental constraints the generator under test must meet in order to swap to and operate on the alternate fuel.

Capacity and Energy Assessments

Consideration should be given to the development of forward looking capacity analyses with which the electric industry is familiar but applying the impacts of fuel restrictions that may occur due to pipeline constraints or other fuel delivery constraints such as LNG shipments or liquid fuel delivery considerations. In order to conduct these types of assessments, the analysis needs to consider the LDC loads within the region. The weather component of the assessment should consider normal, abnormal and extreme conditions (i.e., Gas Design Day, which is the equivalent to the highest peak that the pipeline was designed for). This capacity assessment can be on several time horizons including; Real-time, Day Ahead, Month Ahead and Years into the future.
These assessments should consider pipeline maintenance, known future outages, construction and expansion activities as well as all electric industry considerations, including known or potential regulatory changes, which are normally analyzed.

- In addition to a capacity assessment that represents only a single point in time, consideration should be given to the development of a seasonal, annual or multiannual energy analysis that uses fuel delivery capability/limitations as a component. Such assessments can be scenario based, simulate varied weather conditions over the course of months, seasons and/or years, and consider the same elements as discussed in the capacity analysis. The output of the assessments should determine whether there is the potential for unserved energy and/or determine the ability to provide reserves over the period in question.

- **Winter Readiness Reviews**
  - Recent system events have magnified the need to ensure that seasonal awareness and readiness training is completed within the electric industry including System Operators, Generator Operators and Transmission Operators. Seasonal readiness training for winter weather could include reviews and training associated with dual fuel testing, emergency capacity and energy plans, weather forecasts over the seasonal period, fuel survey protocols and storage readiness. Other areas that require attention in winter readiness reviews include reviewing and setting specific operational expectations on communications protocols. Finally, any winter readiness seminars should include individual generator readiness such as ensuring adequate fuel arrangements are in place for unit availability, adequate freeze protection guidelines are in place, understanding access to primary and secondary fuels and testing to switch to alternate fuels, ensuring all environmental permitting is in place for the fuel options available to the asset, and making sure that the Balancing and Transmission Operators are kept apprised of the unit availability.

- **Extreme Weather Readiness Reviews**
  - Seasonal readiness reviews for extreme summer weather events (e.g., Gulf of Mexico hurricane) could include response to potential natural gas supply limitations and corresponding decreases in natural gas deliveries that may impact electric generation. Many of the same benefits as winter readiness exercises can be realized with the added benefit of exercises under summer operating conditions when electric loads are higher than winter loads.

**C. Establish and Maintain Open Communication Channels**

- **Industry Coordination**
  - In the long and short term planning horizons, regularly scheduled meetings between the gas and electric industries should be held to discuss upcoming operations including outage coordination, industry updates, project updates and exchange of contact information.
  - Operating entities should consider the development of a coordinated and annually updated set of operational and planning contact information for both the gas and electric industries. This information should include access to emergency phone numbers for management contacts as
well as all control center real-time and forecaster desks for use in normal, abnormal and emergency conditions.

- Gas and Electric emergency communication conference call capability should be considered between the industries such that operating personnel can be made available from both industries immediately, including off hours and within the confines of the individual confidentiality provisions of each entity. Electric sector personnel should periodically monitor pipeline posted information and notices.

- Emergency Notifications to Stakeholders
  - Operating Entities may want to consider proactive notifications to stakeholders of abnormal and or emergency conditions on gas infrastructure to ensure widespread situational awareness and obligations associated with dispatch relationships in the electric sector. An example of a notification used for generators in New England appears below:

    1. Notices Indicating Abnormal and/or Emergency Conditions on the Pipeline Infrastructure Serving Generators

      
      **NOTE**
      
      Notices indicating abnormal and/or emergency conditions on the pipeline infrastructure serving a Generator in the ISO RCA/BAA could come in the form of, but not limited to, Operational Flow Orders, Imbalance Warnings or even a verbal notification.

      A) When electronic or verbal notices indicating abnormal and/or emergency conditions on the pipeline infrastructure serving a Generator in the ISO RCA/BAA are received, the Forecaster notifies the Operations Forecast and Scheduling Supervisor (or designee):

      1. The Forecaster reviews this information and depending upon the severity of the condition may pass the publicly available information along by drafting an email and submitting it to Customer Service for dissemination to each applicable Generator Designated Entity (DE) management contact(s) and/or Lead Market Participant (MP) contact(s).

      **NOTE**
      
      The following guideline or one tailored to the current situation can be used as a template for drafting this notification:

      "ISO-NE has received the following information via the publicly available notices published by the gas pipelines:
      
      (Insert Notice, such as Operational Flow Order or Force Majeure, etc.)
      
      "Because of this situation, it is critical that each applicable Generator DE or Lead MP provide ISO-NE with up to date and reliable estimates of each Generator current and future capacities including the ability to have fuel for a Generator under their control. This includes immediately reporting any information that may prevent a Generator from operating in accordance with submitted offers data, including, but not limited to the following:

      - Planned, Maintenance and/or Forced outages of the Generator facilities as soon as that information is available
      - Immediate reporting of any updates to outages including overruns and or early returns to service of the Generator facilities
      - Any high risk activities at a Generator location that may reduce its capability or place the capability at risk
      - Any fuel reductions or outages that may limit a Generator’s ability to perform in any way
      - Any changes to operating limits of a Generator which must reflect the most accurate and up to date information available
      - Any changes at all in a Generator ability to follow dispatch instructions including manual response rates, ability to provide reserve, ability to provide energy, and/or ability to provide capacity
      - Any changes in projected Generator self schedules"

      Depending upon the level of severity and risk exposure, these written notifications and a means to communicate them may need to be followed up with direct verbal communications.

- Emergency Communication Protocols in the Public and Regulatory Community
  - Most every electric operating entity has long standing capacity and energy emergency plans in place that focus on public awareness, abnormal and emergency communications as well as appeals for conservation and load management. However, as the gas and electric industry become further dependent, considerations should be made for both industries to coordinate for extreme circumstances. Gas and electric operators in coordination with public officials, including relevant regulatory communities, may find situations where the energy of both the gas and electric sector is required to be reduced in order to preserve the reliability of both.
While these types of efforts are still in their infancy they should be explored depending upon the particular circumstances of each entity’s Region.

D. Intelligence and Situational Awareness

- Fuel Surveys and Energy Emergency Protocols
  - Energy emergency procedures and fuel surveys can be important tools in understanding the energy situation in a region. The surveys can be used to determine energy adequacy for the region’s electric power needs and for the communications and associated actions in anticipation or declaration of an energy emergency. Interestingly, the fuel surveys will most likely focus on the fuel availability of other types of fuels if the gas infrastructure is the constrained resource.

- Fuel Procurement
  - Operating entities should consider evaluating each electric generator’s natural gas procurement and commitment to determine fuel security for the operating day.
    - The electric operating entity can collect publicly available pipeline bulletin board data and compare the gas procurement for individual generators against the expected electric operations of the same facility in the current or next day’s operating plan. An example of this type of data collection appears below with the data helping to determine if enough fuel is available to meet an individual plant or in aggregate an entire gas fleet’s expected operation for the current or future day. The report can indicate whether a fuel surplus or deficit exists by asset or for an entire pipeline. If sufficient gas has not been nominated and scheduled to the generator meter, assessments can be done to determine the impact on system operations and the operating staff may call the generator to inquire as to whether the intention is to secure the requisite gas supply to match its expected dispatch plus operating reserve designations.

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3 Seasonal survey example – See section 7.3.5 in Manual 14 [http://www.pjm.com/~/media/documents/manuals/m14d.ashx](http://www.pjm.com/~/media/documents/manuals/m14d.ashx)
Varying configurations of generator gas supplies can quickly complicate reports. Efforts should be made prior to the development of such reporting tools to ensure that all facets of gas scheduling can be displayed. Not all scheduled gas data will be publically available, especially when dealing with LDC- and intrastate-connected generators. Generators are often supplied by multiple pipelines simultaneously and may change supply sources based on daily natural gas prices. If possible, the electric operating entity should list its range of contractual arrangements with the natural gas sector such as firm supply, no-notice storage, etc.

- **Gas System Visualization**
  - Several Reliability Coordinators have developed visualization tools to provide scheduling and real-time operations staff with situational awareness that ties the gas and electric infrastructure together at their common point of operation. What follows is an example of one such tool that has been made generic for the purposes of the illustration. The bubbles in the tool indicate the functionality available to the user with notes that follow.
E. Summary
The transformation in the mix of fuel sources used to power electric generation throughout North America and in particular, the continued increase in the use of natural gas has naturally led to the coordination processes discussed in the preceding guideline. The guideline should serve as a reference document that NERC functional entities may use as needed to improve and ensure BES reliability and is
based upon actual lessons learned over the last several years as natural gas has developed into the fuel of choice due to its availability and economic competitiveness. The document focuses on the areas of preparation, coordination, communication, and intelligence that may be applied to improve gas and electric coordinated operations and minimize interdependent risks. Each entity should assess the risks associated with this transformation and apply a set of appropriate processes and practices across its system to mitigate those risks. The guidance is not a “one size fits all” set of measures but rather a list of principles and strategies that can be applied according to the circumstances encountered in a particular system, Balancing Authority, generator fleet or even an individual Generator Operator.