Evaluation of Reactive Power Planning and Voltage Control Practices in Response to NERC Blackout Recommendation 7a

North American Electric Reliability Council

Prepared by the Transmission Issues Subcommittee of the NERC Planning Committee

NERC Board of Trustees
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Appendix A. Transmission Issues Subcommittee Survey of Regional Reactive Power and Voltage Control Practices


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I. Executive Summary

The NERC Planning Committee (PC) has a primary role in the pursuit of several recommendations that NERC adopted following its investigation of the August 14, 2003, blackout. The PC assigned one of these recommendations, Recommendations 7a, to its Transmission Issues Subcommittee (TIS).

Recommendation 7a states “the PC shall reevaluate within one year the effectiveness of the existing reactive and voltage control standards and how they are being implemented in practice in the ten NERC regions. Based on this evaluation, the PC shall recommend revisions to standards or process improvements to ensure voltage control and stability issues are adequately addressed.”

This report provides the results of the TIS’s investigation of Recommendation 7a, including observations and considerations for enhancements to the reactive power and voltage control NERC Reliability Standards and the identification of several notable (best) practices to complement the NERC standards.

TIS found that, in general, existing NERC reactive power and voltage control standards and regional practices and procedures, if followed, are adequate and effective for voltage control and reactive power planning. In the interest of enhancing reactive power and voltage control requirements and planning, and based on its survey of and discussions with the ten NERC regions on their regional practices and procedures, TIS has developed and identified: 1) a number of observations and considerations for possible inclusion into future NERC Reliability Standards, and 2) several notable (best) practices for information purposes to complement the NERC standards.

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1 August 14, 2003 Blackout: NERC Actions to Prevent and Mitigate the Impacts of Future Cascading Blackouts, approved by NERC Board of Trustees on February 10, 2004.
II. Regional Survey

To understand and evaluate the effectiveness of the existing reactive power and voltage control standards and how the regions implement them, TIS prepared a survey, included as Appendix A, for the regions to complete in late September 2004 that addressed the following features:

- Most survey questions were generic and open-ended to ensure that the survey captured all of the regional practices and their differences. This flexibility gave the regions an opportunity to provide answers as detailed as they deemed appropriate.

- Some questions addressed NERC Planning Standards I.A.², I.D.³, and II.B.⁴ because the blackout investigation team had referred to violations of and/or the requirements of these standards. The questions were formulated to derive information on notable (best) practices and effectiveness and avoid getting into compliance issues.

- To avoid receiving yes/no answers or an unwieldy volume of information, TIS suggested that the regions work with their regional TIS members to provide an appropriate level of information.

A. Review Process for the Survey Responses

All ten regions responded to the survey; TIS members held a meeting to review and discuss the regional survey responses. Based on this meeting and subsequent deliberations, TIS identified several notable (best) practices and developed recommendations.

B. Results of the Survey Responses

The following is a brief summary of the responses to each of the survey questions:

Q. 1a: Table I of NERC Planning Standard 1.A requires evaluation of Categories A, B, and C contingencies to be within applicable ratings and applicable voltage limits. Describe the methodologies used for determining these applicable voltage limits, e.g., P-V, Q-V, or other analysis.

Responses:
- Various methods/assessments are used to determine applicable voltage limits. In general, there is neither a single region-wide limit nor would it be appropriate.
- Practices differ among the regions. Some regions have oversight responsibility and/or a peer review process in place.
- A single or common voltage limit(s) may be used by a region for screening purposes.
- Transmission entities within the regions use their own voltage limits based on the unique aspects of their systems. Limits are not uniform, but may have similarities.
- The methods and assessments used include P-V and/or Q-V analyses, transfer studies, operating experiences, and customer complaints.
- Limits used include minimum and maximum bus voltage limits, delta V limits, and minimum acceptable limits at generator or plant buses.

⁴ II. System Modeling Data Requirements, B. Generation Equipment.
These NERC Planning Standards may be found at http://www.nerc.com/~filez/pss-psg.html.
Notable (Best) Practices and/or Observations:  
- The transmission planner or transmission owner has a documented process in place and follows it for determining applicable voltage limits on a system.  
- This documented process determines voltage limits throughout the system for all Categories A, B, and C events.  
- This documented process includes specific limits for generator busses to ensure that plant auxiliary equipment will not trip causing subsequent loss of generation.  
- This documented process is shared with the region for peer review.

Q.1.b: Whether in planning assessments, voltage control or reactive power system limitations are determined on a region- or ISO/RTO-wide basis, for specific load/generation pockets, and/or by transmission provider/owner, and what factor(s) are used to make such determination?

Responses:
- Planning assessments are performed at regional and local levels.  
- Transmission owners, transmission planners, and ISOs/RTOs perform load pocket assessments, subregions perform assessments within and between subregions, and regions perform region-wide assessments.  
- In general, limits are not established on a region- or ISO/RTO-wide basis. Local load or generation voltage criteria are often the determining factors.  
- Regional guidelines may exist. Some regions are pursuing activities to determine whether region-wide limits are appropriate.  
- Coordination of limits between adjacent transmission systems is handled generally between the adjacent systems.

Notable (Best) Practices and/or Observations:  
- Transmission owners perform studies to assess areas.  
- Regions perform studies to determine specific voltage and reactive power limitations throughout the regional transmission system.  
- Establishing and applying a single blanket limit to each bus in the region is not appropriate except as a parameter for carrying out initial screening studies.  
- The area studies are shared with the regions and incorporated into regional studies.

Q.1.c: Whether sensitivities of the planning assessments are performed assuming one or more generation/transmission facilities are unavailable, and/or different load levels, and what are the general criteria used for determining the sensitivities to be assessed?

Responses:  
- Sensitivities may include:  
  - Generating unit and transmission facility outages.  
  - Operating experience scenarios.  
  - Highly likely scenarios at either on-peak or off-peak times and under light load conditions.  
  - Low probability scenarios.

5 Notable (best) practices and/or observations are practices worthy of attention that are either followed by some, but not necessarily all, regions or noted by TIS.
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- Maintenance outage considerations.
- Expected transfers.
- Transfer capability at regional, subregional, and interregional levels.
- Load levels in excess of forecasts.
- Different dispatches.

Sensitivities are based on:
- Regional and local criteria and guidelines.
- NERC standards (Category C contingencies).
- History (operating experience, transfer levels).

Notable (Best) Practices and/or Observations:
- Transmission owners perform planning studies based on their historical assessments which have identified key sensitivities of what is important to their systems, and current knowledge of appropriate load and generation mix.
- In some circumstances precontingency measures are incorporated into Category C contingencies (e.g., sensitivity of a critical unit unavailable scenario is assessed).
- Studies are shared with the regions and incorporated into regional studies.

Q.1.d: The type(s) of load model used in the planning assessments specific to voltage control and reactive power limitations (i.e., constant power, constant impedance, etc.)?

Responses:
- Electric Power Research Institute (EPRI) load model.
- Constant MVA for steady state.
- Constant current and constant admittance for transient studies.

Notable (Best) Practices and/or Observations
- Transmission planners use a constant MVA load model for steady state to obtain conservative results in steady state studies.
- Load models other than constant MVA, if used by the transmission planner, are validated by measurement and comparison to actual system performance.
- Networked subtransmission is incorporated into the transmission planner’s models to the extent possible.

Q.1.e: The basis and verification process used for establishing load power factor in the system models?

Responses:
- Historical assessment.
- Formal verification process.
- Metering not universally available to measure power factor.
- Power factor supplied by individual transmission owners.
- Distribution capacitors equivalenced in models.
- Sensitivity studies performed by varying power factors.

Notable (Best) Practices and/or Observations:
- The transmission planner has a formal process for establishing the load power factor.
**Q.1.f:** The time frames modeled in the planning assessments specific to voltage control and reactive power limitations (e.g., short-term dynamics, mid-term 3–60 seconds, load flow) and generally, how are the results of the time frame(s) studied used in the assessment?

*Responses:*
- Match load model with time frame.
- 100 seconds predisturbance and 20 seconds post disturbance – short term.
- 20 seconds to 30 minutes – mid-term.
- 30+ minutes for steady state.
- Varies according to study.
- Load tap changing (LTC) for transformers, capacitor switching, and system adjustments allowed in steady state.

**Notable (Best) Practices and/or Observations:**
- A time frame for post-contingency power flow analysis allows for LTC adjustments and switching of the reactive power devices (capacitors, reactors, and static var compensation).

**Q. 1.g:** The periodicity and horizon of the assessments specific to voltage control and reactive power planning?

*Responses:*
- Annual five-to-ten-year studies.
- Study every two years with appropriate horizon.
- Semi-annual seasonal studies.
- Periodic assessment, comprehensive study every five years.
- Five-to-ten-year period may not be valuable due to uncertainty of assumptions about generation.

**Notable (Best) Practices and/or Observations:**
- A five-year horizon is the typical time frame for study.
- A second five-year time frame (which makes for a ten-year planning horizon) is appropriate if the transmission planner has reasonable confidence in data assumptions.
- Annual studies of the peak load season(s) are carried out by individual transmission owners.

**Q. 1.h:** How reactive power resources are planned to ensure an appropriate balance between static and dynamic characteristics and that the resources are appropriately distributed?

*Responses:*
- Compliance with Table I of NERC Planning Standard 1.A generally translates to an adequate balance of static and dynamic reactive resources.
- There is no specific target balance between static and dynamic reactive resources.
- The current Standard I.D is ambiguous.
- No formal measure is in place and the need for it has not been identified.
- Utilities have fully integrated reactive plans for distribution, transmission, and generation. They base the balance on engineering analysis, economic analysis, operating experience, and good utility practices.
- Regions generally consider guidelines in Standard I.D in the transmission planning process.
Notable (Best) Practices and/or Observations:
- If the transmission planner meets the requirements of Table I of Standard 1.A, it implies that a proper balance of static and dynamic reserves is maintained.
- The objective of the planning standards is for a transmission owner to be compliant with Table I of Standard 1.A.
- The guidelines in Standard I.D are useful and important, and are generally considered in the transmission planning process.

**Q. 1.i:** What generation equipment testing is performed to verify that data submitted for steady state and dynamics modeling in planning (one year or more) and operating studies (less than one year) are consistent with the actual physical characteristics of the equipment? This data includes, but is not limited to, gross and net generator MW dependable capability, gross and net reactive power capability, voltage regulator controls, speed/load governor controls, and excitation systems.

**Responses:**
- Specific gross and net MW testing.
- Var testing requirements under development.
- Annual MW testing and biennial Mvar testing.

Notable (Best) Practices and/or Observations:
- MW capability testing for generation (typically for reserve sharing purposes) is common.
- Mvar testing is becoming more common.
- Transmission planners have more confidence in generating unit models that have been verified.

**Q. 2:** Please provide any additional information as well as other types of planning assessments performed in the region and considered useful to ensure that voltage control and stability issues are adequately addressed.

**Responses:**
- Voltage sag guidelines are under development.
- Periodic reviews take place with adjoining systems.
- There are joint studies for intra-regional ties.
- Regions perform peer review processes for new facilities.
- Regions conduct region-wide screening studies for Categories C and D contingencies and share the results with transmission providers, regulators, and security agencies.

**Q.3:** Does your region have undervoltage load shedding programs?

**Responses:**
- No region-wide undervoltage load shedding (UVLS) program.
- Local UVLS programs only.
- No regional coordination of local UVLS programs deemed necessary.
III. Overall Recommendations

TIS found that, as a general rule, existing NERC reactive power and voltage control standards and regional practices and procedures, if followed, are adequate for voltage control and reactive power planning. In the interest of improving reactive power and voltage control planning, and based on its review of regional reactive power and voltage control practices and procedures, TIS has developed a number of observations and considerations for possible inclusion in future NERC standards. These observations and considerations are described below. TIS also has identified several notable (best) practices from the regions that are presented below for informational purposes to complement the NERC standards.

A. Observations and Considerations for Future Standards

1. Each transmission owner or transmission planner should be responsible for establishing applicable voltage limits in its respective area. Each transmission owner should have a documented process for determining applicable voltage limits in its respective area in accordance with NERC standards. This process should be shared with the region for review and approval. The region(s) should be responsible for facilitating the resolution of any potential conflicts in the applicable voltage limits established between adjacent transmission owners.

2. Each transmission owner or transmission provider, in coordination with the generator owner, distribution provider or load serving entity, as appropriate, should establish a documented process for validating the data and models used for voltage control and reactive power planning. This validation should include the real and reactive capability of generators, generator characteristics incorporated into models, reactive resources, generator step-up transformer characteristics and settings, load power factor, and load models. This process should be shared with the region for review and approval. The region should be responsible for facilitating the resolution of any potential conflicts in data or models between adjacent transmission owners.

3. The requirements of NERC Planning Standard I.D., System Adequacy and Security, Voltage Support and Reactive Power, are adequately addressed in other reliability standards (Planning Standards TPL-001-0, TPL-002-0, TPL-003-0, and TPL-004-0, System Performance, which may be found at http://www.nerc.com/~filez/standards/Reliability_Standards.html), making Standard I.D. redundant. A proper balance between static and dynamic reactive resources depends on the integrated design and practices of the distribution, transmission, and generation systems. The balance between static and dynamic characteristics can be different, but still comply with all NERC standards by virtue of meeting or exceeding the performance requirements of those TPL standards (including Table I of these standards).

The guidelines under Standard I.D., included as Appendix B, are useful and important in the transmission planning process. The following principles in the guidelines should be retained and incorporated into the NERC standards:
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i) Guidelines G1 and G5 should be combined and incorporated into a NERC standard stating that the system should be planned to provide adequate and sufficient dynamic and static reactive power capabilities under peak and off-peak system conditions.

ii) Guideline G2 — Distribution entities and customers directly connected to the transmission system should plan their respective systems to operate close to a specified power factor.

iii) Guideline G3 — At continuous rated power output, new generators should have an overexcited power factor capability, measured at the point of interconnection with the transmission system, of 0.95 or less and underexcited power factor of 0.95 or less. If a generator does not meet this requirement, the generation owner should make alternate arrangements (e.g., Statcoms, SVC, etc.) for supplying an equivalent dynamic reactive power capability to meet this requirement.

B. Notable (Best) Practices

Processes, practices, assessments, criteria, and guidelines are generally customized to meet the uniqueness and requirements of the different regions and areas in meeting the NERC standards. If the processes are followed in a manner consistent and in accordance with the NERC standards, they can be effective. Describing notable (best) practices is not meant to identify any specific practice, criteria, or process for universal application, but to define adequate checks and balances to ensure implementation of NERC standards at the appropriate local (transmission owner), subregion, ISO/RTO, or regional level on a regular basis.

Based on the review of the regional responses, there are various practices that can be considered notable (best) practices and which, if implemented, could assist in effectively meeting current NERC standards as well as any future standards based on the above observations and considerations. TIS encourages the NERC regions to incorporate these practices, along with other various guidelines contained in Standard I.D., into regional study review processes. Specifically:

1. Each NERC region should provide oversight of its members’ documentation associated with major studies, processes, data and model validation and implementation of study notable (best) practices.

2. Each NERC region should conduct a peer review process for member reactive power and voltage control studies and study results of a significant nature as determined by the region.

3. Standard I.D., Guideline G7: Power flow simulation of contingencies, including P-V and Q-V curve analysis, should be used for reactive planning and voltage analyses, and verified by dynamic simulation when steady-state analyses indicate possible voltage instability.

4. Guideline G4: Reactive power compensation should be close to the area of high reactive power consumption or production.
Appendix A

Transmission Issues Subcommittee
Survey of Regional Reactive Power and Voltage Control Practices

September 28, 2004

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William J. Museler, Chairman

Ladies and Gentlemen:

Transmission Issues Subcommittee Survey
Reactive Power and Voltage Control Practices

The Planning Committee (PC) is tasked with the follow-up to NERC Blackout Recommendation 7a, “The Planning Committee shall reevaluate within one year the effectiveness of the existing reactive power and voltage control standards and how they are being implemented in practice in the ten NERC regions. Based on this evaluation, the Planning Committee shall recommend revisions to standards or process improvements to ensure voltage control and stability issues are adequately addressed.”

The PC assigned this follow-up activity to the Transmission Issues Subcommittee (TIS). TIS’s first step in this evaluation will be to assemble the current reactive power and voltage control procedures that each regional reliability council (region) follows. We request that each region respond to the attached Transmission Issues Subcommittee Survey no later than November 5, 2004. Respondents are urged to be as expansive as possible and to provide sufficient information or references to allow TIS to gain a full understanding of all aspects of reactive power and voltage control planning in your region. The requested information should be sent to the NERC office in Princeton, or electronically to John Twitchell, staff support for TIS (john.twitchell@nerc.net). TIS will review and evaluate the current regional practices, and report to and provide recommendations to the PC.
Prior to reporting to the PC, TIS may also ask representative(s) from each region to meet with them to further clarify and explain the region’s practices and standards. This review will be scheduled, if necessary, after TIS has had an opportunity to review the survey responses. We appreciate your cooperation in assisting the PC and TIS in addressing an important blackout related follow-up issue.

If you have any questions, please feel free to consult with the TIS member who represents your region. A TIS roster is attached for your reference.

Sincerely,

[Signature]
Chairman
NERC Planning Committee

JRT:an
Attachments

cc: Planning Committee
   Technical Steering Committee
   Transmission Issues Subcommittee
One of the tasks assigned to the Transmission Issues Subcommittee (TIS) is NERC Blackout Recommendation 7a:

“Recommendation 7a - Evaluate Reactive Power and Voltage Control Practices: The Planning Committee shall reevaluate within one year the effectiveness of the existing reactive power and voltage control standards and how they are being implemented in practice in the ten NERC regions. Based on this evaluation, the Planning Committee shall recommend revisions to standards or process improvements to ensure voltage control and stability issues are adequately addressed.”

In order to “reevaluate” the “effectiveness” of the existing planning practices in the ten NERC regions, it is necessary to first understand what the existing planning practices are and how they are implemented. The information requested below from the regions is intended to provide such understanding. Based on the information received, standards/criteria/policies/processes/procedures will be identified, evaluated and recommended so as to ensure voltage control and voltage stability issues are adequately addressed.

Information provided in response to this survey is to be coordinated and assembled by the regions.

Responses to the information requested below are to be provided to the NERC office, or electronically to John Twitchell (john.twitchell@nerc.net) no later than November 5, 2004.

Information Request:

1. Please provide any regional standards/criteria/policies/processes/procedures that are specific to voltage control and reactive power planning assessments. The region should also survey the ISOs/RTOs and member transmission providers/owners in their respective region for standards/criteria/policies/processes/procedures specific to their system, and include such information if it substantially differs or supplements that of the region. The response should address the following specific items:

   a. Table 1 of NERC Planning Standard 1.A requires evaluation of Categories A, B, and C contingencies to be within applicable ratings and applicable voltage limits. Describe the methodologies used for determining these applicable voltage limits, e.g. PV, QV, or other analysis;

   b. Whether in planning assessments, voltage control or reactive power system limitations are determined on a region- or ISO/RTO-wide basis, for specific load/generation pockets, and/or by transmission provider/owner, and what factor(s) are used to make such determination;

   c. Whether sensitivities of the planning assessments are performed assuming one or more generation/transmission facilities are unavailable, and/or different load levels, and the general criteria used for determining the sensitivities to be assessed;
d. The type(s) of load model used in the planning assessments specific to voltage control and reactive power limitations (i.e., constant power, constant impedance etc.);

e. The basis and verification process used for establishing load power factor in the system models;

f. The time frames modeled in the planning assessments specific to voltage control and reactive power limitations (e.g., short-term dynamics, mid-term 3–60 seconds, load flow) and generally, how the results of the time frame(s) studied are used in the assessment;

g. The periodicity and horizon of the assessments specific to voltage control and reactive power planning;

h. How reactive power resources are planned to ensure an appropriate balance between static and dynamic characteristics and that the resources are appropriately distributed; and

i. What generation equipment testing is performed to verify that data submitted for steady state and dynamics modeling in planning (one year or more) and operating studies (less than one year) are consistent with the actual physical characteristics of the equipment. This data includes, but is not limited to, gross and net generator MW dependable capability, gross and net reactive power capability, voltage regulator controls, speed/load governor controls, and excitation systems.

2. Please provide any additional information as well as other types of planning assessments performed in the region and considered useful to ensure that voltage control and stability issues are adequately addressed.

3. Does your Region have undervoltage load shedding programs?
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Appendix B

Guidelines to NERC Planning Standards I.D.

I. System Adequacy and Security
D. Voltage Support and Reactive Power

G1. Transmission owners should plan and design their reactive power facilities so as to ensure adequate reactive power reserves in the form of dynamic reserves at synchronous generators, synchronous condensers, and static var compensators (SVCs and STATCOMs) in anticipation of system disturbances. For example, fixed and mechanically-switched shunt compensation should be used to the extent practical so as to ensure reactive power dynamic reserves at generators and SVCs to minimize the impact of system disturbances.

G2. Distribution entities and customers connected directly to the transmission systems should plan and design their systems to operate at close to unity power factor to minimize the reactive power burden on the transmission systems.

G3. At continuous rated power output, new synchronous generators should have an overexcited power factor capability, measured at the generator terminals, of 0.9 or less and an underexcited power factor capability of 0.95 or less.

If a synchronous generator does not meet this requirement, the generation owner should make alternate arrangements for supplying an equivalent dynamic reactive power capability to meet the area’s reactive power requirements.

G4. Reactive power compensation should be close to the area of high reactive power consumption or production.

G5. A balance between fixed compensation, mechanically-switched compensation, and continuously-controlled equipment should be planned.

G6. Voltage support and voltage collapse studies should conform to Regional guidelines.

G7. Power flow simulation of contingencies, including P-V and V-Q curve analyses, should be used and verified by dynamic simulation when steady-state analyses indicate possible insufficient voltage stability margins.

G8. Consideration should be given to generator shaft clutches or hydro water depression capability to allow generators to operate as synchronous condensers.
Appendix C

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<tbody>
<tr>
<td>SPP</td>
<td>Jay Caspary</td>
<td>Southwest Power Pool</td>
<td>415 North McKinley, Suite 800, Little Rock, AR</td>
<td>(501) 614-3220</td>
<td>(501) 666-0376</td>
<td><a href="mailto:jcaspary@spp.org">jcaspary@spp.org</a></td>
</tr>
<tr>
<td></td>
<td>Sandra L. Johnson</td>
<td>Xcel Energy, Inc.</td>
<td>550 15th Street, Suite 700, Denver, CO</td>
<td>(303) 571-7095</td>
<td>(303) 571-7877</td>
<td><a href="mailto:sandra.l.johnson@xcelenergy.com">sandra.l.johnson@xcelenergy.com</a></td>
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<tr>
<td>Federal</td>
<td>Marvin J. Landauer</td>
<td>Bonneville Power Administration</td>
<td>905 N.E. 11th Avenue, Mail Stop R-3, Portland, OR</td>
<td>(503) 230-4105</td>
<td>(503) 230-3270</td>
<td><a href="mailto:mjlandauer@bpa.gov">mjlandauer@bpa.gov</a></td>
</tr>
<tr>
<td>Investor Owned</td>
<td>W. Perry Stowe</td>
<td>Southern Company Services, Inc.</td>
<td>Bin 13N-8183, P.O. Box 2641, Birmingham, AL</td>
<td>(205) 257-6138</td>
<td>(205) 257-1040</td>
<td><a href="mailto:wpstowe@southernco.com">wpstowe@southernco.com</a></td>
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<tr>
<td>IPP</td>
<td>Scott M. Helyer</td>
<td>Tenaska, Inc.</td>
<td>1701 East Lamar Blvd., Suite 100, Arlington, TX</td>
<td>(817) 462-1512</td>
<td>(817) 462-1510</td>
<td><a href="mailto:shelyer@tnsk.com">shelyer@tnsk.com</a></td>
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<tr>
<td>ISO/RTO</td>
<td>Jeffrey R. Webb</td>
<td>Midwest ISO, Inc.</td>
<td>701 City Center Drive, Carmel, IN</td>
<td>(317) 249-5412</td>
<td>(317) 249-5910</td>
<td><a href="mailto:jwebb@midwestiso.org">jwebb@midwestiso.org</a></td>
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<td>Power Marketer</td>
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<td>Transmission</td>
<td>Samuel T. Stryker</td>
<td>Fayetteville Public Works Commission</td>
<td>955 Old Wilmington Road, Fayetteville, NC</td>
<td>(910) 223-4517</td>
<td>(910) 323-2990</td>
<td><a href="mailto:sam.stryker@faypwc.com">sam.stryker@faypwc.com</a></td>
</tr>
<tr>
<td>Utility</td>
<td>Yury Tsimberg</td>
<td>Hydro One, Inc.</td>
<td>483 Bay Street, TCT15N-A6, Toronto, ON</td>
<td>(416) 345-5867</td>
<td>(416) 345-5188</td>
<td><a href="mailto:yury.tsimberg@hydroOne.com">yury.tsimberg@hydroOne.com</a></td>
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<tr>
<td>Canada</td>
<td>Steve Corey</td>
<td>New York Independent System Operator</td>
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<td>(518) 356-6134</td>
<td>(518) 356-6208</td>
<td><a href="mailto:scorey@nyiso.com">scorey@nyiso.com</a></td>
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<tr>
<td>ISO/RTO - Alternate</td>
<td>George Bowden</td>
<td>AltaLink Management Ltd.</td>
<td>1035 - 7th Avenue, S.W., P.O. Box 20, Calgary, AB</td>
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</table>
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