UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Mandatory Reliability Standards for the Bulk Power System	Docket No. RM06-16-000

COMMENTS OF THE TRANSMISSION ACCESS POLICY STUDY GROUP

Pursuant to the Commission's notices of September 10 and October 1, 2009, the Transmission Access Policy Study Group ("TAPS") comments on the preliminary Topological and Impedance Element Ranking ("TIER") Report, prepared by Bernard C. Lesieutre, Christopher L. DeMarco, and Daniel R. Schwarting of the University of Wisconsin-Madison.

As discussed below, while there might be merit in developing a more uniform ranking system to identify facilities that should be included in the bulk power system ("BPS"), TAPS' evaluation of the preliminary TIER Report suggests that this analysis is not well-suited to assist in identifying the importance of facilities for purposes of inclusion in or exclusion from the BPS.

1. The key concept for defining the bulk power system for purposes of applicability of reliability standards is a facility's role in achieving reliable operations – the purpose of reliability standards, which relates to ability to avoid instability, uncontrolled separation, cascading outages. It is not at all clear that TIER values correspond to the relative importance of facilities for reliable interconnected operations.

2. TIER neglects consideration of real parameters that are very important to reliable operations (notably generator size, load levels, stability limits, critical contingencies, etc.), and thus divorces its results from a valid assessment of a facility's contribution to reliability.

3. The TIER determinations are not well-behaved and are contrary to experience and common sense. For example, an incremental generator addition to what was previously a radial to load leads to a large step change in TIER value that

is not justified by reliability impact. And does anyone seriously believe that some <69 kV facilities in PJM are more important for reliability than roughly half of the 765 kV facilities in PJM, as Figure 4.1 of the TIER Report suggests?

4. TIER will not avoid the need for drawing judgmental lines as to what facilities to include in the bulk power system.

In contrast, the bulk electric system ("BES") definition currently in use more reasonably approximates the impact of a facility on grid reliability, and the existing registration criteria provide for inclusion of facilities not otherwise subject to registration if the facility is shown to have a material impact on reliability. We are not aware of any reliability issues associated with facilities now excluded from the bulk electric system. If the Commission nevertheless wishes to pursue this course, TAPS recommends that an industry group be put together through NERC, along with the authors of TIER if desired, to develop a more realistic, more useful method.

I. INTEREST OF TAPS

TAPS is an informal association of transmission-dependent utilities in more than 30 states, promoting open and non-discriminatory transmission access.[1] As entities entirely or predominantly dependent on transmission facilities owned and controlled by others, TAPS members recognize the importance of a reliable bulk power system, properly defined. Many TAPS members (or their municipal members) own distribution systems or low-voltage transmission facilities that do not currently fall within NERC's

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[1] TAPS is chaired by Roy Thilly, CEO of WPPI Energy ("WPPI"). Current members of the TAPS Executive Committee include, in addition to WPPI, representatives of: American Municipal Power, Inc.; Blue Ridge Power Agency; Clarksdale Public Utilities; Connecticut Municipal Electric Energy Cooperative; ElectriCities of North Carolina, Inc.; Florida Municipal Power Agency; Illinois Municipal Electric Agency; Indiana Municipal Power Agency; Madison Gas & Electric; Missouri Public Utility Alliance; Missouri River Energy Services; NMPP Energy; Northern California Power Agency; Oklahoma Municipal Power Authority; and Southern Minnesota Municipal Power Agency.

bulk electric system ("BES") definition, and are concerned that the TIER Report inappropriately suggests that facilities below 100 kV – even as low as 34.5 kV – that have no material impact on reliability should be included within the BPS.

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II. COMMENTS

A. Identification of the Facilities that Fall Within the Scope of the Bulk Power System Needs to Focus on the Statutory Purpose of Reliability Standards: Preventing Cascading Outages

As described in the TIER Report (at 7, footnote omitted), the TIER methodology is intended to identify and rank the BPS elements in terms of importance; to do this, the TIER methodology uses LMP profiles that reflect the degree to which constraining the power flow along a particular "branch" will cause a variation in the optimal dispatch of resources:

> In this report we introduce a method for ranking branch elements in the electric grid (typically lines and transformers), with the purpose of 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 considered part of the Bulk-Power System, 2) identifying the elements needed to operate each of the electric interconnections, and 3) ranking the importance of those elements. A metric, referred to as Topological and Impedance Element Ranking (TIER), is derived that relates

> the impact of controlling the power flow along a branch to variation in an optimal solution for dispatchable resources. Ideally, with no other restrictions, a topological characteristic of a non-BPS element is that variation of power flow in a non-BPS element should have no impact on the marginal cost profile of optimal dispatch.

Application of the methodology yields results showing average importance reduced as voltage is reduced, but with overlap – some 765 kV facilities have a lower ranking than much lower voltage facilities. TIER Report at 8-9. The Report does not propose a breakpoint between BPS and non-BPS facilities, but seems suggestive of a breakpoint in the "transition band" with TIER value ranging from 0 (radials to load) to 0.0001. *See* TIER Report at 8 (discussing the results of the PJM system):

> A notable characteristic of the plot is a sharp transition involving relatively few elements. Prior to this transition, to the left, one observes a gradual decrease in TIER values among the roughly 6000 highest ranked elements each with a TIER value at or exceeding 0.0001. At the transition band with TIER values ranging from 0 to 0.0001, there are 77 elements identified. Beyond the transition, to the right, approximately 2000 lines and transformers connect to radial loads and have identical TIER values equal to zero (as is expected intuitively and hence are off the bottom of the vertical scale in this logarithmic plot). The plot is both informative and suggestive. Connections to radial loads are one topological characteristic of distribution system elements. On the other side, prior to the sharp transition, it is difficult to identify a clear demarcation between elements. The transition identifies a relatively small subset that may require individual consideration of elements.

TAPS recognizes that there could be value in developing a consistent ranking of facilities to assist in identification of which facilities should be included in the bulk power system to which reliability standards are directed. However, to be useful for that purpose, the ranking methodology must be designed to rank facilities in terms of their importance in achieving the purpose of reliability standards, *i.e.*, avoiding instability, uncontrolled separation, and cascading failures as a result of sudden disturbance.

FPA Section 215(a), 16 U.S.C. § 824*o*(a), defines BPS as including "facilities and control systems *necessary* for operating an interconnected electric energy transmission network (or any portion thereof)" and "electric energy from generation facilities *needed* to maintain transmission system reliability," and expressly excludes facilities used in local distribution of electric energy. (Emphasis added.) Because it focuses on the facilities "necessary" or "needed" for operational transmission system reliability, the BPS definition must be interpreted in the context of the related statutory definitions of "reliability standard" and "reliable operations."[2] These definitions, FPA Sections 215(a)(3) and (4), make clear that the focus of reliability standards is achieving reliable operations – avoiding instability, uncontrolled separation, and cascading failures as a result of a sudden disturbance.

> (3) The term ''reliability standard'' means a requirement, approved by the Commission under this section, to provide for reliable operation of the bulk-power system. The term includes requirements for the operation of existing bulk-power system facilities, including cybersecurity protection, and the design of planned additions or modifications to such facilities to the extent necessary to provide for reliable operation of the bulk-power system, but the term does not include any requirement to enlarge such facilities or to construct new transmission capacity or generation capacity.
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> (4) The term ''reliable operation'' means operating the elements of the bulk-power system within equipment and

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[2] This same focus on the facilities necessary or essential to reliable operations is reflected in FPA Section 215(a)(5)'s definitions of "Interconnection" (area where "failure of one or more of such components may adversely affect the ability of the operators of other components within the system to maintain reliable operation of the facilities within their control"), and FPA Section 215(a)(8)'s definition of "cybersecurity incident" (including disruption of "hardware, software and data that are essential to the reliable operation of the bulk power system").

> electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements.

To reflect the statutory intent,[3] the facilities captured by the BPS definition should include those facilities needed to avoid instability, uncontrolled separation, and cascading failures as a result of a sudden disturbance, including a cyber security incident or unanticipated failure of system elements.

NERC currently uses a largely voltage-based definition of the bulk electric system. While there is some variation among the regions, NERC's Commission-approved Compliance Registry Criteria provide for inclusion, on a case-by-case basis, of facilities important to reliability that would otherwise be excluded from registration and therefore from coverage by reliability standards.[4]

> The above are general criteria only. The Regional Entity 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.

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[3] In Order No. 672, the Commission adopted the statutory definitions of "Reliable Operation" and "Reliability Standard" into the Commission's regulations. Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards, Order No. 672, 71 Fed. Reg. 8662, 8668 (Feb. 17, 2006), [2006-2007 Regs. Preambles] F.E.R.C. Stat. & Regs. ¶ 31,204, PP 64, 66, 70, *corrected*, 71 Fed. Reg. 11,505 (Mar. 8, 2006), *on reh'g*, Order No. 672-A, 71 Fed. Reg. 19,814 (Apr. 18, 2006), [2006-2007 Regs. Preambles] F.E.R.C. Stat. & Regs. ¶ 31,212, *modified*, 73 Fed. Reg. 21,814 (Apr. 23, 2008), 123 F.E.R.C. ¶ 61,046 (2008); *see also* 18 C.F.R. § 39.1.

[4] NERC, Statement of Compliance Registry Criteria (Revision 5.0) at 10 (Oct. 16, 2008) (footnote omitted), http://www.nerc.com/files/Statement_Compliance_Registry_Criteria-V5-0.pdf.

TAPS is aware of no reliability concerns associated with facilities now excluded from coverage, nor any problems with the Registry Criteria's case-by-case approach to inclusion of additional facilities when warranted.

It is against the backdrop of the purposes of Section 215 and NERC's current approach to defining which facilities are subject to reliability standards (which seems to be working to achieve those purposes) that TAPS evaluates the TIER methodology as an alternative approach to defining the bulk power system.

B. TIER Does Not Assist in Identifying the Importance of Facilities for Reliability—Preventing Cascading Outages—and Therefore for Inclusion in the BPS

The TIER analysis does not assist in identifying the importance of facilities for reliability purposes. While development of a consistent ranking of facilities with regard to their importance for reliability purposes could be useful, and the idea of making the ranking system independent of cost, load level and dispatch assumptions has conceptual appeal, TIER is not well-adapted for identifying which facilities should be included in the bulk power system that is subject to reliability standards designed to avoid cascading outages.

The TIER Report does not demonstrate how TIER is a measure of the impact of individual system components on reliability, as measured by operation within thermal, voltage, frequency, and stability limits such that instability, uncontrolled separation, cascading failures, or the inability to perform system restoration, will not occur. It is not clear what TIER rankings do say about the individual system components, but they do not seem to correlate with a given element's importance to reliability in the real world. While the TIER methodology correctly eliminates radials to load, TIER's narrow focus on the impact of a 1 MW constraint of a given facility, assuming all other facilities are unconstrained, fails to assess the facility's contribution to reliable operations – avoiding instability, uncontrolled separation, and cascading failures.

A key assumption of the TIER approach seems to be that the change in profile of LMPs resulting from a 1 MW restriction of power flow over a particular transmission element is an indicator of the impact of that element on the reliability of the bulk power system. It is unclear how changes in the pattern of LMPs measure the ability to continue to serve load under various conditions while avoiding cascading outages. Indeed, the TIER calculation is independent of load levels, generation dispatch patterns, generator sizes, transmission element flows, and transmission element limits (capabilities), all of which are among the factors that, in practice, affect the ability to serve load without triggering cascading outages in the event of sudden disturbances.

It is also hard to have confidence in the TIER methodology because it produces results that are contrary to experience and common sense. For example, under the TIER methodology, while a 69 kV radial line connecting a 25 MW load to the grid would have a zero TIER ranking, the addition of a 2 MW behind-the-meter peaking generator that hardly ever runs would dramatically increase the ranking of that 69 kV radial. As discussed below, with the addition of that 2 MW generator, the 69 kV radial would be given the same high TIER value as the 345 kV generator step-up connecting a 1000 MW nuclear unit. Loss of that 69 kV radial line may well affect service to the 25 MW load (in the same way as loss of a radial to load, whose TIER is zero, would no doubt affect service to that load, perhaps even more dramatically). But the addition of a 2 MW generator that merely reduces the net load connected by the radial would not be noticed on the grid, much less be capable of causing a cascading outage. The fact that TIER rankings would be radically altered by an addition that is plainly insignificant from a grid reliability perspective calls into question TIER's usefulness and validity for purposes of assessing inclusion of facilities in the bulk power system.

Indeed, the TIER Report states (at 8), "The overlap in TIER values, between voltage levels, weighs against exclusive use of voltage level as the distinguishing metric in identifying BPS." This statement presumes - rather than demonstrates - that the TIER values are appropriate measures of BPS characteristics. But common sense and experience point to just the opposite. For example, Figure 4.1 of the TIER Report shows facilities below 69 kV in PJM that are identified as more important than roughly half of the 765 kV branches. The TIER Report's untenable findings focus attention on the absence of relationship between what TIER measures and what is really important for reliable operations, which is the purpose of Section 215 reliability standards.

Finally, the TIER approach does not avoid difficult judgments, where regional circumstances may matter, in determining the scope of the bulk power system.

1. TIER Rankings Do Not Measure Importance of a Segment to Grid Reliability

A fundamental and implicit assumption of the TIER approach seems to be that the change in profile of LMPs resulting from a restriction of power flow over a particular transmission element is an indicator of the impact of that element on the reliability of the bulk power system. TIER rankings correlate (as do Generator Shift Factors) with how much redispatch would be necessary to reduce the loading on a given line by 1 MW. But redispatch is not a measure of reliability; even if redispatch as used in TIER does not depend on cost information, it remains more of an economic metric than a reliability metric. If more than enough generation is available for redispatch, the need for redispatch has nothing to do with the susceptibility of the system to instability, uncontrolled separation, or cascading failures.[5]

The need to dispatch generation on one side of a transmission constraint out-of-economic merit order is irrelevant from a reliability perspective, as long as there is more than enough generation. Said another way, the TIER valuation is based on the impact of a system element on the "optimal" operation of the system. The TIER sensitivity index measures the marginal impact of an element on optimal operation, as opposed to ranking the element's significance in terms of threat or contribution to the reliability of the system. As a result, the model cannot be counted on to rank facilities having the greatest impact on reliability with the highest TIER values, or vice versa. It is therefore not helpful in assessing which facilities should be included in the bulk power system.

2. Size Matters to Grid Reliability; 1 MW Changes Do Not

From the perspective of the statutory purpose of reliability standards—achieving reliable operations by avoiding instability, uncontrolled separation, and cascading failures as a result of sudden disturbances—a 1 MW change in the system does not matter; what matters for grid reliability is the ability to accommodate unplanned changes of hundreds or thousands of MWs. The TIER methodology, however, focuses on marginal impacts – identifying the LMP changes associated with constraining an individual element by 1 MW. As a result, TIER rankings fail to reflect the relative importance of facilities for grid reliability.

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[5] For instance, if there is 2000 MW of load on one side of a constraint and 5000 MW of expensive generation on that same side of the constraint, but the constraint is limited to 1000 MW SOL, is the system unreliable? Not with almost a 300% reserve margin.

All TIER calculations are based on marginal (*e.g.*, the next infinitesimal MW, commonly determined as 1 MW) impacts. In any given system, all generator step up units ("GSUs") and radials connecting a generator will have the same, relatively significant TIER value, although that value will vary depending on the size of the system considered. This relationship was identified at page 27 of the TIER Report ("The TIER values for radial transmission elements that connect generators to the rest of the transmission system are all equal."). It was further explained by one of the authors at the September 22, 2009 Technical Conference. *See* Tr. 44-46 (emphasis added): [6]

> MR. SCHWARTING: I think what we were really trying to show here was that if there was constraint on the generator step-up transformer, or similarly a line that independently connected the generator to the rest of the network, that constraint would affect--it would have a fairly large effect on the Lagrange Multiplier at that generator. And it actually does have a very small effect. It's not exactly zero, but on this graph it is very close, a very small effect on the Lagrange Multipliers, or LMPs at every other generator in the system.
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> And depending on the size of the system--well, first of all let me say that *one result of this is that any generator step-up transformer actually ends up having the same TIER Value*. They will all have a plot that looks almost identical to this one, the only difference being that the single generator that has the very high impact will change which generator that is from one GSU to the next.
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> *As a result, they all do end up having the same TIER Value*. In very small systems such as the 9-bus example that we had earlier in our presentation, that equal TIER Value for all GSUs will usually be the most important, the highest TIER Value in the system.

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[6] Mr. Schwarting was responding to questions referring to slide 30 of the PowerPoint presentation (which corresponds to Fig 3.5 in the TIER Report) and slide 34 (the TIER curve for the Eastern Interconnection).

> As the system gets larger, that value usually will start to drop and not be the most important. If I may jump back actually a couple of slides here, let me actually go to the one for the Eastern Interconnection, the last slide in our presentation here.
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> You can see just above the TIER Value of .01 there's a flat spot in our graph. And that flat spot in the graph actually indicates that that set of generator step-up transformers, or radial generator connections, that all have the same exact TIER Value. And as you can see in this graph, they're not the most important--they're no longer the most important elements in the system. They are still fairly important, but there are some transmission elements that rise above that in importance once you get to a larger system.

The GSU or 34.5 kV radial connecting a 1 MW diesel generator that runs a few hours a year has the same TIER value as the GSU connecting a 1000 MW nuclear plant, whose sudden loss can have a significant impact on reliable operations. For TIER purposes, 1 MW is 1 MW, regardless of whether it's the entire plant capacity or one one-thousandth of its capacity.

TIER's focus on marginal calculations prevents it from being useful to assessing which facilities have an impact on reliable operations – avoiding cascading outages – and which facilities therefore should be included in the bulk power system subject to reliability standards designed to avoid such outages. Power system reliability depends on large quantities of power (*e.g.*, operating reserves are typically based on the largest loss of source which is typically > 1000 MW), not single MW constraints. It is not apparent that marginal calculations have any relationship to importance to reliability. A methodology that gives the same TIER value to every GSU, regardless of size of the generator, defies experience as a measure of importance to reliability. It fails to distinguish the facilities that are significant to maintaining reliability in the event of sudden loss of a major generator from the local impact (if any) associated with loss of a behind-the-meter peaking generator connected to the grid by a low-voltage radial line. Similarly, it is common sense that a transmission line rated for 1000 MVA has a different impact on reliability than a transmission line rated for 100 MVA, yet the TIER value of facilities is independent of their facility ratings.

By focusing on the marginal calculation, the TIER methodology also fails to accurately assess the impact of loss of particular transmission facilities on reliability. Under the TIER methodology, no lines are actually considered to be taken out of service to assess their importance. Rather, each line is evaluated separately as a constraining facility, *i.e*. operating at its limit with a 1 MW constraint, but not as an outaged facility.

In short, the only thing that TIER seems to measure is what redispatch is needed to reduce the loading on a facility by 1 MW, which is not a reliability metric (as discussed above), and produces rankings having little to do with what is more important for reliability purposes. That is, it tells you little or nothing about whether loss of that facility is likely to contribute to a cascading outage.

3. "Real" Constraints Matter, Not the Limited Artificial Constraints that TIER Assumes

The TIER methodology assumes no constraints except for those introduced by constraining the studied facility by 1 MW. It assumes that absent the 1 MW constraint imposed on the facility being studied, locational marginal prices would be uniform (*i.e.*, equal at every generator or dispatchable resource). The TIER analysis then ranks elements by their relative ability to impact LMPs. The only inputs into the TIER calculation are branch topology (pattern of connections), branch impedances and whether a bus is a generator bus.

TIER's analysis is far removed from the real world in which the contribution of a facility to avoiding cascading outages should be assessed. The bulk power system is operated to real facility ratings and real System Operating Limits ("SOL"), not to artificial constraints (or lack thereof) as used by the TIER methodology to make the optimization model work without the use of cost or load information or dispatch assumptions. TIER omits a great deal of important detail on how a given system operates (*e.g.*, generator size), and what and where susceptibilities to reliability problems are.

Even if one were to agree that an optimization model could be used to identify the importance of elements from a reliability perspective (and we do not), TIER's failure to account for factors important to reliability divorces this method from realistically reflecting what happens on the system and thus prevents it from yielding meaningful results. Evaluation of the importance of various facilities to reliability would necessitate adding generator cost information, load information and dispatch assumptions, so that the modeling would actually optimize dispatch using real constraints, rather than an artificially unconstrained system. However, introduction of those variables would make the rankings dependent on cost information, load level and dispatch assumptions, and therefore subject to change from hour to hour as load level and dispatch change. Modifying TIER to account for real world constraints would therefore not be useful for the intended purposes of identifying BPS facilities – a methodology whose rankings change on an hourly basis could not be used for determining which facilities are included in the bulk power system and subjected to reliability standards.

Thus, for the TIER methodology to have practical application, it must be rendered artificial and unrealistic by eliminating cost, load level and dispatch assumptions, but that artificiality prevents TIER and its rankings from being useful for identifying BPS facilities. The TIER method boils down to a calculation of how a given branch would be affected by incremental flows between generators on the system, which is determined strictly by network topology and impedance in the linear simplification. It totally disregards system conditions, *i.e.* load, generator cost characteristics, dispatch, branch ratings and other flow constraints faced in actual operations. Aside from the facility under consideration, there is no consideration of congestion. TIER therefore disregards factors that would play an important role in determining the importance of a facility to the reliable operation of the grid.

In sum, even if one can get past the disconnect between optimal dispatch and reliability, TIER would not be useable for BPS identification purposes. The methodology confines itself to an imaginary virtually unconstrained world. By divorcing itself from real world conditions, TIER produces results that have little or no relationship to the importance of facilities to reliability.

4. TIER Produces Irrational Results from the Perspective of Identifying Facilities' Importance for Reliable Operations

The TIER Report's explanation of why certain low-voltage facilities will have high TIER rankings illustrates the irrationality of the results produced by TIER. The Report (at 41) gives an example of load with a generator whose capacity is less than the load's peak, served by two 69 kV radials, and explains that the relatively high TIER value (0.0335) is justified because constraining either of the lines will have a large effect on the generator at this location, which will have to run at full output to serve that load. But why is that relevant in term of reliable operations – avoiding cascading outages? The loss of one of the radials (or the generator) might affect service to the load at the 69 kV bus (just like loss of a radial-to-load would affect service to the load at the end of that radial), but it would not affect reliable operation of the grid. The TIER Report's attempt to explain away what it terms an "anomaly" only highlights the limited utility of the TIER rankings.

Similarly, as noted above, all generator step-up units or radial generator leads – regardless of the size of the generator – have relatively high TIER rankings, and would presumably be included in the bulk power system. (As described at the Technical Conference, Tr. 44-46, quoted above, these rankings are reflected in the flat region of the TIER ranking curve, extending from about 700 on the horizontal scale to about 1500 for the PJM curve included in the Report as Figure 3.1.) The TIER rankings of these generator radials would be the same, regardless of whether the generator is a 1000 MW nuclear plant, or a 1 MW behind-the-meter diesel that runs a handful of hours per year. Nor is it clear that TIER would treat differently distributed generation, or even a rooftop solar photovoltaic panel whose failure would not even impact the service to an individual home; would that too have the same TIER value as the nuclear plant's GSU?

It also defies common sense and experience (*i.e.*, as to what contributes to cascading outages) that a large number of 69 kV networked branches – and even a non-negligible number of branches below 69 kV – are given TIER values greater than the lowest-ranked 765 kV branches, and that are well within the range of TIER values for higher voltage facilities. Indeed, as noted above, Figure 4.1 of the TIER Report goes so far as to suggest that some below 69 kV facilities in PJM are more important than half the 765 kV branches in PJM.

In addition, a methodology should not be treated as a rational basis to determine the scope of the bulk power system where changes that are insignificant from the standpoint of reliable operations can radically change the ranking of a facility. For example, radials to load have a TIER value of zero. TIER Report at 8. Accordingly, typical low-voltage radials serving small loads would not be categorized as part of the BPS under the TIER methodology. As discussed at the Technical Conference (Tr. 53-54), multiple radial lines serving the same load bus would have zero TIER value, and would also excluded from the BPS threshold. However, once a generator – no matter how small – is added to the radial load, these rankings would increase dramatically.

Consider a 25 MW load that adds a 5 MW diesel generator at the end of a 46 kV radial line. The TIER calculation would catapult what was formerly a radial-to-load with a zero TIER value into the same high TIER ranking as the GSU for a 1000 MW plant and presumably into the set of BPS facilities.[7] The TIER methodology is not well-behaved, because a step change in TIER value results from a very small, nearly incremental, change in installed generation. Any valid assessment of facilities to be included in the bulk power system should be less volatile and better-behaved than this.

5. Adoption of the TIER Methodology Would Not Eliminate Controversy and Judgment as to the Definition of BPS

The TIER methodology is hardly a self-executing method for determining, on a non-discriminatory basis, which facilities should be included in the bulk power system for application of reliability standards. For instance, the TIER Report raises but does not answer the key, judgmental issue of at which point in the rankings is the cutoff between

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[7] Indeed, as noted above, potentially the addition of a rooftop solar panel would yield the same result.

BPS and non-BPS facilities. TIER Report rightly excludes all radials to load, but (Report at 38-39) seems to suggest an intent to capture all but less than 1% of the non-radial-to-load facilities 34 kV and above as BPS using a cut off of 0.0001, which seems extremely over-inclusive. *See also* TIER Report at 8, quoted above, which is suggestive of a breakpoint in the "transition band" with TIER value ranging from 0 (radials to load) to 0.0001. The TIER Report, however, provides no support for establishing the threshold at such a *de minimis* level. Thus, use of TIER rankings plainly does not avoid the inherently judgmental issue of where in the rankings the BPS cutoff should be.

In addition, although TIER appears to be an attempt to move away from the current BES approach, which may not be consistent across regions and draws bright lines between line voltages and generator sizes, the TIER approach is dependent on many judgmental and potentially rather arbitrary decisions. These implicit judgments are not apparent from the TIER Report's examples, which start from specific models that include some generators and lines, and exclude other (smaller and lower-voltage) facilities. But, if the Commission adopts the TIER methodology for determining the scope of the bulk power system, it will then have to decide which lines and generators should be included in the models to which the methodology is applied.

While the TIER Report authors stressed the importance of a complete model (*see, e.g.*, Tr. 39), the question of how complete is complete will remain a matter for debate. Current models are typically built from smaller, area-specific models, which do not necessarily include the appropriate set of facilities for TIER analysis, and do not employ consistent criteria as to which facilities to explicitly represent. For example, models may differ on the number of small, low-voltage-connected generators that are included.

Existing models almost certainly reflect inconsistent criteria as to which small generators are included the model. Region-specific reasons why more or fewer facilities should be included in the model are likely to make it difficult, and potentially undesirable, to use identical modeling parameters throughout the country. Thus, TIER-based approaches to deciding which facilities should be included in the BPS do not avoid judgments inherent in defining the BPS or the potential for regional differences.

Nor would modeling-related controversies end there. As the TIER Report authors noted (Tr. 45), the size of the system modeled affects the level of the TIER rankings. In addition, as noted above, rankings are dependent upon the grid topology and the "completeness" of the model. But how accurate are the system models that are the basis for the TIER analysis, particularly given its extreme sensitivity to the inclusion of very small generators? How will the models be tested to ensure that they are correct representations of the systems under study? How frequently will that analysis be performed?

The dependence of the result on grid topology also means that the TIER rankings will be different as the network changes over time. That factor gives rise to questions as to the frequency of changes to the determination as to whether a particular facility should be included in the bulk power system for purposes of applicability of reliability standards, *i.e.*, once an element is identified as either in or out of the bulk power system, can that determination be changed at a later date, how often, and what is the process? And who will maintain the master model(s); how does the model(s) get updated; and how often?

In short, adoption of TIER would not eliminate controversy or assure non-discriminatory, consistent determinations as to facilities to be included in bulk power system.

CONCLUSION

While the TIER methodology appropriately confirms the exclusion from the bulk-power system of radials to load, regardless of voltage, the TIER approach does not significantly contribute to the BPS/non-BPS delineation. In contrast, the BES definition currently in use more reasonably approximates the impact of a facility on grid reliability. We are not aware of reliability issues associated with facilities excluded from the BES.

If the Commission nevertheless wishes to pursue this course, TAPS recommends that an industry group be put together through NERC, along with the authors of TIER if desired, to develop a realistic, useful method. TAPS members have ideas for alternative ranking systems and we are sure others do as well.

Respectfully submitted,

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