UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

MANDATORY RELIABIITY STANDARDS FOR THE BULK-POWER SYSTEM	**)** **)**	**Docket No. RM06-16-000**

COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION ON THE TOPOLOGICAL AND IMPEDANCE ELEMENT RANKING (TIER) OF THE BULK-POWER SYSTEM PRELIMINARY REPORT

Rick Sergel
President and Chief Executive Officer
David N. Cook
Vice President and General Counsel
North American Electric Reliability Corporation
116-390 Village Boulevard
Princeton, NJ 08540-5721
(609) 452-8060
(609) 452-9550 – facsimile
david.cook@nerc.net

Rebecca J. Michael
Assistant General Counsel
Holly A. Hawkins
Attorney
North American Electric Reliability Corporation
1120 G Street, N.W.
Suite 990
Washington, D.C. 20005-3801
(202) 393-3998
(202) 393-3955 – facsimile
rebecca.michael@nerc.net
holly.hawkins@nerc.net

October 28, 2009

TABLE OF CONTENTS

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

MANDATORY RELIABIITY STANDARDS FOR THE BULK-POWER SYSTEM	**)** **)**	**Docket No. RM06-16-000**

COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION IN RESPONSE TO THE TOPOLOGICAL AND IMPEDANCE ELEMENT RANKING (TIER) OF THE BULK-POWER SYSTEM PRELIMINARY REPORT

I. Introduction

The North American Electric Reliability Corporation ("NERC") is pleased to provide these comments on the "Topological and Impedance Element Ranking ("TIER") of the Bulk-Power System" August 2009 Preliminary Report ("TIER Report"), prepared for the Federal Energy Regulatory Commission ("FERC" or the "Commission") by the University of Wisconsin-Madison. The TIER Report proposes a methodology to aid in identifying and ranking the elements of the bulk power system in the United States.

II. Notices and Communications

Notices and communications with respect to this filing may be addressed to the following:

Rick Sergel
President and Chief Executive Officer
David N. Cook*
Vice President and General Counsel
North American Electric Reliability Corporation
116-390 Village Boulevard
Princeton, NJ 08540-5721
(609) 452-8060
(609) 452-9550 – facsimile
david.cook@nerc.net

Rebecca J. Michael*
Assistant General Counsel
Holly A Hawkins*
Attorney
North American Electric Reliability Corporation
1120 G Street, N.W.
Suite 990
Washington, D.C. 20005-3801
(202) 393-3998
(202) 393-3955 – facsimile
rebecca.michael@nerc.net
holly.hawkins@nerc.net

*Persons to be included on FERC's service list are indicated with an asterisk. NERC requests waiver of FERC's rules and regulations to permit the inclusion of more than two people on the service list.

III. Background

In a September 10, 2009 Notice,[1] FERC stated that FERC's Office of Electric Reliability ("OER") initiated a project to develop, for purposes of Section 215 of the Federal Power Act ("FPA"), a methodology to aid in identifying and ranking the elements of the bulk power system in the United States. Specifically, OER Staff is seeking to: (1) develop a process to distinguish those facilities that should not be considered part of the bulk power system from those facilities that should be considered part of the bulk power system; (2) identify the elements needed to operate each of the

[1] *Mandatory Reliability Standards for the Bulk-Power System*, Notice of Public Meeting, Docket No. RM06-16-000 (September 10, 2009) ("September 10 Notice").

electric interconnections; and (3) rank the importance of those elements.[2] FERC noted that this project may lead to a methodology that could be utilized in future proceedings to aid in refining the scope of what constitutes the bulk power system subject to Section 215 of the Federal Power Act.[3]

As a first step, OER Staff and the University of Wisconsin-Madison developed and tested a mathematically-based model intended to reflect the physics of the bulk power system by distinguishing those facilities that should be included in the bulk power system from those that should not. This methodology, referred to as the TIER methodology, introduces a method for ranking elements that can be used to determine whether those elements should be considered part of the bulk power system. Presumably, the higher the ranking, the more likely that element will be determined to be part of the bulk power system. This is referred to as the TIER Ranking.[4]

The TIER methodology was introduced in a report called the *Topological and Impedance Element Ranking (TIER) of the Bulk-Power System* (the "TIER Report"), which was prepared for FERC by researchers from the University of Wisconsin-Madison. The TIER Report states that calculation of TIER relies on information about system topology (*i.e.* interconnection structure), branch element electrical characteristics, and location of relevant dispatchable resources, and does not require information about resource costs.[5] The TIER Report further states that the TIER methodology only uses

[2] *Id.* at 1.
[3] *Id.* at 1.
[4] TIER Report at pp. 13-14.
[5] TIER Report at p. 8.

information associated with network constraints, and is independent of the cost functions or offer curves associated with generators or other dispatchable resources.[6]

As the authors of the report noted at the FERC public presentation, they have taken the approach "of looking and focusing on the topology of the network, very physical, how the topology of the network impacts the operation of the network and the electrical properties of components within the network."[7] The authors stated that their approach was "to classify components, based on their potential to impact capacity resources . . ."[8]

The TIER Report was presented as a preliminary analysis of the bulk power system. As the FERC-designated electric reliability organization,[9] NERC's primary focus with respect to a study that examines elements that should be considered part of the bulk power system is on the impacts to bulk power system reliability. Because NERC's mandate is to develop and enforce mandatory Reliability Standards that apply to users, owners and operators of the bulk power system, implementing a new methodology to define the bulk power system could have a significant impact on entities subject to compliance with NERC Reliability Standards. Accordingly, NERC's comments focus, in part, on these impacts.

NERC notes that the Commission's future intent regarding the use of the TIER methodology is not clear from the TIER Report or the Commission's September 10 Notice. If the Commission intends to use the TIER methodology to develop a modified

[6] TIER Report at pp. 7-8.
[7] *In the Matter of: Mandatory Reliability Standards for the Bulk-Power System*, Docket No. RM06-16-000, Transcript of September 22, 2009 FERC Meeting ("Transcript"), p. 7, lines 11-15.
[8] Transcript at p. 7, lines 16-18.
[9] *See Rules Concerning Certification of the Electric Reliability Organization: Procedures for the Establishment, Approval and Enforcement of Electric Reliability Standards*, Order No. 672, 71 FR 8662 (February 17, 2006), FERC Stats. & Regs. ¶ 31,204 (2006), *order on reh'g*, Order No. 672-A, 71 FR 19814 (April 18, 2006), FERC Stats. & Regs. ¶ 31,212 (2006).

definition of the bulk power system, NERC requests that the Commission initiate a process to adequately examine appropriate methodologies, including TIER, that focus on bulk power system reliability. Although the TIER methodology may have some merit in determining those elements that could be included in the bulk power system definition, more information is required before industry participants can fully evaluate whether this or any other methodology provides a reasonable alternative that can be used to determine which elements are crucial to bulk power system reliability and therefore should be included in a revised definition of the bulk power system. Accordingly, NERC looks forward to working with the Commission and the industry in exploring appropriate methodologies that can best be utilized to determine those facilities that should be included in the definition of bulk power system.

IV. Comments

a. General Comments

The TIER Report includes questions regarding the effectiveness of the methodology proposed to determine those facilities that should be included in a modified definition of the bulk power system. Because the Commission has not indicated that the TIER Report will be adopted as a determinative method for defining the bulk power system, NERC is focusing its comments on additional questions that should be considered in the process of refining what constitutes the bulk power system. NERC has assumed that the calculations used in the TIER methodology are accurate.

i. Any Ranking Methodology Should Provide a Correlation to Reliability

The TIER Report presents a computable, numeric ranking of elements that the Report's authors assert may be used to provide structure in (1) developing a process to distinguish those facilities that should not be considered part of the bulk power system from those facilities that should be included; (2) identifying the elements needed to operate each of the electric interconnections; and (3) ranking the importance of those elements.[10] The methodology presented in the TIER Report relies on the use of a sensitivity analysis[11] to classify elements in order to characterize the potential of an individual element to modify or impose network constraints, which, the Report states, can be analyzed to determine how they impact dispatchable resources in achieving optimal operation.[12] The TIER methodology looks at network congestion by analyzing Locational Marginal Price ("LMP") profiles to determine how constraining power flow along a particular branch of the bulk power system will cause a variation in the optimal dispatch of resources. It is these patterns of LMPs that are used to compute the TIER Rankings that determine a given element's importance in operating each of the electrical interconnections.[13]

The TIER Report appears to presume that by establishing TIER Rankings through a congestion pricing model, the value to bulk power system reliability can be inferred. However, with the exception of anecdotal descriptions of system operator agreements with the TIER rankings, at no place in the report is this presumption that bulk power

[10] TIER Report at pp. 13-14.
[11] The TIER Report defines a "Sensitivity Analysis" as a standard tool in most technical fields, including mathematics, engineering, economics, and the sciences. *See* TIER Report at p. 14.
[12] TIER Report at p. 14.
[13] TIER Report at p. 14.

system reliability is correlated to congestion verified or validated. The TIER methodology focuses on congestion factors by assuming that all LMP is equal, and that the grid is always operated optimally. As such, this methodology looks at the impact of constraints related to each element on the unconstrained LMP profile rather than analyzing its effect on system reliability. In other words, the TIER methodology appears to provide a statistical measure to determine impact to efficiency, but not necessarily impact to reliability.

Defining those elements that are critical to bulk power system reliability by using a mathematical-based model that does not examine an element's potential impact to the reliability of the system would directly contravene the very purpose of Section 215 of the FPA. Accordingly, the Commission should ensure that any modified definition of the bulk power system considers an element's impact to reliability before any such modification is adopted.

ii. The TIER Report's Assertion of Disadvantages in the Currently-Existing Definition of the Bulk Electric System is Inaccurate

In explaining why a computable numeric ranking should be used to classify elements that should be considered part of the bulk power system, the TIER Report cites the currently existing definition of the bulk power system to demonstrate possible disadvantages in the use of this definition. The bulk power system is defined in the Act as:

> (A) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and (B) electric energy from generation facilities needed to maintain transmission system reliability. The term does not include facilities used in the local distribution of electric energy.

The authors of the TIER Report state that, while this definition includes any elements of the transmission system that are necessary for operating an interconnected electric energy network to achieve reliable operation, it does not directly yield an objective test to classify an element as part of the bulk power system.[14]

Additionally, the TIER Report seems to indicate that the current NERC definition of bulk electric system ("BES") is inadequate to determine elements that should be included in the bulk power system. The bulk electric system is defined by NERC as:

> As defined by the Regional Reliability Organization, the electrical generation resources, transmission lines, interconnections with neighboring systems, and associated equipment, generally operated at voltages of 100 kV or higher. Radial transmission facilities serving only load with one transmission source are generally not included in this definition.

The TIER Report states that, while "[t]his definition has the clear advantage of being simple to apply; … [a] potential disadvantage of this definition comes from its disregard for the function of the transmission elements." The authors continue that because "[s]ome interconnected electric energy transmission networks are built with strong underlying networks at voltages below 100 kV . . . while others will build networks that serve the same function at 115 or 138 kV . . .much larger portions of the electric system may be included in the bulk electric system in some areas, and others may have a fairly small fraction of their transmission system included even if both are necessary for the reliable operation of the network."[15]

The TIER Report's authors incorrectly assume that all elements below a certain kV, by definition, cannot be considered part of the bulk power system. This is not the case. The definition allows Regional Entities to include or exclude system elements

[14] TIER Report at p. 11.
[15] TIER Report at p. 12.

based on their individual circumstances and topology. Further, NERC's *Statement of Compliance Registry Criteria*, which provides the criteria for registration of smaller entities that do not meet the NERC definition of BES, specifically provides that "Regional Entit[ies] considering registration of an organization not meeting (e.g. smaller in size than) the criteria may propose registration of that organization if the Regional Entity believes and can reasonably demonstrate[] that the organization is a bulk power system owner, or operates, or uses bulk power system assets, and is material to the reliability of the bulk power system."[16] Therefore, even though the definition for the BES includes all elements that are greater than 100 kV as part of the bulk power system, if a 69 kV facility (not "local-distribution" facilities) is determined to have a material impact on the reliable operation of the bulk power system, there is a process in place for NERC and the Regional Entities to register the entity that uses, owns, or operates that facility. That is, any system element that is reasonably deemed to be material to the reliability of the bulk power system can be included in the bulk power system, and its owner can be registered, irrespective of other criteria or considerations.[17]

While the TIER methodology may appear to provide a more consistent approach in determining elements to be included in the bulk power system, this type of methodology may not adequately consider each transmission line's relative importance to the reliability of the bulk power system. By treating all of these system elements equally, reliability could actually be degraded. For example, system elements that do not have a material impact on the bulk power system but that produce a high TIER ranking may fall within the scope of elements to be included in a modified definition of the bulk power

[16] *Statement of Compliance Registry Criteria* at "Notes to the Above Criteria," P 1.
[17] *Statement of Compliance Registry Criteria* at p. 3.

system. Presumably, the entities that use, own, or operate these system elements would then be required to register on the NERC Compliance Registry and be required to comply with NERC Reliability Standards even though there was no real assessment of how these entities' facilities impact bulk power system reliability. Accordingly, NERC would have to shift some of its registration and compliance resources to work with those entities whose facilities do not have a material impact on the reliability of the bulk power system.

NERC intends to comprehensively and thoroughly protect the reliability of the bulk power system, but believes that only those system elements with the potential to materially impact reliability should be included in the definition of the bulk power system. The potential costs and efforts of ensuring that every organization with facilities of a certain TIER ranking becomes registered while ignoring their facilities' impact upon reliability could be disproportionate to the reliability benefits of registering these entities. Therefore, while NERC recognizes the TIER Report's concern that the current definition of the bulk electric system could potentially exclude elements that may be critical to bulk power system reliability, NERC believes it is important to validate this concern before a modified definition of the bulk power system is adopted.

iii. The Scope of the Reliability Standards Will have to be Carefully Analyzed if the Definition of the Bulk Power System is Modified

Any new methodology for improving the determination of system elements to be included in the definition of the bulk power system will require careful consideration of the resultant impacts on the applicability of Reliability Standards to any additional system elements. That is, if a there is a significant expansion of the elements to be included in the bulk power system to encompass large numbers of sub-100 kV facilities, a systematic

review of *all* Reliability Standards must be done to look for unintended consequences. Such a significant expansion could result in reliability coordinators being responsible for wide-area view over thousands of low-voltage lines that they are not capable of monitoring; and Regional Entities could be responsible for registering hundreds of municipals and cooperatives.

NERC's role as the ERO is to work with the Commission to develop, implement, and enforce mandatory Reliability Standards for the bulk power system, subject to Commission approval, in accordance with Section 215 of the FPA.[18] Section 215 requires that all users, owners and operators of the bulk power system in the United States be subject to the Commission-approved Reliability Standards. NERC-enforced, and Commission-approved Reliability Standards are designed to ensure the reliability of the bulk power system and typically apply to facilities at the transmission and generation level. Section 401.2 of the NERC Rules of Procedure provide that "[w]here required by applicable legislation, regulation, rule or agreement, all bulk power system owners, operators, and users, regional entities, and NERC, are required to comply with all approved NERC reliability standards at all times.

While some NERC Reliability Standards apply to every entity registered on the NERC Compliance Registry, other Reliability Standards are developed only for certain classes of elements that make up the bulk power system. For example, some standards, such as the vegetation management standard (FAC-003-1), only apply to transmission lines that are operated at 200 kV and above and to any lower voltage lines designated by the Regional Entity as critical to the reliability of the electric system in the region.

[18] *North American Electric Reliability Corporation*, 116 FERC ¶ 61,062 (July 20, 2006), *citing to* FPA §§ 824, 824o.

Similarly, other standards that apply to certain types of entities (such as Reliability Coordinators, Transmission Owners, and Transmission Operators) may be dependent on the definition of the bulk power system when defining responsibilities or scope of authority.

While the TIER Report focuses on the methodology used to determine TIER rankings of system elements, it does not address how the Reliability Standards will apply to these system elements (and their associated Registered Entities) if those elements produce a high enough TIER ranking to be considered part of the bulk power system. Originally, only those smaller entities (such as those with facilities operated at voltage levels below 100 kV) determined to have an impact on the reliable operation of the bulk power system were expected to have to comply with a given Reliability Standard. Therefore, any Reliability Standards impacted by a redefinition of the bulk power system will have to be re-examined to determine if they should be modified to include lower-voltage facilities by default or by exception, as well as whether any such criteria should be explicit in the standard or implicit in the definition of bulk power system. For these reasons, new methodologies for defining the bulk power system, such as the TIER methodology, should be fully vetted before making any changes to define the bulk power system, and NERC urges the Commission to consider the impacts to Reliability Standard applicability in evaluating proposed modifications to the definition of the bulk power system.

b. Technical Comments for Consideration in Developing a Methodology for Identifying Elements of the Bulk Power System

The remainder of NERC's comments focuses on questions that should be considered in the exploration of any methodology to determine appropriate system

elements to include in the definition of the bulk power system. In the event the Commission determines that a formal proceeding should be initiated to determine whether the use of the TIER or any other methodology is an appropriate method for determining elements to be included in the bulk power system, NERC would appreciate the opportunity to work collaboratively with FERC and stakeholders in this process.

i. A Ranking Methodology Alone May Not be Adequate

The TIER Report introduces a ranking methodology to identify which facilities should be included in the bulk power system.[19] While NERC recognizes that there is some value to a ranking system, the TIER ranking methodology introduces some questions that merit further consideration prior to its use in modifying the definition of the bulk power system.

The TIER methodology proposes to apply a ranking to elements to determine whether they should be included in the definition of the bulk power system. However, it is possible that an element can produce a low TIER rank, but actually have a greater impact on the reliability of the bulk power system than a facility that produces a higher TIER rank. If the TIER methodology ranking system is treated as the sole criterion for determining impact on the reliability of the bulk power system, that lower-ranking element cannot be considered more critical to the reliable operation of the bulk power system by virtue of its TIER rank.

Elements may be built for different purposes. A transmission circuit that is built for economic purposes and not reliability purposes is not needed for the reliable operation of the bulk power system. However, if the circuit is integrated into the bulk power system for reliability purposes, it is a part of the bulk power system. For example, if the

[19] TIER Report at pp. 13-14.

circuit is used in the determination of Available Transfer Capacity which in turn is used to determine whether additional Firm Transmission Service can be sold by a Transmission Service Provider, that circuit is part of the bulk power system. [20]

Similarly, facilities may be built to address specific reliability situations that infrequently occur. For example, Special Protection Systems (or "Remedial Action Schemes")[21] are necessary for the reliable operation of the bulk power system *only if* a set of specific circumstances arise, such as after the outages of several other elements, (planned or unplanned). While a circuit may not be critical during normal operating conditions, because there are times when that circuit *is* critical for reliability of the bulk power system, it is important that the methodology considers such elements in the analysis. The TIER methodology does not appear to recognize the importance of such circuits. Therefore, a ranking methodology alone may not be adequate.

Additionally, a different ranking methodology may be required for each type of Reliability Standard because one ranking approach may not be capable of adequately addressing all the aspects and complexities of what is important for reliability of the bulk power system given a specific subject area. The Commission should consider the possible application of ranking methodology(ies) coupled with other criteria to determine importance to reliability.

ii. The TIER Methodology Assumes All Lines and Generators are in Service, Which is Not an Accurate Picture of the Grid

The TIER methodology first assumes that all lines and generators are in service at all times, which is not an accurate picture of how the bulk power system is actually operated; there are always lines out at any given time for scheduled maintenance. The

[20] The capitalized terms are defined in NERC's *Glossary of Terms Used in Reliability Standards.*
[21] *Id.*

TIER methodology then assumes that there can only be a true N-1 condition at any given time. The methodology fails to take into account the possibility of more severe, multiple-element contingencies, which is a necessary step in analyzing bulk power system reliability. That is, as topology changes and more than one system element is out of service, the facilities necessary for reliably operating the bulk power system change, and elements that are not critical when all facilities are in service can become critical to the bulk power system as their associated distribution factors change.

Given this scenario, any methodology for identifying bulk power system elements should include an analysis of the possibility of multiple outage (N-2 or higher) conditions on the system.

iii. The TIER Methodology Ignores the Size of Generators in Considering Their Importance to the Bulk Power System

The TIER methodology assigns equal weighting factors to all generators regardless of their size. Therefore, the generator step-up transformers at a 150 MW combustion turbine plant would be determined to have the same TIER values as those at a generating station consisting of two 1,200 MW nuclear units. By not acknowledging that the loss of a large base-loaded facility has a different reliability impact than the loss of a small peaking unit, the TIER methodology seems to unintentionally diminish the importance of those differences. Given that different types of generation have different roles throughout the day, the week, and the year, it would seem appropriate that any modification to the definition of the bulk power system include an approach for recognizing and weighting the related importance of those facilities.

iv. The TIER Methodology Only Considers the Impacts on Generation and Excludes Impacts on Load

The purpose of the bulk power system is to serve load. However, the TIER optimization calculation does not account for elements that may be crucial to serving large amounts of load. For example, three transmission lines (of any voltage) that serve a load pocket with 1,000 MW of load with little or no local generation would receive very low TIER ratings.

While NERC has not conducted an extensive review of proposed alternatives, alternative formulas could be explored. Any alternate ranking calculations should consider weightings that account for the importance of load-serving elements.

v. The TIER Methodology Only Considers the Use of Steady-State Assessment

The TIER methodology uses system topology to rank elements based on a steady-state assessment of the bulk power system. The authors discuss the use of "proxy" flowgates to simulate stability and voltage limits by identifying the equivalent thermal limitation that would result in the condition of concern. However, the authors do not propose a method to identify these limits; only how to include them once they have been identified (presumably through some other process or study). Because voltage and transient stability concerns play a significant role in system reliability over significant parts of the North American electric system, NERC is concerned that further study and analysis of voltage and stability limitations are required in order to thoroughly evaluate the importance of system elements to reliability.

While NERC believes that the use of "proxy" flowgates is an acceptable stop-gap measure for expediency in some cases (*e.g.* near-real time analysis), it is not a robust

enough solution to determine the importance of a system element to reliability when time allows for more in-depth analysis. Stability issues can have significant complexity and interactions that cannot be captured using only a thermal limit. Examples of this can easily be found in the Western Electricity Coordinating Council and Midwest Reliability Organization Regions. Accordingly, a suite of tests, rather than a single methodology, would be needed to identify elements necessary to address all aspects of power system reliability, including those related to voltage and transient stability.

V. Conclusion

NERC appreciates the opportunity to provide comments on the TIER Report. Should the Commission determine that a modified definition of the bulk power system is necessary, NERC respectfully requests that the Commission engage NERC and stakeholders in a deliberative process to develop a modified definition that will ensure that the safety and reliable operation of the bulk power system is maintained.

Respectfully submitted,

/s/ Holly A. Hawkins

Rick Sergel
President and Chief Executive Officer
David N. Cook
Vice President and General Counsel
North American Electric Reliability Corporation
116-390 Village Boulevard
Princeton, NJ 08540-5721
(609) 452-8060
(609) 452-9550 – facsimile
david.cook@nerc.net

Rebecca J. Michael
Assistant General Counsel
Holly A. Hawkins
Attorney
North American Electric Reliability Corporation
1120 G Street, N.W.
Suite 990
Washington, D.C. 20005-3801
(202) 393-3998
(202) 393-3955 – facsimile
rebecca.michael@nerc.net
holly.hawkins@nerc.net

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service list compiled by the Secretary in this proceeding.

Dated at Washington, D.C. this 28th day of October, 2009.

/s/ Holly A. Hawkins
Holly A. Hawkins

Attorney for North American Electric Reliability Corporation