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Standard Authorization Request Form

Title of Proposed Standard	Transmission Relay Loadability
Request Date	January 09, 2006

SAR Requester Information	**SAR Type** (Check box for each one that applies.)	
Name NERC System Protection and Controls Task Force (SPCTF)	☒	New Standard
Primary Contact Charles Rogers, Chairman of SPCTF	☐	Revision to existing Standard
Telephone (517) 788-0027 Fax (517) 788-0917	☐	Withdrawal of existing Standard
E-mail cwrogers@cmsenergy.com	☐	Urgent Action

Purpose/Industry Need ~~(Provide one or two sentences)~~

Protective relays have contributed to virtually all major system disturbances including the Northeast Blackout of 1965, the New York Blackout of 1977, the WECC Blackouts of 1996, and the Blackout of August 14, 2003. ~~Protective relays have often contributed to system disturbances including the Northeast Blackout of 1965, and the Blackout of August 14, 2003.~~ During the 2003 blackout, relay loadability was found to have played a pivotal role in accelerating and spreading the early part of the cascade in Ohio and Michigan. Although the U.S.-Canada Power System Outage Task Force focused on the role played by "zone 3" relays, it was later found that other phase-distance and over-current relays also contributed to the cascade.

As a result, recommendations were made for the review of relay settings and the mitigation of zone 3 relays operating under load included in NERC Blackout Recommendation 8a, *Improve System Protection to Slow or Limit the Spread of Future Cascading Outages*, and U.S.-Canada Power System Outage Task Force Recommendation 21a, *Make More Effective and Wider Use of System Protection Measures*.

Over the last 18 months, the electric industry has been reviewing protection systems to determine their conformance with the loadability criteria set forth in those recommendations. The monumental effort to review and mitigate relay loadability issues done by the industry is to be applauded. However, those improvements to the protection systems cannot be allowed to lapse if relay loadability problems are to cease to be an ongoing contributor to system disturbances.~~Codifying those criteria and their implementation are essential to ensuring that relay loadability problems cease to be an ongoing contributor to system disturbances.~~

It is imperative to the continued reliability of the North American power system that the problems of relay loadability remain corrected and that the technical solutions ~~be~~are properly codified in NERC reliability standards.

~~Definition of Transmission Protection System Owners (TPSOs)~~

~~Entities that own and/or operate protective relaying systems applied to protect transmission facilities operated at 100 kV and above, including transformer banks with low-voltage terminals operated at 100 kV and above.~~

~~Applicability~~

- ~~This standard pertains to phase protection systems applied to:~~
  - ~~Transmission lines operated at 200 kV and above~~
  - ~~Transmission lines operated at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits.~~
  - ~~Transformers with low voltage terminals connected at 200 kV and above voltage levels~~
  - ~~Transformers with low voltage terminals connected at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits.~~
- ~~Any protective functions which could trip with or without time delay, on normal or emergency load current, including but not limited to:~~
  - ~~Phase distance~~
  - ~~Out-of-step tripping~~
  - ~~Out-of-step blocking~~
  - ~~Switch-on-to-fault~~
  - ~~Overcurrent relays~~
  - ~~Communications aided protection schemes including but not limited to:~~
    - ~~Permissive overreach transfer trip (POTT)~~

- Permissive under-reach transfer trip (PUTT)
- Directional comparison blocking (DCB)

- The following protection systems are excluded from requirements of this standard:
  - Relay elements that are only enabled when other relays or associated systems fail.
    - Overcurrent elements that are only enabled during loss of potential conditions.
    - Elements that are only enabled during a loss of communications.
  - Protection systems intended for the detection of ground fault conditions
  - Protection systems intended for protection during stable power swings.
  - Generator protection relays that are susceptible to load.
  - Relays elements used only for special protection systems, applied and approved in accordance with NERC Reliability Standards PRC-012 through PRC-017.
- This standard applies to the following entities:
  - Regional Reliability Organizations.
  - Transmission Owners that are Transmission Protection System Owners (TPSOs).
  - Generation Owners that are TPSOs.
  - a. Distribution Providers that are TPSOs.

Reliability Functions

The Standard will Apply to the Following Functions *(Check box for each one that applies.)*		
☒	Regional Reliability Organization	Ensures the reliability of the bulk electric system within its Region.
☐	Reliability Authority	Ensures the reliability of the bulk transmission system within its Reliability Authority area. This is the highest reliability authority.
☐	Balancing Authority	Integrates resource plans ahead of time, and maintains load-interchange-resource balance within its metered boundary and supports system frequency in real time
☐	Interchange Authority	Authorizes valid and balanced Interchange Schedules
☐	Planning Authority	Plans the bulk electric system
☐	Resource Planner	Develops a long-term (>1year) plan for the resource adequacy of specific loads within a Planning Authority area.
☐	Transmission Planner	Develops a long-term (>1 year) plan for the reliability of transmission systems within its portion of the Planning Authority area.
☐	Transmission Service Provider	Provides transmission services to qualified market participants under applicable transmission service agreements
☒	Transmission Owner	Owns transmission facilities
☐	Transmission Operator	Operates and maintains the transmission facilities, and executes switching orders
☒	Distribution Provider	Provides and operates the “wires” between the transmission system and the customer
☒	Generator Owner	Owns and maintains generation unit(s)
☐	Generator Operator	Operates generation unit(s) and performs the functions of supplying energy and Interconnected Operations Services
☐	Purchasing-Selling Entity	The function of purchasing or selling energy, capacity and all necessary Interconnected Operations Services as required
☐	Market Operator	Integrates energy, capacity, balancing, and transmission resources to achieve an economic, reliability-constrained dispatch.
☐	Load-Serving Entity	Secures energy and transmission (and related generation services) to serve the end user

Reliability and Market Interface Principles

Applicable Reliability Principles *(Check box for each one that applies..)*	
☒	1. Interconnected bulk electric systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
☐	2. The frequency and voltage of interconnected bulk electric systems shall be controlled within defined limits through the balancing of real and reactive power supply and demand.
☐	3. Information necessary for the planning and operation of interconnected bulk electric systems shall be made available to those entities responsible for planning and operating the systems reliably.
☒	4. Plans for emergency operation and system restoration of interconnected bulk electric systems shall be developed, coordinated, maintained and implemented.
☒	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk electric systems.
☐	6. Personnel responsible for planning and operating interconnected bulk electric systems shall be trained, qualified, and have the responsibility and authority to implement actions.
☒	7. The security of the interconnected bulk electric systems shall be assessed, monitored and maintained on a wide area basis.

Does the proposed Standard comply with all of the following Market Interface Principles? *(Select 'yes' or 'no' from the drop-down box by double clicking the grey area.)*
1. The planning and operation of bulk electric systems shall recognize that reliability is an essential requirement of a robust North American economy. Yes
2. An Organization Standard shall not give any market participant an unfair competitive advantage.Yes
3. An Organization Standard shall neither mandate nor prohibit any specific market structure. Yes
4. An Organization Standard shall not preclude market solutions to achieving compliance with that Standard. Yes
5. An Organization Standard shall not require the public disclosure of commercially sensitive information. All market participants shall have equal opportunity to access commercially non-sensitive information that is required for compliance with reliability standards. Yes

Detailed Description (Provide enough detail so that an independent entity familiar with the industry could draft, modify, or withdraw a Standard based on this description.)

Scope

The scope of the proposed standard would be to ~~C~~codify the relay loadability criteria and their implementation in accordance with the tenets of NERC Blackout Recommendation 8a, *Improve System Protection to Slow or Limit the Spread of Future Cascading Outages*, and U.S.–Canada *Power System Outage* Task Force Recommendation 21A, *Make More Effective And Wider Use Of System Protection Measures,* to ensure that protection systems and settings shall not limit transmission loadability, nor contribute to cascading outages.

~~***This proposed Standard must apply to transmission lines operated at 200 kV and above, transmission lines operated at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits, transformers with low voltage terminals connected at 200 kV and above voltage levels, and transformers with low voltage terminals connected at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits.***~~**Applicability**

[Definition of Transmission Protection System Owners (TPSOs)
Entities that own and/or operate protective relaying systems applied to protect transmission facilities operated at 100 kV and above, including transformer banks with low-voltage terminals operated at 100 kV and above.]

1. This standard pertains to phase protection systems applied to:
    a. Transmission lines operated at 200 kV and above
    b. Transmission lines operated at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits.
    c. Transformers with low voltage terminals connected at 200 kV and above voltage levels
    d. Transformers with low voltage terminals connected at 100 kV to 200 kV, identified by the Region as Operationally Significant Circuits.
2. Any protective functions which could trip with or without time delay, on normal or emergency load current, including but not limited to:
    a. Phase distance
    b. Out-of-step tripping
    c. Out-of-step blocking
    d. Switch-on-to-fault
    e. Overcurrent relays
    f. Communications aided protection schemes including but not limited to:
        i. Permissive overreach transfer trip (POTT)
        ii. Permissive under-reach transfer trip (PUTT)
        iii. Directional comparison blocking (DCB)
3. The following protection systems are excluded from requirements of this standard:
    a. Relay elements that are only enabled when other relays or associated systems fail.
        i. Overcurrent elements that are only enabled during loss of

potential conditions.

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

b. Protection systems intended for the detection of ground fault conditions

c. Protection systems intended for protection during stable power swings.

d. Generator protection relays that are susceptible to load.

e. Relays elements used only for special protection systems, applied and approved in accordance with NERC Reliability Standards PRC-012 through PRC-017.

4. This standard applies to the following entities:

a. Regional Reliability Organizations.

b. Transmission Owners that are Transmission Protection System Owners (TPSOs).

c. Generation Owners that are TPSOs.

d. Distribution Providers that are TPSOs.

The standard should incorporate relay loadability criteria for all phase distance (including zone 3) and overcurrent relays, ~~as prescribed in the *EHV Transmission System Relay Loadability Review and Requests for Temporary and Technical Exceptions* report approved by the NERC Board of Trustees on August 2, 2005 and the subsequent *Protection System Review Program - Beyond Zone 3* report approved by the NERC Planning Committee in September 2005.~~ as well as~~Also~~, any protective functions which could trip with or without time delay, on normal or emergency load current. The Standard should specifically exclude: relay elements that are only enabled when other relays or associated systems fail, protection systems intended for the detection of ground fault conditions, protection systems intended for protection during stable power swings, generator protection relays that are susceptible to load, relays elements used only for special protection systems, applied and approved in accordance with NERC Reliability Standards PRC-012 through PRC-017.

The proposed~~re is a general consensus of opinion that~~ standard should consider that during emergency loading conditions on the transmission system, the system operators should be making the human decision to open overloaded facilities, if conditions so warrant. Protection systems should not interfere with the system operators' ability to consciously take remedial action to protect system reliability. The relay loadability criterion should~~has~~ be~~en~~ specifically developed to not interfere with system operator actions, while allowing for short-term overloads, with sufficient ~~-~~margin to allow for inaccuracies in the relays and instrument transformers. ~~(This transmission protection and operating philosophy is different than the philosophy of many protection distribution systems. Most distribution protection systems are designed such that loads may be automatically tripped by relays at some multiple of the relay pickup current, often very near the 100% emergency rating of the distribution facilities.)~~

The system operator actions may include manual removal of the transmission circuit from service at any loading level in accordance with the transmission owner's operating policies and planned operating procedures, if doing so does not violate a system operating limit (SOL) or an interconnection reliability operating limit (IROL).

Additional Information

The *Working Paper on a Proposed Transmission Relay Loadability Standard,* prepared by the System Protection and Controls Task Force includes a proposed draft Transmission Relay Loadability Standard that codifies the relay loadability criteria prescribed in the NERC and U.S.-Canada Power System Outage Task Force recommendations on relaying. It is available on the NERC SPCTF website using the hotlink above~~at:~~

~~**ftp://www.nerc.com/pub/sys/all_updl/pc/spctf/Working%20paper%20relay%20loadability%20standard%201-9-06.pdf**~~.

That working paper was prepared to assist the Standards Authorization Committee and its SAR and/or standards drafting team in the development of the proposed standard. This working paper takes full advantage of the recent experience of applying those criteria to the EHV transmission system (200 kV and above) and ongoing work on the 100–200 kV Operationally Significant Circuits.

Additional technical information can also be found in *EHV Transmission System Relay Loadability Review and Requests for Temporary and Technical Exceptions* report and *Protection System Review Program - Beyond Zone 3* report at the NERC website~~The attached working paper includes a proposed draft Transmission Relay Loadability Standard that codifies the relay loadability criteria prescribed in the NERC and U.S.-Canada Power System Outage Task Force recommendations on relaying. This working paper was prepared to assist the Standards Authorization Committee and its SAR and/or standards drafting team in the development of the proposed standard. This working paper takes full advantage of the recent experience of applying those criteria to the EHV transmission system (200 kV and above) and ongoing work on the 100-200 kV Operationally Significant Circuits, thereby possibly eliminating any need for field trials of this proposed Standard.~~

Related Standards

Standard No.	Explanation

Related SARs

SAR ID	Explanation

Regional Differences

Region	Explanation
ECAR	
ERCOT	
FRCC	
MRO	
NPCC	
RFC	
SERC	
SPP	
WECC	