UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Transmission Relay Loadability Reliability Standard	Docket No. RM08-13-000

COMMENTS OF THE TRANSMISSION ACCESS POLICY STUDY GROUP

Pursuant to the Commission's May 21, 2009 Notice of Proposed Rulemaking[1] ("NOPR") and its July 13, 2009 Notice of Extension of Time,[2] the Transmission Access Policy Study Group ("TAPS") comments on the Commission's proposal to direct the North American Electric Reliability Corporation ("NERC") to significantly expand the applicability of and develop modifications to PRC-023-1. As discussed below and supported by the attached Affidavit of Frank Gaffney, Florida Municipal Power Agency,[3] TAPS urges the Commission to approve PRC-023-1 as proposed by NERC on July 30, 2008,[4] as corrected February 4, 2009,[5] giving the due weight to NERC's technical expertise required by statute, and without requiring NERC to expand applicability or modify its proposed Transmission Relay Loadability ("TRL") Reliability Standard.

Reliability Standard PRC-023-1, as proposed by NERC, strikes an appropriate balance. NERC's restrictions on applicability focus the standard on the facilities that are

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[1] Transmission Relay Loadability Reliability Standard, 74 Fed. Reg. 25, 461 (proposed May 21, 2009), IV F.E.R.C. Stat. & Regs. ¶ 32,642.

[2] *Available at* eLibrary Accession No. 20090713-3041.

[3] Affidavit of Frank Gaffney, Florida Municipal Power Agency, on Behalf of the Transmission Access Policy Study Group, Attach. 1 ("Gaffney Aff.").

[4] *Available at* eLibrary Accession No. 20080730-5136.

[5] *Available at* eLibrary Accession No. 20090204-5097.

likely to have an impact on preventing thermal cascading outages – facilities in excess of 200 kV plus facilities between 100 kV and 200 kV identified by Planning Coordinators as critical for this purpose, consistent with the recommendations of the Final Blackout Report.[6] NERC's proposed applicability reasonably balances the intended purpose of the standard with avoiding over-applicability to a great number of facilities that are unlikely to have any impact on thermal cascading outages. In this way, NERC's proposal is crafted to avoid placing substantial burdens on NERC, its Regional Entities, and registered entities, including many small entities, that would not significantly advance the objectives of this standard and that could detract from other activities more central to bulk power system reliability. Similarly, the substantive requirements of PRC-023-1, including the Attachment A, Section 3 exclusions, strike an appropriate balance between the purposes of PRC-023-1's transmission relay loadability requirements – avoiding thermal cascading – and other important reliability concerns, such as equipment protection, particularly in the case of multiple or extreme contingencies.

Given the highly technical nature of this standard, the Commission should follow the Federal Power Act ("FPA") Section 215(d)(2)'s (16 U.S.C. 824*o*(d)(2)) directive to "give due weight to the technical expertise of the Electric Reliability Organization with respect to the content of a proposed standard or modification to a reliability standard" in assessing whether the standard is "just, reasonable, not unduly discriminatory or preferential, and in the public interest." This is precisely the type of standard where the Commission should not substitute its judgment for that of NERC and the industry, as

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[6] U.S.-Canada Power System Outage Task Force, Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations (April 2004) ("Final Blackout Report"), *available at* http://www.ferc.gov/industries/electric/indus-act/blackout.asp (last visited Aug. 17, 2009).

reflected in the standard developed and approved through NERC's Commission-approved standards development process, as to how to balance considerations of different types of threats to reliability as well as an assessment of cost relative to impact on the bulk power system. Specifically, the Commission should:

- Approve the Applicability section of PRC-023-1 as proposed by NERC; do not expand the standard's applicability to all facilities between 100 kV and 200 kV, or facilities under 100 kV determined to be critical for TO/TOP registration; and do not direct NERC to develop a modified standard that makes PRC-023-1 applicable to generator step-up and auxiliary transformers;

- Approve the substantive provisions of PRC-023-1 as proposed, giving due weight to NERC's expertise, including:

    - Refrain from directing NERC to develop a maximum allowable reach for zone 3/zone 2 relays applied as remote circuit breaker failure and backup protection beyond what is already implicit in the proposed standard;

    - Give due weight to NERC's decision not to require applicable entities to use protective relay systems that can differentiate between faults and stable power swings, rather than harming reliability by adopting the NOPR's proposal;

    - Refrain from directing NERC to modify PRC-023-1 to harmonize with TOP-004-1, recognizing that there is no conflict between the standards;

    - Refrain from directing NERC to develop unnecessary modifications to PRC-023-1 R1.10;

    - Give due weight to NERC's expertise with respect to PRC-023-1 R1.12;

- Give due weight to NERC's expertise with respect to the Attachment A, Section 3 exclusions from applicability;

- Refrain from requiring NERC to shorten the timelines for implementing the standard; and

- Particularly if the Commission adopts any of the NOPR's proposed directives with respect to applicability, the substance of, or exclusions from the NERC-proposed standard, revise the NOPR's Regulatory

> Flexibility Act certification to reflect the very significant impact the revised standard would have on small entities.

At most, the Commission should approve the standard while directing NERC to consider *whether* the concerns identified by the Commission merit a change in the standard, rather than deciding such highly technical issues and prescribing the actions to be taken by NERC, as the NOPR proposes.

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.[7] As entities entirely or predominantly dependent on transmission facilities owned and controlled by others, TAPS members recognize the need to avoid the thermal cascading outages that PRC-023-1 was designed to protect against. At the same time, as owners of transmission facilities with voltages below 200 kV that have little or no operational significance to cascading outages, TAPS members seriously question the NOPR's proposals to dramatically expand the reach of these requirements and direct modifications to this highly technical standard, thereby imposing unnecessary costs; needlessly burdening small systems; diverting the attention of NERC, its Regional Entities, and registered entities away from efforts of far greater consequence to bulk power system reliability; and eroding protections against other important threats to reliability.

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[7] 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.

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II. NERC'S PROPOSED APPLICABILITY OF PRC-023-1 IS REASONABLE AND WARRANTS DEFERENCE

As described in the NOPR P 15, NERC proposes that PRC-023-1 apply to transmission owners, generator owners, and distribution providers with load-responsive phase protection systems described in Attachment A to PRC-023-1, with regard to: (1) all transmission lines and transformers with low-voltage terminals operated or connected at 200 kV and above; and (2) those transmission lines and transformers with low-voltage terminals operated or connected between 100 kV and 200 kV that are designated by Planning Coordinators as critical to the reliability of the bulk electric system.

The NOPR proposes to direct NERC to dramatically alter the applicability of PRC-023-1. Specifically, it proposes to presumptively apply the standard to *all* facilities between 100 kV and 200 kV, with provision for case-by-case exceptions for what it expects to be the rare facility not critical to the reliability of the bulk electric system – that "demonstrably would not result in cascading outages, instability, uncontrolled separation, violation of facility ratings, or interruption of firm transmission service." NOPR P 43. It also proposes to sweep in facilities *below* 100 kV that have been designated by the Regional Entity, as reflected in TO/TOP registrations pursuant to the

Compliance Registry, as necessary for the reliable operation of the bulk electric system. *Id.* P 44.

The NOPR also seeks comments on whether the Commission should assure that the applicability of PRC-023-1 to generator step-up and auxiliary transformers that NERC omitted from PRC-023-1 be timely addressed through a new or modified standard. *Id.* P 48.

As to all of these applicability issues, TAPS strongly urges the Commission not to pursue the course proposed in the NOPR, but instead to accord the required "due weight" to NERC's technical expertise. By doing so, the Commission would allow NERC to balance conflicting factors as Order 672 rightly provided,[8] permissibly considering the size of the entities that must comply with the standard and associated cost relative to their impact on the bulk power system.[9]

A. The Commission Should Approve NERC's Proposed Application of PRC-023-1 to Facilities Between 100 kV and 200 kV Designated Critical

As noted above, NERC's proposed PRC-023-1 would apply to all facilities 200 kV and above, as well as those transmission lines and transformers with low-voltage terminals operated or connected between 100 kV and 200 kV that are designated by Planning Coordinators as critical to the reliability of the bulk electric system. NERC's

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[8] 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 (Feb. 17, 2006), [2006-2007 Regs. Preambles] F.E.R.C. Stat. & Regs. ¶ 31,204 ("Order 672"), *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).

[9] *See id.* P 330 ("A proposed Reliability Standard may take into account the size of the entity that must comply with the Reliability Standard and the cost to those entities of implementing the proposed Reliability Standard" so long as it does not propose a "lowest common denominator" standard, which PRC-023-1 plainly does not).

proposed applicability reasonably balances factors to achieve the purpose of PRC-023-1 – avoiding thermal cascading outages – consistent with the Final Blackout Report.

NERC's Petition[10] explained (at 19) that it adopted voltage-specific applicability to address the variation among the Regions in defining the bulk electric system, and based on its assessment that extending applicability indiscriminately to all 100-200 kV facilities would vastly increase implementation costs while producing little benefit to bulk power system reliability and undermining other efforts with a greater impact on reliability:

> On this issue, the standard drafting team also considered that the unilateral imposition of these requirements upon all 100 kV and above circuits … would establish an increase of the implementation costs by approximately two orders of magnitude above those endemic in the proposed standard as drafted, and that this cost increase would distract financial, analytical and staffing resources from other areas with a higher effect on reliability. Subjecting such circuits to this Standard (absent determination of criticality as established in the requirements) would have little additional benefit to the reliability of the interconnected system.
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> The standard drafting team, when considering these factors, decided that the system applicability should be to all 200 kV and above circuits, and those lower voltage level circuits that are specifically determined to be critical to the reliability of the bulk electric system.

As NERC further explained (Petition at 22-23), limiting applicability as proposed is consistent with Order 672's directive (P 328) to "achieve its reliability goal effectively and efficiently" recognizing the different characteristics and relay equipment used in lower voltage lines. NERC (Petition at 23-24 and Ex. C) described the technical

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[10] Petition of the North American Electric Reliability Corporation for Approval of PRC-023-1 Reliability Standard, filed July 30, 2008 in Docket No. RM08-13-000 ("Petition"), *available at* eLibrary Accession No. 20080730-5136.

justifications for its standard and the efforts undertaken to validate them, and demonstrated (Petition at 24) that this proposal is by no means a "lowest common denominator" compromise that the Commission should second guess:

> The proposed reliability standard is not a "lowest common denominator," and does not reflect a compromise that fails to adequately protect bulk power system reliability. The proposed standard establishes a first-ever, challenging threshold through a set of minimum requirements that will considerably advance the formalization of preventative settings and operations of protective equipment. This will serve the important reliability goal of minimizing the contribution of protective relays to future system events. While these requirements are "minimum" requirements, they have been determined by careful analysis of Facility Ratings, and by review of practical System Operating Limits to establish base thresholds not in existence heretofore, and carefully balance those thresholds with the need to provide effective fault protection for the affected circuits.

The NOPR (PP 41-43) relies on the Final Blackout Report to dispute NERC's expert assessment, but the NOPR's own recitation of the relevant reports demonstrates that NERC's restriction of applicability to facilities between 100 kV and 200 kV identified as critical for the purpose mirrors the Final Blackout Report's recommendation. See NOPR P 41 (emphasis added) (footnotes omitted):

> In its report on the 2003 blackout, NERC recommended that all transmission owners should evaluate the zone 3 relay settings "operating at 230 kV and above." In the Final Blackout Report, the Task Force recommended that NERC go further than it had proposed and "broaden the review to include *operationally significant* 115 kV and 138 kV lines, e.g., lines that are part of monitored flowgates or interfaces."

Contrary to the NOPR's suggestion (*id.*), NERC's restriction of applicability to facilities determined by the Planning Coordinator ("PC") to be critical is fully consistent

with the 2003 Final Blackout Report. It is reasonable to construe the term "critical" as used in PRC-023-1 for the purpose of determining which relays must be set to reduce the likelihood of cascading thermal outages consistent with the "operationally significant" terminology used in the Final Blackout Report.

In contrast, the NOPR's proposal to subject virtually *all* facilities between 100 kV and 200 kV to compliance with PRC-023-1 is clearly at odds with the Final Blackout Report's focus on "operationally significant 115 kV and 138 kV lines." NOPR P 41. The NOPR's description of its proposal (P 43) highlights the NOPR's departure from the Final Blackout Report's recommendation on which it relies:

> The Commission expects that a comprehensive process to determine which facilities are critical to the reliability of the bulk electric system should necessarily identify nearly every facility operated at or above 100 kV. This is because a large percentage of the bulk electric system not only falls into the 100 kV to 200 kV category, but also supports the reliability of the high voltage transmission system (200 kV and above). Therefore, the Commission proposes to direct the ERO to modify PRC-023-1 to make it applicable to all facilities operated at or above 100 kV. The Commission recognizes that there might be a few limited examples of facilities operated between 100 kV and 200 kV that are not critical to the reliability of the bulk electric system. Therefore, the Commission also proposes to consider exceptions on a case-by-case basis for facilities operated between 100 kV to 200 kV that demonstrably would not result in cascading outages, instability, uncontrolled separation, violation of facility ratings, or interruption of firm transmission service.

The Final Blackout Report's reference to "operationally significant 115 kV and 138 kV lines, *e.g.*, lines that are part of monitored flowgates or interfaces" (as quoted in the NOPR P 41) cannot be squared with the NOPR's narrow provision for "a few limited examples" where facilities "demonstrably would not result in cascading outages,

instability, uncontrolled separation, violation of facility ratings, or interruption of firm transmission service." NOPR P 43.

It is also significant that under the industry-developed and NERC-approved PRC-023-1, the Planning Coordinator has responsibility to designate the facilities from 100 kV to 200 kV that are "critical to the reliability of the Bulk Electric System." PRC-023-1, A.4.1.2, A.4.1.4. Contrary to the Commission's suggestion (NOPR P 40), there is no basis to assume that Planning Coordinators will fail to do their job in making such identification. In many cases, the Planning Coordinator will be an entity other than the transmission owner whose facilities are being assessed. In RTO and ISO areas, the PC tends to be the RTO/ISO, an independent entity entrusted with ensuring the operational reliability of the grid.[11] There is every reason to have confidence in an RTO's independent judgment.

Even outside of RTOs, the PC often has responsibility covering entities other than itself. If the Commission is concerned about the quality of the assessment performed by the PC where the PC is assessing its own facilities, creating the potential for a self-serving assessment, the answer is to put a check in place in those limited circumstances. TAPS would not object to having the Regional Entity make the criticality determination in non-RTO regions in circumstances where the PC would otherwise be making a determination as to whether its own facilities are critical.

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[11] 18 C.F.R. § 35.34(j)(3) and (4).

The concerns evinced by the NOPR (P 40 & n.66) with regard to the CIP-002 critical asset identification are distinct substantively[12] and procedurally from NERC's proposal to require PCs to designate facilities between 100 kV and 200 kV that are critical for purposes of PRC-023-1. And any residual concern about self-certification in the regions without RTOs/ISOs can be addressed by a more narrow solution (*i.e.*, designation of the Regional Entities as making the criticality determination in the absence of an independent PC). They certainly do not support the NOPR's shift to an "opt-out" approach, with the assumption, contrary to the Final Blackout Report, that virtually all facilities operated at 100 kV are critical for purposes of avoiding thermal cascading outages.

Further, the NOPR's proposal to presumptively include all facilities from 100 kV to 200 kV is more likely to detract from reliability than improve it. As NERC concluded, expansion of applicability to include all facilities in excess of 100 kV will significantly burden all involved, without improving reliability, and will distract from activities of greater value to reliability. *See* NERC Petition at 19.

NERC is well within its responsibility in assessing the number and size of entities that would have to comply with PRC-023-1 if extended to all facilities in excess of 100 kV and the cost of such compliance, relative to reliability benefits, as Order 672 expressly provides. *See* Order 672, P 330; *see also id.* P 328. NERC's assessment that "subjecting all facilities operated above 100 kV to PRC-023-1 would increase implementation costs 'by approximately two orders of magnitude' and distract financial,

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[12] The determination of a "critical" facilities between 100 kV to 200 kV for purposes of PRC-023-1 relay loadability requirements is distinct from the determination of "critical assets" under the risk-based assessment set forth in CIP-002.

analytical, and staff resources from other areas that might have a greater impact on reliability" (NERC Petition at 19) cannot be dismissed by a generic statement of the importance of avoiding cascading outages. *See* NOPR P 42.

Thus, the Commission should not adopt the NOPR's proposal to apply PRC-023-1 to all facilities between 100 kV and 200 kV (subject to limited "opt-out" in rare cases), but instead should approve and endorse NERC's proposed standard as applicable to facilities designated by the Planning Coordinator as critical to the reliability of the bulk electric system. If the Commission has concerns about self-serving determinations as to criticality, it should direct NERC to develop a revised standard that moves that determination to an independent entity in those limited cases where the PC and the TO are the same. But the Commission should adhere to NERC's "add in" scheme, as a technically reasonable approach that wisely balances the resources of the Regional Entities and the many registered entities that would be diverted from tasks more important to grid reliability.

If, despite its statutory deference requirement and the demonstration by NERC, as supplemented above, that coverage of all 100+ kV facilities is unnecessary and counterproductive, the Commission nevertheless adheres to its opt-out scheme, it should at least remove the unjustified presumptions that "nearly every facility operated at or above 100 kV" is "critical to the reliability of the bulk electric system" and that only a "few limited examples of facilities operated between 100 kV and 200 kV … are not critical to the reliability of the bulk electric system." *Id.* P 43. As described in the accompanying Affidavit of Frank Gaffney at ¶¶ 3-9, neither of these determinations is consistent with a realistic assessment of which facilities are "operationally significant"

for purposes of avoiding thermal cascading outages. As Mr. Gaffney explains, in the Florida Reliability Coordinating Council region, only about 5% of facilities between 100 and 200 kV, when individually removed from service, "cause loading beyond Normal Rating on other facilities," and "[a]n analysis that takes a wide-area view… in other Regions will likely have similar results." Gaffney Aff. ¶ 9.

Further, the Commission should make explicit that its reference to "nearly every facility operated at or above 100 kV" (NOPR P 43) is intended to exclude facilities that are not included in NERC's Bulk Electric System ("BES") definition. As set forth in NERC's Statement of Compliance Registry Criteria (Revision 5.0) (at 4)[13], and approved in Order 693[14] at PP 95-96, NERC defines BES 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.

Radials to load of 100 kV and higher that are not even within the BES definition plainly cannot be deemed "critical to the reliability of the bulk electric system" as the NOPR might be read to suggest. Nor can radials be reasonably construed to be included in the operationally significant facilities between 100 kV to 200 kV referenced in the Final Blackout Report. Indeed, inclusion of radials is particularly senseless in the context of

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[13] *Available at* http://www.nerc.com/files/Statement_Compliance_Registry_Criteria-V5-0.pdf (last visited Aug. 17, 2009).

[14] Mandatory Reliability Standards for the Bulk-Power System, Order No. 693, 72 Fed. Reg. 16,416 (Apr. 4, 2007), [2006-2007 Regs. Preambles] F.E.R.C. Stat. & Regs. ¶ 31,242 ("Order 693"), *effective date stayed*, 72 Fed. Reg. 31,452 (June 7, 2007), *aff'd*, Order No. 693-A, 72 Fed. Reg. 40,717 (July 25, 2007), 120 F.E.R.C. ¶ 61,053 (2007).

PRC-023-1, a standard designed to prevent over-tripping of parallel paths that may cause thermal cascading outages. Gaffney Aff. ¶¶ 5-6.

Thus, the Commission should make clear that its reference to "nearly every facility operated at or above 100 kV" as critical was intended to exclude radial facilities not covered by the BES definition and was not intended to expand the entities subject to registration. Otherwise, the Commission's action will have departed from its approved Registry Criteria without justification, and exponentially expanded the number of registered entities and registered facilities without any basis to demonstrate that these facilities have any impact on the bulk electric system, much less the critical impact the Commission recognizes as the test for inclusion in PRC-023-1. However, the unjustified burden on many entities, particularly small entities, will be enormous.

In addition, if the Commission determines to pursue the NOPR's unjustified course, it should revamp the NOPR's test for opting out to directly address the purpose of the standard at issue. The proposed exclusions for "facilities operated between 100 kV to 200 kV that demonstrably would not result in cascading outages, instability, uncontrolled separation, violation of facility ratings, or interruption of firm transmission service" (NOPR P 43) exact far more than a showing that the facility is not likely to contribute to a cascading thermal outage absent application of PRC-023-1. For example, the exclusion plainly should not be tied to a demonstration unrelated to the purpose of PRC-023-1, *i.e.*, whether the line would "result in … interruption of firm transmission service" (*id.* P 43). Interruption of firm transmission service is a business issue, not a reliability issue. Similarly, the NOPR's reference to "violation of facility ratings" is unduly vague and over-broad. For example, the generalized reference to facility ratings is not restricted to

bulk electric system facilities other than the facility in question; nor is the test focused on violation of emergency ratings caused by outage of the facility in question. The over-broad way the NOPR's proposed tests are described will unduly raise a barrier to the exclusion of facilities between 100 kV to 200 kV that have no likely impact on cascading bulk electric system outages, thereby unnecessarily increasing the analysis and compliance burden without contributing to reliability.

We note that a literal reading of the NOPR suggests that the Commission contemplates that it would make the proposed case-by-case determinations as to which facilities between 100 kV and 200 kV may be excluded from applicability: "[T]he Commission also proposes to consider exceptions on a case-by-case basis for facilities operated between 100 kV to 200 kV." NOPR P 43. Requiring each entity to go through a process at the Commission to opt out of an obligation to comply with PRC-023-1 would be an enormous and unjustifiable burden, and would be inconsistent with the statutory scheme under which the ERO, as the expert entity, is the primary enforcer of compliance with reliability standards, subject to Commission review. *See* Order 672, PP 140, 344. If the Commission retains the NOPR's proposal to presumptively include all facilities between 100 kV and 200 kV in the standard's applicability section, it should at a bare minimum specify that the case-by-case opt-out review is to be conducted by the ERO, the REs, or the PCs, not through an exemption proceeding at the Commission.

More generally, given the Commission's role in the statutory scheme, it should avoid prescribing specific changes to NERC standards as it seems to be doing here. If it has a concern about applicability, the Commission, consistent with Section 215 and Order 693, should at most direct NERC to consider further whether the standard's applicability

is consistent with its purpose and whether other measures need to be taken to ensure that operationally significant 100 kV facilities are covered. FPA § 215(d)(4) and (5); Order 693, PP 185-87.

B. The Commission Should Approve NERC's Proposed Exclusion of Facilities Below 100 kV from Application of PRC-023-1

NERC's proposed standard correctly excludes facilities under 100 kV from application of PRC-023-1. The NOPR's proposal to sweep within PRC-023-1's scope facilities below 100 kV designated by the Regional Entities as critical for purposes of the TO/TOP registration is unnecessary and unreasonable.

The fallacy of the NOPR's proposal to make PRC-023-1 applicable to facilities under 100 kV designated by the Regional Entity as "critical" for purposes of being included on the registry as a TO/TOP[15] is that criticality for that purpose does not mean the facility is "operationally significant" for purposes of avoiding cascading thermal outages, which is the reliability issue PRC-023-1 is addressing. For example, a line below 100 kV connecting a black start unit material to and designated as part of a transmission operator entity's restoration plan would be deemed critical for TO/TOP registration purposes, but may not have any "operational[] significan[ce]" for purposes of thermal cascading outages. Thus, the fact that **"**NERC acknowledges that there are facilities operated below 100 kV that are critical to the reliability of the bulk electric system" (NOPR P 44) does not demonstrate that those facilities are critical for purposes of PRC-023-1 and should be covered.

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[15] As noted in the NOPR, P 44 n.75, NERC's Statement of Compliance Registry Criteria provides, as a basis for registration as TO/TOP (Criteria III.d.2): "An entity that owns/operates a transmission element below 100 kV associated with a facility that is included on a critical facilities list defined by the Regional Entity."

Nothing in NERC's Blackout Report[16] or the Final Blackout Report (on which the NOPR so heavily relies) supports application of PRC-023 to facilities *below* 100 kV. Such facilities do not come within NERC's findings with regard to facilities 230 kV and above or the Final Blackout Report's recommendations with regard to operationally significant facilities between 100 kV and 200 kV.

In this highly technical domain, the Commission should accord the statutorily required "due weight" to NERC's technical expertise. The Commission should reject the NOPR's proposal to needlessly expand the number of the facilities and entities (including many small entities) subjected to PRC-023-1, with the associated time and cost burden on those entities and Regional Entities, but little or no reliability benefit.

If the Commission nevertheless adheres to the NOPR's unsupported course, it should at minimum clarify that inclusion of facilities identified as critical below 100 kV is limited to those facilities already registered under TO/TOP Registration Criteria III.d.2, as set forth in NERC's Statement of Compliance Registry Criteria, and is not intended to expand applicability beyond the registry criteria. Thus, the Commission should make clear that it is not directing Regional Entities to expand the facilities under 100 kV designated as critical, and that any further registration of facilities would be subject to a case-by-case demonstration that the particular facility is critical. As the Commission has rightly held**,** registration should not be based on the designation of an overbroad class as

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[16] NERC Steering Group (Report to the NERC Board of Trustees), Technical Analysis of the August 14, 2003, Blackout (July 13, 2004), *available at* http://www.nerc.com/docs/docs/blackout/NERC_Final_Blackout_Report_07_13_04.pdf (last visited Aug. 17, 2009).

potentially material to reliability. *Mosaic Fertilizer, LLC*, 121 F.E.R.C. ¶ 61,058, P 37 (2007).

C. The Commission Should Leave Applicability to Generator Step-up and Auxiliary Transformers to NERC, With No Specific Directive

NERC intentionally omitted generator step-up and auxiliary transformers relay loadability from the scope of PRC-023-1, because its inclusion would have required expanding the standards drafting team to include additional experts, and delayed issuance of the proposed standard. The NOPR seeks comments on whether the Commission should assure that these facilities be timely addressed through a new or modified standard and on the time frame for such an effort. NOPR P 48.

TAPS urges the Commission to leave to NERC the question of whether and when to apply PRC-023-1 to generator step-up and auxiliary transformers. Leaving the evaluation of the need for and timing of application of PRC-023-1 to generator step-up and auxiliary transformers to NERC is particularly appropriate because it would be reasonable for NERC to conclude that they are not appropriately subject to PRC-023-1's requirements.

PRC-023-1 is designed to prevent over-tripping of parallel paths that may cause thermal cascading outages. As explained in the Gaffney Affidavit ¶¶ 26-27, generator equipment and auxiliaries are generally radial from the generators. Because of their radial nature, overloading from parallel flows is not an issue with regard to generator equipment and auxiliaries. As Mr. Gaffney further described (Gaffney Aff. ¶ 27):

> The purpose of PRC-023-1 is to reduce the likelihood of thermal cascading, which can happen along a collection of parallel paths where if one facility trips, it can overload a parallel facility, possibly causing that facility to trip, which

> in turn can overload another parallel facility, possibly causing that facility to trip, etc. In general, generators, their GSUs and their auxiliary transformers are not parallel paths, but are rather radial, and would not be involved in this type of cascading event. In fact, the output of generators does not change significantly with transmission lines tripping off-line, and GSUs and auxiliary transformers are radial to the generator. Instead, generators and their transformers need to be able to assist in transient stability and voltage stability events, which are properly handled in other standard development activities, such as Project 2007-06 (System Protection Coordination), for a revision to PRC-001.

Thus, there is no need or basis for the Commission to substitute its judgment for NERC's expert assessment of the timing, content or need for extending PRC-023-1 to generator step-up and auxiliary transformers.

III. THE SUBSTANTIVE CONTENT OF PRC-023 SHOULD BE APPROVED AS PROPOSED

The NOPR seeks comments on potential changes to numerous technical aspects of the NERC-proposed PRC-023-1. Especially given the highly technical nature of this standard, TAPS urges the Commission to give NERC the due weight to its technical expertise that FPA Section 215(d)(2) directs, rather than second guess NERC and the industry experts that developed and adopted this standard. As Order 672 rightly recognized (PP 328-330, 335), NERC has the responsibility and flexibility to balance various factors, including cost relative to anticipated reliability impacts. The Commission should restrain the NOPR's apparent desire to substitute the Commission's judgment for that of NERC and industry experts.

We highlight in particular several instances where the NOPR appears to be proposing to direct modifications that would require many transmission and generation protective schemes to be redesigned, recertified, and implemented. Such a direction

would not only impose significant costs that are likely to distract from activities far more important to bulk power system reliability, but is on statutorily weak grounds, given the FPA's express prohibition on requiring enlargement of facilities or the addition of generation or transmission capacity. *See* FPA §§ 215(a)(3) and (i)(2). The NOPR also overreaches the Act's express preservation of state jurisdiction with respect to safety. *See* FPA § 215(i)(2).

As demonstrated in the examples below, the NOPR's suggestions as to further modifications to the proposed standard are not justified. In any event, given the highly technical nature of these standards and the Commission's stated intent not to prescribe changes to standards,[17] consistent with the inherent limits on its authority to remand a standard or order a modification "that addresses a specific matter," FPA Sections 215(d)(4) and (5), any Commission concern should be framed as directing issues for NERC's further consideration, rather than essentially dictating the terms of a revised standard.

A. NERC Should Not Be Directed to Address Maximum Allowable Reach for Zone 3/Zone 2 Relays Applied as Remote Circuit Breaker Failure and Backup Protection

The Commission seeks comment on whether it should direct NERC to develop a maximum allowable reach for zone 3/zone 2 relays applied as remote circuit breaker failure and backup protection, and if so, whether it should direct NERC to develop a modification to PRC-023-1 or a new reliability standard. NOPR P 53.

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[17] Order No. 693, PP 185-87.

No new or modified standard should be directed. PRC-023-1, as proposed by NERC, already addresses the issue. As described in the Gaffney Affidavit ¶¶ 23-24, the proposed standard provides for relay settings of 150% of normal rating and 115% of emergency rating, which translates into the maximum allowable reach. *See* PRC-023-1 R1.1-1.3. Further, in many cases, added protection against the NOPR's concerns is provided by coordination of protection systems in accordance with PRC-001-1, which would mean that zone 3/zone 2 relays should not trip without an intentional time delay and/or without the assistance of a high speed communication schemes. Gaffney Aff. ¶ 25. Thus, the Commission should give due weight to NERC's technical expertise and not direct modifications to this requirement.

B. NERC Should Not Be Directed to Require Applicable Entities to Use Protective Relay Systems that Can Differentiate Between Faults and Stable Power Swings

To prevent protective relays from operating unnecessarily due to stable power swings, the NOPR proposes to direct NERC to develop a reliability standard or a modification that requires applicable entities to use protective relay systems that can differentiate between faults and stable power swings and that phases out protective relay systems that cannot meet this requirement. NOPR P 60. TAPS strongly urges the Commission not to do so, in order to ensure continued protection of equipment and avoid other potentially severe reliability problems.

PRC-023-1, as proposed by NERC, appropriately balances concerns about preventing thermal cascading outages against other reliability concerns, *e.g.*, protecting equipment from melting in the context of multiple or extreme contingencies (beyond the

single/double contingencies operated and planned for). The NOPR's proposal would eliminate relays that afford this very important protection to the system.

The NOPR incorrectly assumes that preventing operation of relays due to stable power swings will improve reliability. *See* NOPR P 57. It is an important, though secondary, function of protective relaying to help prevent equipment damage and associated unsafe environments. Gaffney Aff. ¶¶ 12-13. The power system is operated to single and usually to credible double contingencies; however, extreme contingencies beyond single and credible double contingencies can and do occur which can overload facilities to well beyond their emergency ratings. *Id*. ¶ 14. It is impractical to rely on operators to manually operate beyond single and double contingency situations, so automatic equipment is needed to protect the system when contingencies those extreme contingencies occur. *Id.* ¶¶ 15-18 While impedance/distance relaying is susceptible to operating for stable power swings, such relays are often the only protection for facilities loaded beyond emergency ratings (*id.* ¶ 21); eliminating relays that operate for stable power swings would therefore eliminate relays needed to protect equipment from loading well beyond emergency ratings. NERC's proposed standard properly balances relay loadability concerns with the need for relays to operate to prevent current from reaching levels that would melt a line before operators can reasonably take action.

Requiring NERC to adopt the NOPR's suggestion would *reduce* the reliability of the power system by exposing the system to longer-term outages due to equipment damage. Destruction of equipment creates real reliability problems, aggravating and lengthening outages. Gaffney Aff. ¶¶ 18-20. Also forfeited would be the significant reliability benefits that zone 3/zone 2 relays can provide as back-up in the event of a

stuck breaker and/or a failure of a transfer trip scheme for a stuck breaker. *Id.* ¶ 22. In addition, the safety considerations to which the NOPR elsewhere points (P 68) argue against the directives proposed by the NOPR; a system vulnerable to equipment melting or blowing up is neither a safe nor a reliable system.

The NOPR's suggestion that NERC be required to phase out protective relay systems that cannot refrain from operating under non-fault conditions not only would harm reliability, but it would do so at very high cost. This proposal, in combination with the NOPR's proposed elimination of NERC's proposed exclusions in Attachment A of PRC-023-1, particularly Subsection 3.1, would require redundant high speed protective systems for every transmission line, even when not needed for critical clearing time purposes. Requiring the addition of new protective relay systems also runs up against the FPA's limitation on standards requiring enlargement of facilities or the addition of generation or transmission capacity. *See* FPA §§ 215(a)(3) and (i)(2). Order 672 recognizes (P 330) that in developing standards it is appropriate for NERC to consider the cost of compliance, so long as the standard does not reflect the "lowest common denominator," which PRC-023-1 plainly does not.

As the NOPR observes (P 57), NERC and industry experts considered this issue in the standards development process. The highly technical judgments involved in assessing the different harms to reliability and balancing among protection against the various types of risks to reliability are precisely the types of judgments with respect to which Congress directed the Commission to give due weight to NERC's technical expertise. Consistent with that directive, the Commission should not adopt the NOPR's proposal, but should approve PRC-023-1 as proposed by NERC.

C. The Commission Should Not Direct Changes to PRC-023-1 to Harmonize with TOP-004-1

The NOPR is concerned about a perceived conflict between R1.2 of PRC-023-1 and R4 of existing reliability standard TOP-004-1, stating that the requirements should give a transmission operator the same amount of time to restore the system to normal operations. The Commission is concerned that based on TOP-004-1:

> [T]he transmission operator (or any other reliability entity affected by the facility) might conclude that it has 30 minutes to restore the system to normal when in fact it has only 15 minutes because the relay settings for certain transmission facilities have been set to operate at the 15-minute rating in accordance with Requirement R1.2.

NOPR P 64. It proposes to direct NERC to either revise Requirement R1.2 (which references publishing the facility's 15-minute rating) to apply it to Reliability Standard TOP-004-1 (which requires restoration within 30 minutes) or develop a new requirement that transmission owners, generation owners, and distribution providers give their transmission operators a list of transmission facilities that implement Requirement R1.2, or propose an equally effective and efficient approach to avoid the potential conflict. NOPR P 65.

No directive is needed to avoid confusion or conflict, as the NOPR presumes. The time periods identified in PRC-023-1, R1.2 and in TOP-004-1, R4 are for two very different actions, so there's no reason for them to be the same. As explained in the Gaffney Affidavit ¶¶ 32-34, the 15-minute rating referenced in PRC-023-1, R1.2 refers to the time to respond to a contingency in a known state (*i.e.*, within the emergency rating). In contrast, TOP-004-1, R4 refers to a 30-minute period for responding to an unknown

state (*i.e.*, in a situation where the operating limits are unknown, typically a state that has not been studied in stability studies to identify stability limits).

Because of the clear distinction between the referenced intervals, there is no reason for them to be same, and no confusion will result from their being different. The NOPR's directive is not needed and could harm reliability. Deference to NERC's technical expertise, as required by statute, is appropriate. No change should be directed.

D. NERC Should Not be Directed to Change R1.10 to Address Safety Concerns

Asserting that reliability standards should not be interpreted to require unsafe actions or designs, the NOPR proposes to direct NERC to develop a modification that would require any entity that implements Requirement R1.10 to verify that the limiting piece of equipment is capable of sustaining the anticipated overload current for the longest clearing time associated with the fault from the facility owner. If the facility owner cannot verify that ability, the facility owner should either apply different protection systems or change the topology to avoid this configuration to be in compliance with PRC-023-1. NOPR P 69.

Under FPA Section 215(i)(2), states retain jurisdiction over safety, as the NOPR acknowledges when it notes that "safety considerations are outside the jurisdiction of the Commission." *Id.* P 68. The NOPR's assertion (*id.*) that a "Reliability Standard should not be interpreted as requiring unsafe actions or designs" is a jurisdictional bootstrap that does not avoid placing the NOPR's directive on jurisdictionally questionable grounds.

Moreover, the NOPR's proposed revision would burden affected registered entities and Regional Entities with unnecessary and unproductive analyses, for which compliance would need to be monitored. Because "the IEEE standard for transformers

calls for the ability to withstand 2500% loading for 2 seconds," 150% loading for the less than one second duration of most faults is unlikely to present a problem for any facilities. Gaffney Aff. ¶ 35.

The NOPR's proposal would impose on numerous registered entities, and Regional Entities, significant administrative costs that will not advance reliability. The Commission should give the requisite due weight to NERC's technical expertise, and refrain from directing the changes proposed in the NOPR.

E. No Change to Requirement R1.12 Should be Ordered

According to the NOPR, entities subject to PRC-023-1 must employ a protection system that meets their reliability obligations, but a protection system that requires the application of Requirement R1.12 may not satisfy this requirement. The Commission seeks comment on whether to require entities that employ such a system to use a different protection relay system that would meet the reliability objective of the reliability standard. NOPR P 73.

This provision is an example of NERC and industry experts properly exercising flexibility to balance a number of reliability factors, including cost, as Order 672 recognizes is appropriate. *See, e.g.*, Order 672, PP 328-330, 335. As Order 672 recognized (P 328), "[t]he proposed Reliability Standard does not necessarily have to reflect the optimal method, or 'best practice,' for achieving its reliability goal without regard to implementation cost or historical regional infrastructure design." In assessing whether the standard achieves its reliability goals efficiently and effectively (Order 672, P 328), the Commission should give due weight to NERC's balancing of factors. *See* FPA § 215(d)(2); *see also* Order 672, P 335. The NOPR's directive would also impose

high costs by requiring a broad change out of equipment, which would run afoul of the FPA's limitation on standards that require expansion of facilities. *See* FPA §§ 215(a)(3) and (i)(2).

F. Attachment A's Exclusions Should Not Be Altered

The NOPR (PP 79-81) proposes to direct NERC to modify Section 3 of Attachment A to PRC-023-1 to eliminate exclusions from application of PRC-023-1.

> For example, subsection 3.1 excludes from the requirements of PRC-023-1: (1) overcurrent elements that are enabled only during loss of potential conditions and (2) elements that are enabled only during a loss of communications. This subsection could be interpreted to exclude certain protection systems that use communications to compare current quantities and directions at both ends of a transmission line, such as pilot wire protection or current differential protection systems supervised by fault detector relays. The Commission understands that if supervising fault detector relays are excluded from PRC-023-1, and are set below the rating of the protected element, the loss of communications and heavy line loading conditions that approach the line rating would cause these protective relays to operate and unnecessarily disconnect the line. If adjacent transmission lines have similar protection systems and settings, those protection systems would also operate unnecessarily, resulting in cascading outages.

NOPR P 79.

The Commission should approve Attachment A, Section 3 without change, and should not adopt the NOPR's proposed elimination of exclusions. The purpose of PRC-023-1 is "relay loadability" requirements. As explained in the Gaffney Affidavit ¶¶ 28-30, it makes sense to exclude from PRC-023-1's requirements any protection systems that are not subject to being tripped for heavy load currents caused by loss of a parallel path. The exclusions are well designed to ensure that PRC-023-1 applies where it is needed to address loadability concerns, while not interfering with relays that are not

tripped by load current, but serve other important reliability purposes. This explanation supports the exclusions proposed by NERC in Attachment A, Subsections 3.2 through 3.8. As Mr. Gaffney further explains, Attachment A, Subsection 3.9's exclusion of generators, DC converters, and their transformers is similarly appropriate because the output of generators and DC line converters is not changed significantly with loss of other facilities. Thus, with the possible exception of Attachment A, Subsection 3.1 (Gaffney Affidavit ¶ 31), the NOPR's proposed elimination of the exclusions is unjustified.

In light of the highly technical nature of the proposed standard and proposed exclusions, and their interrelationship with other reliability issues, deference to NERC's technical expertise, as Congress instructs, is appropriate. According the statutorily-required respect to NERC's expertise is particularly appropriate given the high cost involved in eliminating the exclusions, and the significant time that would be required for implementation.

IV. EFFECTIVE DATE

TAPS urges the Commission to adhere to NERC's proposal for making PRC-023-1 effective, and reject the NOPR's proposed acceleration of that timeline.

NERC proposes to make the standard effective as to facilities operated at 200 kV and above the first calendar quarter following regulatory approval, but would postpone applicability to designated critical facilities of 100 – 200 kV until the first calendar quarter 39 months after approval, with 24 months notice thereafter for applicability to newly designated critical facilities in that voltage range. In contrast, the NOPR would make the standard applicable only 18 months following regulatory approval to all

facilities of 100 kV and above (with the potential for very limited case-by-case exceptions) and designated critical facilities below 100 kV. NOPR P 85. The NOPR does not expressly address the 24 months notice period for newly designated facilities (which, under the NOPR's approach, could be either above or below 100 kV).

Order 672 (P 333) recognizes that implementation timelines must balance any urgency in the need to implement versus "the reasonableness of the time allowed for those who must comply to develop the necessary procedures, software, facilities, staffing or other relevant capability." The Commission should give due weight to NERC's expert assessment of that balance and adopt the implementation schedule proposed by NERC.

Maintaining NERC's proposed implementation schedule is particularly essential if, over TAPS objections, the Commission extends application of PRC-023-1, or requires development of modified standards that require significant change out of equipment. Indeed, the NERC-proposed implementation schedule may be overly aggressive if the NOPR-proposed modifications are adopted by the Commission.

V. THE NOPR'S RFA CERTIFICATION FAILS TO ACCURATELY CONSIDER THE IMPACT ON SMALL SYSTEMS

Congress requires the Commission to make a Regulatory Flexibility Act ("RFA") certification as to the impact on entities whose total electric output does not exceed 4 million MWh. *See* 5 U.S.C. § 601-12; 13 C.F.R. § 121.201 n.1. It has not fairly made this assessment in the NOPR.

As discussed above, the NOPR proposes to significantly expand the burden of PRC-023-1 on small entities. It does so by bypassing NERC's "add-in" approach under which PCs are tasked with identifying those facilities between 100 kV and 200 kV that are critical for purposes of PRC-023-1, and substituting a generic and unsupported

judgment that all facilities operating at 100 kV and above should be subject to the standard, with a limited provision for demonstrating the rare exception where such coverage is not necessary. The NOPR also proposes to extend PRC-023-1 to facilities below 100 kV where the Regional Entity has determined that the facility is critical for TO/TOP registration purposes.

The NOPR would radically expand the burden on small systems. Many of the 100 kV to 200 kV facilities to which the NOPR proposes to extend applicability are owned by small entities. If "all" 100 kV facilities includes radials, the Commission will be departing from the Compliance Registry Criteria that formed the basis for its RFA certification for Order 693,[18] encompassing many small entities that have radials to load not previously considered to be within the BES definition and therefore not registered. The NOPR's RFA certification fails to address NERC's own assessment of the "two orders of magnitude" impact of expanding of applicability of PRC-023-1 to all facilities operating at 100 kV and above. *See* NERC Petition at 19.

Thus, with the NOPR's proposed expanded reach, the Commission is in no position to certify that "[m]ost of the entities, *i.e.*, transmission owners, generator owners, distribution providers, and 'planning coordinators,' or alternatively 'planning authorities,' to which the requirements of this rule would apply do not fall within the definition of small entities." NOPR P 116. Nor would the number of entities now on the registry provide an accurate gauge of the impact on small systems, as the NOPR assumes. *Id.* P 117. When the NOPR's proposal to cover all 100 kV facilities is combined with the

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[18] Order 693, PP 1938-1942.

NOPR's proposed substantive changes to the standard to broadly expand the change out of equipment that would be required to comply with the standard, the burden on small systems becomes very severe. Thus, the NOPR's "certifi[cation] that this rule will not have a significant economic impact on a substantial number of small entities" (P 118) needs to be revisited, and the final rule revised to mitigate the significant impact that would otherwise result.

CONCLUSION

For the reasons set forth above, the Commission should approve PRC-023-1 as proposed by NERC, without directing the modifications proposed in the NOPR.

Respectfully submitted,

/s/ *Cynthia S. Bogorad*

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August 17, 2009

ATTACH. 1

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Transmission Relay Loadability Reliability Standard	**Docket No. RM08-13-000**

Affidavit of Frank Gaffney, Florida Municipal Power Agency,
on Behalf of the Transmission Access Policy Study Group

I. INTRODUCTION

1. My name is Frank Gaffney, Regulatory Compliance Officer, Florida Municipal Power Agency ("FMPA"), 8553 Commodity Circle, Orlando, FL 32819, where I lead both FMPA's compliance program and its transmission planning. Before commencing my position at FMPA in January 2009, I headed transmission planning, transmission regulatory services and the North American Electric Reliability Corporation ("NERC") compliance efforts for the consulting firm of RW Beck for more than 12 years. Before that, I was with Boston Edison (now NSTAR) for ten years, where I held various positions including Protective Relay Engineer, Substation Design Engineer and Manager of Transmission Planning. My resume, attached as Exhibit 1, further summarizes my background and experience.
2. The purpose of this affidavit is to provide additional technical support for a number of the positions described in the Comments of the Transmission Access Policy Study Group ("TAPS") regarding the Commission's May 21, 2009 Notice

of Proposed Rulemaking[1] ("NOPR") regarding the Transmission Relay Loadability Reliability Standard proposed by NERC. My comments support Commission approval of NERC's proposed standard without the NOPR's proposed directives of specific modifications.

II. ONLY A SMALL PERCENTAGE OF FACILITIES BETWEEN 100 AND 200 KV ARE "OPERATIONALLY SIGNIFICANT," AS OPPOSED TO THE LARGE PERCENTAGE THAT THE NOPR CLAIMS (NOPR P 43).

3. In proposing to expand applicability of PRC-023-1 to all facilities operated between 100 kV and 200 kV subject to a limited "opt out," the NOPR (P 43) states: "The Commission expects that a comprehensive process to determine which facilities are critical to the reliability of the bulk electric system should necessarily identify nearly every facility operated at or above 100 kV. This is because a large percentage of the bulk electric system not only falls into the 100 kV to 200 kV category, but also supports the reliability of the high voltage transmission system (200 kV and above)."

4. I disagree with the NOPR's conclusion for two reasons: i) the NOPR's phrasing could be interpreted as applying to radial facilities, to which it is obvious that PRC-023-1 should not apply; and ii) the NOPR's assertion that nearly all facilities between 100 kV and 200 kV are critical to the reliability of the power system is not a correct assessment.

5. First, the use of the phrase "nearly every facility operated at or above 100 kV" is ambiguous and could be interpreted as including radial facilities that are

[1] Transmission Relay Loadability Reliability Standard, 74 Fed. Reg. 25,461 (proposed May 21, 2009), IV F.E.R.C. Stat. & Regs. ¶ 32,642.

"generally not included" in the definition of the bulk electric system.[2] It is obvious that radial facilities do not participate in what I call thermal cascading. Thermal cascading is one of three general types of potential cascading events:

a. Thermal cascading, which can occur on a collection of parallel paths where loss of one or more of those paths can cause another parallel path to overload, which can cause that path to trip (either by relay action, operator action or equipment damage caused by the overload), which in turn can cause other parallel paths to overload and possibly trip, which in turn can cause other parallel paths to overload and trip, etc. It is important to note that the "tripping" of the parallel paths can be caused by relay operation, operator action, or damage to the facility that causes an actual fault.

b. Voltage instability or voltage collapse, which is caused by trying to push too much power across a transmission path and not being able to maintain voltage at the other end of the path.

c. Transient instability, which is caused by a large mismatch of supply and demand causing frequency excursions and the system unable to find a new match of supply and demand before the system becomes unstable.

6. The purpose of PRC-023-1 is to help decrease the likelihood of thermal cascading by limiting the operation of relays to allow operators more time to take other actions. Since a radial line is not a parallel path, radial lines are not involved in thermal cascading events, and this standard should not apply to radial lines. I

[2] NERC Glossary of Terms Used in Reliability Standards: Updated April 20, 2009, at 3, available at http://www.nerc.com/files/Glossary_2009April20.pdf (last visited Aug. 17, 2009).

assume that the NOPR intended to exclude radials, but the wording is ambiguous. If the NOPR intends to include radials, then that inclusion would be unjustified in light of the purpose of PRC-023-1, which only applies to parallel paths.

7. Second, the NOPR's assertion that nearly all facilities between 100 and 200 kV are critical is not correct. The NOPR proposes (P 43) that: "[i]n order to meet this goal, it is the Commission's view that the process for determining the facilities operated between 100 kV and 200 kV that are critical to the reliability of the bulk electric system must include the same system simulations and assessments that are required by the TPL Reliability Standards for reliable operation for all Category of Contingencies used in transmission planning." The power system is planned, designed and operated to withstand the worst case single and credible double contingencies. In a path consisting of parallel 500 kV lines, 230 kV lines and 138 kV lines, the worst case contingencies are loss of individual 500 kV lines, then possibly 230 kV double circuit tower lines; and the 138 kV line contingencies will infrequently be the worst-case contingencies. So, the NOPR's own proposed assessment method will yield relatively few facilities between 100 and 200 kV that will be critical for Category A, B or C contingencies (TPL-001-0, TPL-002-0 and TPL-003-0 respectively), and NERC's "add-in" approach is much more appropriate.

8. The NOPR's inclusion, in its assessment, of "all Category of Contingencies used in transmission planning" (P 43) is overbroad and incorrect. This phrase may encompass TPL-004-0, Category D, or extreme contingency events. Because the parameters of a Category D assessment are inconsistent with the purposes of

PRC-023-1 (*i.e.*, Category D assessments assume that cascading outages may occur,[3] but PRC-023-1 is intended to prevent cascading outages), Category D assessments should not be used to assess which facilities are critical in the PRC-023-1 context.

9. The NOPR's proposed assessment method, which logically should exclude Category D because cascading is acceptable for Category D contingencies, will show that a small minority of facilities between 100 and 200 kV are "critical" as used in the PRC-023-1 standard. For instance, in the Florida Reliability Coordinating Council ("FRCC"), based on the 2009 Summer Seasonal Peak Load Study base case, our analyses of Category A, B and C contingencies show that there are approximately 1300 facilities between 100 and 200 kV in FRCC, and of those 1300 facilities only 69, when taken out of service, cause loading beyond Normal Rating on other facilities. Sixty-nine (69) of 1300 facilities is about 5% of the facilities between 100 and 200 kV within FRCC. These contingencies may not even be the worst case events for those loadings beyond Normal Rating, and it is arguable whether the Normal Rating is applicable and whether we should have used Emergency Ratings (which would have resulted in no facilities being "critical" since the system is planned, designed and operated to be within applicable ratings for single and credible double contingencies). So, an initial assessment using the NOPR's own proposed methodology shows that at most

[3] *E.g.*, the criteria for cascading in Table 1 of TPL-004-0 states, in the column for whether or not cascading is allowed: "[m]ay involve substantial loss of customer Demand and generation in a widespread area or areas" and "[p]ortions or all of the interconnected systems may or may not achieve a new, stable operating point." These criteria and the fact that for Categories A, B and C cascading is explicitly not allowed (*e.g.*, Table 1 says "No"), clearly show that the TPL standard allows cascading for Category D contingencies.

about 5% of facilities between 100 and 200 kV in FRCC might be deemed "operationally significant." An analysis that takes a wide-area view of the impact of removing individual 100 to 200 kV lines in other Regions will likely have similar results. NERC's "add-in" methodology is much more appropriate than the NOPR's proposed approach.

III. PREVENTING RELAY OPERATION FOR NON-FAULT CONDITIONS WILL DECREASE RELIABILITY, NOT INCREASE RELIABILITY, AS CLAIMED (NOPR P 60).

10. The NOPR's assertion (P 60) that "a protective relay system that cannot refrain from operating under non-fault conditions because of a technological impediment is unable to achieve the performance required for reliable operation" is incorrect. The NOPR's proposal will not improve reliability; in my opinion, it will decrease reliability.

11. There are at least two reasons, other than clearing faults off the system, why using phase distance relaying (the primary type of relays susceptible to tripping for stable power swings and for operating under heavy loading) is important to the reliability of the power system:

    a. To help prevent equipment damage, and

    b. To provide remote backup for failed protection systems and stuck breakers at remote locations.

12. An important secondary function of phase distance relaying is to prevent equipment damage for loading well beyond emergency ratings. Although this is a secondary function of phase distance relaying, these relay systems are important to prevent damage to equipment from overloading them beyond their emergency ratings when/if contingencies occur beyond planning and operating criteria.

13. As stated in the Institute of Electrical and Electronic Engineers ("IEEE") book "Protective Relaying for Power Systems":[4] "(t)he function of protective relaying is to cause the prompt removal from service of any element on a power system when it suffers a short circuit, *or when it starts to operate in any abnormal manner that might cause damage* or otherwise interfere with the effective operation of the rest of the system." If a facility is loaded beyond its emergency rating, it is operating abnormally and the loading might cause damage to the facility.

14. The NERC reliability standards require planners to plan to single and credible double contingencies (TPL-002-0 and TPL-003-0), and to plan such that all facilities are within "applicable ratings" following those single and double contingencies. The NERC reliability standards require operating to only a single contingency (FAC-011-2), not credible double contingencies (although a standard under development would require operation to credible double contingencies). Most utilities both plan and operate the system to single and credible double contingencies. But sometimes "stuff" happens and "extreme" contingencies occur, such as loss of a right of way or loss of a substation, well beyond the single and credible double contingencies used for planning and operations. When such an "extreme" contingency occurs, facilities can be loaded to well beyond their emergency ratings. It is unwise to allow facilities to be permanently damaged by loading beyond emergency ratings due to these extreme contingencies.

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[4] Protective Relaying for Power Systems 1 (Stanley H. Horowitz ed., IEEE Press 1980) (emphasis added).

15. It is important to consider how much time an operator has to process incoming data and information and to take appropriate action. Most utilities use a 15 minute rating as the short term emergency rating (in fact, PRC-023-1 refers to 15 minute ratings in requirement R1.2) because, from experience, this is typically the amount of time an operator needs to sort through a barrage of incoming data and information, understand what has happened, formulate a plan of action (with help from pre-established operating procedures), and implement that plan before damage is done to the facility.

16. A "typical" 15 minute emergency rating of an Aluminum Conductor, Steel Reinforced ("ACSR") wire (the most commonly used type of wire) is about 125% of normal rating. A typical 15 minute rating for an All Aluminum Conductor ("AAC"), commonly used in coastal areas where salt corrosion of steel is a problem, is only 115% of normal rating. The PRC-023-1 standard, R1.1, requires that we set relays to trip at or above 150% of a four hour rating. 150% of a four hour rating equates to a less than a 5 minute rating for an ACSR conductor and even less time for an AAC conductor. Therefore, if the line were overloaded to 149% of normal rating due to an extreme contingency, the operator would have less than 5 minutes to respond before the facility was damaged. This is the bare minimum of time an operator needs to respond. For higher currents that can result from extreme contingencies, where the operator would have even less time to assimilate incoming data and respond, the operator may not be able to take action before permanent equipment damage or catastrophic failure occure. Phase

distance relays are needed to prevent damage to equipment that would prolong any outage and complicate system restoration.

17. The NOPR is rightly concerned about cascading, but it is important to understand that cascading can be caused not only by relay operation, but also if the line sags to the ground, a transformer or breaker "blows up" due to loading beyond its emergency rating, or an operator opens the facility to protect it from damage. With loading beyond 150% of normal rating, the line will likely sag to the ground in minutes (possibly before an operator can take appropriate action), creating an unsafe situation in the right of way and on road/canal/water crossings, and create a risk of catastrophic failure of equipment like transformers and breakers. In fact, catastrophic failure of equipment is probably more likely due to loading beyond emergency ratings for minutes rather than due to fault current, which usually lasts less than a second. Although the NOPR elsewhere expresses concerns about safety (P 69), the NOPR fails to recognize that allowing relays to operate for load current beyond emergency ratings improves the safety and reliability of the power system by reducing the possibility of catastrophic failure. Thus, the NOPR's concerns about safety argue strongly against its proposal to eliminate relays that operate for non-fault conditions.

18. If operators are not given enough time to make a more informed decision, they will open facilities whose damage is imminent. Operator action in such circumstances will thus have the same impact on cascading as a phase distance relay operation, but reliance on operator action for such short time frames for

response would be more risky to system reliability due to the threat of equipment damage.

19. For instance, the 1977 blackout of New York City was initiated by four 345 kV lines tripping off-line due to lightning strikes within 20 minutes of each other, well beyond what is planned and operated to. The transmission line ties to Long Island Lighting Company ("LILCo") were loaded to 150% of their emergency ratings and LILCo, not having any time to consider otherwise, opened the ties. New York City went black soon thereafter. LILCo did nothing wrong; imagine how long the blackout would have lasted if the lines had been permanently damaged.

20. As designers, planners and operators of a complex power system, we need to strike a careful balance of planning and operating to more "credible" events, such as single and credible double contingencies, where protective relaying should not enter the picture, and "extreme" events that can and do happen periodically that can cause permanent and severe equipment damage and in which protective relaying ought to be used to prevent that damage. It is not reasonable to plan and operate to more than single and credible double contingencies, so we need to recognize the limits of what the power system can do (emergency ratings) and the limits of how fast an operator can operate (5 - 15 minutes). We need to recognize that if a facility is severely overloaded it will be tripped off-line anyway either by facility damage or through operator action, with the same risk of cascading as a relay operation; but restoring power with undamaged equipment will be much faster than trying to restore power with permanently damaged equipment.

NERC's proposed standard strikes the proper balance between these considerations. Rather than increasing reliability, the NOPR's proposal to disallow protection systems "that cannot refrain from operating under non-fault conditions" (P 60) will decrease reliability.

21. Note that phase distance relaying is likely the only type of relaying on most transmission lines that would operate for loading beyond emergency rating. So employing phase distance relaying is important to the reliability of the power system.

22. Another advantage of phase distance relaying over other forms of relaying is that it provides back-up protection to remote facilities, *e.g.*, for a stuck breaker, or a failed protection system at a remote substation. Other types of protection do not provide this back-up. A commonly used scheme for stuck breaker protection is transfer trip on stuck breaker, which will, on sensing a stuck breaker, send a transfer trip signal to the remote end of the line(s) with the stuck breaker to trip the remote end of those line(s). As has been witnessed in several events, this transfer trip scheme can also fail. In the actual events where the stuck breaker scheme failed, it was the zone 3 relays at the remote substations that cleared the fault. To be clear, these were multi-contingency events beyond planning and operating criteria (*i.e.*, the fault, the stuck breaker, the failure of the stuck breaker scheme, which is a triple contingency, N-3 event beyond planning and operating criteria); however, if the zone 3 relays had not been there, the fault would not have been cleared and equipment would have been damaged and unsafe

conditions created. Zone 3/zone 2 relays acting as back-up is a cost-effective way to increase the reliability of the power system.

IV. LIMITING THE ALLOWABLE REACH FOR ZONE 3/ZONE 2 RELAYS BEYOND THE LIMIT INHERENT IN NERC'S PROPOSED STANDARD WOULD THREATEN RELIABILITY (NOPR P 53).

23. The Commission seeks comment on whether it should direct the Electric Reliability Organization ("ERO") to develop a maximum allowable reach for zone 3/zone 2 relays applied as remote circuit breaker failure and backup protection. In essence, by establishing limits of relay settings of 150% of a 4 hour rating, and 115% of a 15 minute rating, NERC is already establishing a maximum reach of these zone 3/zone 2 relays. For instance, a 1590 ACSR conductor for a 230 kV line has a "normal" rating of about 1380 amps. Therefore, if we set the relay to not operate for less than 150% of a 4 hour rating, that roughly equates to 150% of the normal rating, or 2070 amps. Hence, zone 3/zone 2 relays would not operate for a condition of 2070 amps at roughly 230 kV, and since impedance is equal to voltage divided by current (Ohms law), the maximum zone 3/zone 2 relay "reach" would be equal to 230 kV (divided by the square root of three due to three phase operation) divided by 2070 amps, or about 64 ohms (somewhat over-simplifying a more complex analysis, but generally accurate). A 230 kV line with a 1590 ACSR conductor is about 0.7 ohms per mile, so, the maximum reach already established in the standard for this example would be about 90 miles. Anything longer would be in violation of the standard using these assumptions.

24. In addition, because of this relationship between current and distance, limiting the reach of zone 3/ zone 2 relays would have the effect of increasing the 150% and

115% thresholds. Increasing these thresholds will increase the likelihood of an unsafe condition, and increase the likelihood of equipment damage, decreasing the reliability and safety of the power system. For instance, we already discussed that 150% of a 4 hour rating is approximately a 5 minute rating for an ACSR conductor. Limiting the reach of zone 3/zone 2 relays beyond what is already embedded in the standard will have the effect of increasing the 150% threshold to a higher number. Since impedance is equal to voltage divided by current, and since voltage is essentially constant in the absence of a fault, the only way to limit "reach" by reducing the impedance setting of the relay is to increase the current at which the relay would operate. Therefore, limiting the "reach" of zone 3/zone 2 relays above the 150% of 4 hour rating already embedded in the standard would require operators to act faster than 5 minutes to avoid facility damage for extreme contingencies, risking equipment damage and unsafe conditions, and may still result in cascading because the equipment may become damaged, causing a fault and thus causing the relays to operate anyway.

25. Further, in many cases, added protection against the NOPR's concerns is provided by coordination of protection systems in accordance with PRC-001-1, which would mean that zone 3/zone 2 relays should not trip without an intentional time delay and/or without the assistance of a high speed communication scheme. The NOPR (PP 51, 53) points to the Final Blackout Report and its conclusions that: i) some relays operated for stable power swings, and ii) some zone 3/zone 2 relays operated without any intentional time delay. But the need to address the "maximum reach" of these zone 3/zone 2 relays is mitigated in many instances by

properly coordinated intentional time delay in relay settings. For instance, in order to properly coordinate zone 3/zone 2 relays, there needs to be some intentional time delay; otherwise the relays are not coordinated with the adjacent facilities' protection systems (with special consideration for Directional Comparison Blocking schemes). NERC Standard PRC-001-1 requires coordination of protection systems by providing certain time delays for zone 3/zone 2 relays. The time delay for coordination makes it less likely that a zone 3/zone 2 relay can operate for a stable power swing. Therefore, not only are the NOPR's concerns about specifying the maximum reach of the zone 3/zone 2 relays already captured by NERC's proposed standard (as described above), but enforcing coordination of protection systems in accordance with PRC-001-1 in many cases provides added protection against the NOPR's concerns that zone 3/zone 2 relays should not trip without an intentional time delay and/or without the assistance of a high speed communication scheme.

V. GSU AND AUXILIARY TRANSFORMER RELAY LOADABILITY ARE ALREADY BEING CONSIDERED IN A SEPARATE STANDARD (NOPR P 48).

26. NERC intentionally omitted generator step-up ("GSU") and auxiliary transformer relay loadability from PRC-023-1, because its inclusion would have required expanding the standards drafting team to include additional experts, and delayed issuance of the proposed standard. The NOPR seeks comments on whether the Commission should assure that these facilities be addressed through a new or modified standard and on the time frame for such an effort. P 48. NERC appropriately excluded GSUs and auxiliary transformers from PRC-023-1 because they are radial facilities not subject to thermal cascading events.

27. The purpose of PRC-023-1 is to reduce the likelihood of thermal cascading, which can happen along a collection of parallel paths where if one facility trips, it can overload a parallel facility, possibly causing that facility to trip, which in turn can overload another parallel facility, possibly causing that facility to trip, etc. In general, generators, their GSUs and their auxiliary transformers are not parallel paths, but are rather radial, and would not be involved in this type of cascading event. In fact, the output of generators does not change significantly with transmission lines tripping off-line, and GSUs and auxiliary transformers are radial to the generator. Instead, generators and their transformers need to be able to assist in transient stability and voltage stability events, which are properly handled in other standard development activities, such as Project 2007-06 (System Protection Coordination), for a revision to PRC-001.

VI. THE EXCLUSIONS IN SECTION 3 ARE APPROPRIATE (NOPR PP 78-81).

28. The NOPR (P 80) seeks comment on whether the exclusions in section 3 are technically justifiable and whether the Commission should direct NERC to modify PRC-023-1 by deleting specific subsections in section 3. The Commission also seeks comment on whether it should direct NERC to modify subsection 3.1 to clarify that it does not exclude from the requirements of PRC-023-1 such protection systems as described in the NOPR. The Commission should not direct changes to the exclusions in section 3; at most, further NERC consideration of subsection 3.1 would not be unreasonable.

29. The purpose of the PRC-023-1 standard is to reduce the likelihood of relay operation exacerbating a potential cascading effect due to thermal overloading of

facilities as described above. First of all, it makes complete sense to exclude any protection systems that do not trip for heavy loading caused by loss of a parallel path, that are radial to the system and therefore not subject to parallel flows, or that give operators sufficient time to intervene to prevent equipment damage or other negative effects, because these facilities will not be involved in a cascade. Such protection systems include:

- 3.2. Protection systems intended for the detection of ground fault conditions. Heavy loading caused by a loss of a parallel path will be "balanced"; therefore, there will be no ground current. Hence, ground relays do not operate for non-fault conditions and should be excluded.

- 3.3. Protection systems intended for protection during stable power swings. Protection systems purposely designed to assist system stability by tripping for stable power swings should be excluded.

- 3.4. Generator protection relays that are susceptible to load. As discussed previously, generators are not parallel paths and are not involved in thermal cascading; hence, it is more important to protect a generator from damage and the settings of the relays can be set more closely to the generator ratings. Therefore, since generators are not parallel, generator protection ought to be excluded.

- 3.5. Relay elements used only for Special Protection Systems ["SPSs"] applied and approved in accordance with NERC Reliability Standards PRC-012 through PRC-017. These SPSs are designed to improve the reliability of the power system. To prevent their designed capabilities would only decrease the reliability of the power system. Hence, SPSs ought to be excluded.

- 3.6. Protection systems that are designed only to respond in time periods which allow operators 15 minutes or greater to respond to overload conditions. Such protection systems would help prevent equipment damage in the event operators are unable to unload the facilities within 15 minutes, improving reliability and safety. Hence, these systems ought to be excluded.

- 3.7. Thermal emulation relays which are used in conjunction with dynamic Facility Ratings. Facility ratings are dependent on numerous ambient conditions, such as ambient temperature, wind, and solar heating. The real limit to operation of a transmission line is the temperature of the conductor; if the temperature goes beyond a certain point, then the

conductor can be permanently damaged. A thermal emulation relay estimates the actual temperature of the conductor; hence, it should not be obstructed from operating to prevent equipment damage or unsafe conditions due to line sagging. Therefore, thermal emulation relays ought to be excluded.

- 3.8. Relay elements associated with DC lines. The flow of power on DC lines does not change when a parallel path is lost since the DC line controllers control the flow of power. Therefore, DC lines are not susceptible to thermal cascading and the relays can better protect equipment associated with the DC lines from damage by setting relays more closely to facility ratings.

- 3.9. Relay elements associated with DC converter transformers. *See* discussion of 3.8 above.

30. This leaves only subsection 3.1 as a possible NERC-proposed exclusion that the Commission may want to ask NERC to consider again. Subsection 3.1 excludes relay elements that are only enabled when other relays or associated systems fail. For example:

    - Overcurrent elements that are only enabled during loss of potential conditions; and

    - Elements that are only enabled during a loss of communications.

31. The exclusions of subsection 3.1 depend on the successful operation of a potential source (potential transformer or capacitor coupled voltage transformer ("CCVT")) or a communication system. The TPL standards require planners to plan the system as if one of these had failed (*e.g.*, TPL-003-0). So, although potential sources and communication systems fail infrequently, it could be consistent with the TPL standards for NERC to reconsider the balance of these factors. The Commission should not, however, direct the elimination of the exclusion.

VII. PRC-023-1 IS NOT INCONSISTENT WITH TOP-004-1 (NOPR PP 64-65).

32. FERC concludes that PRC-023-1 and TOP-004-1 should give a transmission operator the same amount of time to restore the system to normal operations. I believe the Commission misunderstands that the time frames given in PRC-023-1 and TOP-004-1 are for two different purposes and they should not be equal.

33. PRC-023-1, R1.2 refers to the most typical time frame used to establish a Short Term Emergency Rating, which would be applicable to the amount of time an operator has to reduce the loading on a facility to within normal ratings immediately after the contingency. So, if we use the example above of a typical ACSR conductor having a 15 minute rating of 125% of normal rating, then, if a contingency occurs that loads that line to 125% of normal rating, an operator has 15 minutes to reduce the loading on that line to within normal rating before the conductor is damaged.

34. TOP-004-2, R4 states that: "If a Transmission Operator enters an unknown operating state (i.e., any state for which valid operating limits have not been determined), it will be considered to be in an emergency and shall restore operations to respect proven reliable power system limits within 30 minutes." By definition, operating to 15 minute emergency ratings as is applicable to PRC-023-1, R1.2 means that valid operating limits have been determined and the operators are in a *known* operating state, not an unknown operating state. Hence, the 15 minutes referred to in PRC-023-1 is for operating to known, valid operating limits and is for a different purpose than the 30 minutes allowed in TOP-004-2 for

operators who are in an unknown operating state to get to within a known operating state.

VIII. THE NOPR'S PROPOSAL TO REVIEW RELAY SETTINGS VERSUS FACILITY FAULT CURRENT CARRYING CAPABILITY IS UNNECESSARY AND A WASTE OF VALUABLE RESOURCES (NOPR PP 67-69).

35. The NOPR (P 69) proposes to "direct the ERO to submit a modification that requires any entity that implements Requirement R1.10 to verify that the limiting piece of equipment is capable of sustaining the anticipated overload current for the longest clearing time associated with the fault from the facility owner." I believe that is not necessary and is an unproductive effort. IEEE Standard C57.12.00-2000 titled "Standard General Requirements For Liquid-Immersed Distribution, Power, and Regulating Transformers" establishes the thermal damage curve for transformers above 30 MVA, and allows 25 times (2500%) rated transformer current for two seconds (much slower than most zone 2 and zone 3 relay operation, which are both typically less than a second). So, requiring verification of 150% loading for 1 second when the IEEE standard for transformers calls for the ability to withstand 2500% loading for 2 seconds seems like an unproductive effort that would entail significant administrative costs.

FURTHER, AFFIANT SAYETH NOT.

State of Florida)
City/County of Orange) ss

Frank Gaffney, being first duly sworn, deposes and says that the facts and conclusions set forth in this affidavit are true and correct to the best of his knowledge, information and belief.

Frank Gaffney

Subscribed and sworn to before me this 14th day of August, 2009.

Donna Sue Utley
Notary Public

DONNA SUE UTLEY
Comm# DD0902343
Expires 7/10/2013
Florida Notary Assn., Inc

EXHIBIT 1

Frank Gaffney

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Professional Experience

2009 – Present

Florida Municipal Power Agency

Regulatory Compliance Officer and Transmission Planning Manager
Lead a 4 person team responsible for administering the NERC Standards compliance program for FMPA, and assisting its members with their compliance programs, and for transmission planning activities for FMPA and its members.

2000 – 2009

R.W Beck, Inc.

National Director and Principal, Transmission Markets Consulting (2007 – 2009)
Vice President and Principal, Sales and Marketing (2006 – 2007)
National Director, Transmission Markets Consulting (2000 – 2006)

Led a 10 person team that provided consulting services related to transmission planning, transmission tariffs, locational marginal pricing (LMP), transmission congestion and reliability standards.

Key Achievements

- Project manager and/or QA/QC expert on hundreds of studies and projects.
- Doubled the size of the Transmission Markets Consulting practice
- Led development of a NERC Reliability Standards, and a LMP Consulting practice
- Developed and implemented more than 50 seminars and workshops on such subjects as transmission planning, transmission tariffs, LMP, strategic impacts of RTOs and organized markets, and NERC reliability standards.
- Published 4 papers, speaker at 12 conferences.

1998 – 2000

TAVA/R.W. Beck

National Director of Operations

Managed the operations for the 100+ person Y2k consulting firm from start-up to exit.

1996 – 1998

R.W. Beck, Inc.

Client Services Director, Transmission and Substation Design

Led a 9 person team in substation and transmission design.

1987 - 1996

Boston Edison, Co.

10 Year continually advancing career filling the following positions:

- Manager, Distribution Design
- Manager, Transmission Planning
- Project Manager, Special Projects
- Transmission Planning Engineer
- Protection Systems Engineer
- Substation Design Engineer

Education

- Master in Electric Power Engineering, Rensselaer Polytechnic Institute
- Completed coursework, Master of Science in Management, Leslie College
- Bachelors in Electrical Engineering, Northeastern University