

Preliminary PRC-023-1 NOPR Comments

General Comments:

Resource Estimates:

[Excel] We have 876 100 kV- 200 kV line terminals. Based on our analysis, we estimate the following resource requirements:

Engineering

3,500 to 7,000 O&M man-hours to complete a review of all 876 terminals.

2,000 to 4,000 O&M man-hours to issue relay settings for terminals requiring mitigation (assumes 30% of terminals require mitigation).

System Protection

2,000 to 4,000 O&M man-hours to implement relay settings for terminals requiring mitigation.

Capital Mitigation

We have not included any resource estimates for capital mitigation solutions. It is likely that there will be some, though we have no way to estimate yet.

Out-of Step Relays:

[Excel] There should not be any reference to stability regarding Out-Of-Step relays in this standard. Out-Of-Step relays only need to be applied to “stability critical” lines. All references to stability in PRC-023-1 should be put in a new System Stability standard.

NOPR Comments:

Paragraph 8

Zone 2 relays provide backup protection and are typically set to reach 125 percent of the protected transmission line, i.e., 100 percent of the protected transmission line and 25 percent of the adjacent transmission line (i.e., they have a 25 percent margin). Because zone 2 relays can operate for faults on both the protected transmission line and on parts of adjacent transmission lines connected to the remote terminal, they are set with a time delay to allow for coordination of protection with the zone 1 relay on the faulted line. This time delay is determined or verified through system planning analysis.

[Excel] The statement “25 percent of adjacent line” is incorrect. The Zone 2 setting is 125 percent of the protected line impedance that provides 25 percent margin.

[ATC] The time delay of zone 2 relays are not determined or verified by transmission planning reliability assessment analysis. The time delay is determined by System Planning coordination studies.

Paragraph 31

Consequently, in implementing PRC-023, registered entities must comply with the requirements of other Reliability Standards. For example, protective relay settings determined and applied in accordance with the requirements of PRC-

Preliminary PRC-023-1 NOPR Comments

023-1 must be included in determining system performance, System Operating Limits, and Interconnection Reliability Operating Limits, and must be coordinated with other protective relay settings as required by the applicable Reliability Coordination (IRO), Transmission Operations (TOP) and TPL Reliability Standards. Only in this way can the entity satisfy its obligations under other Reliability Standards and comply with the requirements in PRC-023-1 to set protective relays while “maintaining reliability protection of the bulk electric system for all fault conditions.

[ATC] FERC does not appear to properly understand the relationship between the FAC, TPL and PRC standards.

[ATC] FAC standards: Address the rules around determining facility ratings. (Establishing the SOL / IROL limits) (Only in the rare case when the relay is the limiting device is the relay setting also the facility rating. Zone 2 and / or 3 protection settings are typically set some percentage over facility rating. (Range 115% to 150%)

[ATC] TPL standards: Addresses the rules around determining expected future system performance. (One of the major inputs is facility ratings.) System planners look for situations where a transmission facility may be operated near or over its ratings. Those situations are determined by the TPL standards and/or more stringent corporate/regional standards. The important thing to remember is that the system planner is not modeling the Zone 2 or 3 relay settings, but is using the facility ratings determined from the FAC standards.

[ATC] IRO and TOP standards: Address communication of SOLs/IROLs in real-time. The Commission supposes that the standard also applies to lower facilities (Below 200 kV and not determined as critical) if their protection takes into account above 200 kV facilities. (If their zone 2 or 3 looks at the 200 kV system then those system are also included in the standard)

Paragraph 32

Similarly, Reliability Standards TPL-001-0 through TPL-004-0 require annual system assessments to determine if the system meets performance requirements, and if not, to determine what corrective action plans must be implemented. Commission’s view, protective relay settings of both primary and backup systems implemented in accordance with PRC-023-1 are subject to these requirements and must be considered as part of performing a valid assessment.

[ATC] If protective relay settings are the basis for any line or transformer circuit ratings, then they will be used to determine whether the system is expected to meet future system performance requirements of the TPL-001 through TPL-004 standards. In addition, if a line or transformer is loaded above the protective relay setting for any line or transformer circuit due to a TPL contingency event, then the subsequent tripping of the line or transformer circuit should be simulated as part of the required TPL analyses.

Preliminary PRC-023-1 NOPR Comments

[ATC] Modeling of protective relays are not necessary in general when the relay setting are above the line or transformer rating because the relay function would not be triggered. Modeling of protective relays are needed whenever the contingent events are identified that could cause a line or a transformer loading to be exceed a protective relay settings.

[ATC] For a system built to comply with TPL-001 through TPL-004 no BES lines or transformers should be critical therefore, all lines and transformers should be assumed to be non-critical. (e.g. could not cause critical cascading outages or violations of thermal ratings, voltage ratings, or stability criteria; and the loss of some cumulative amount of load and generation in excess of a defined limit such as 1000 MW. However, the type of load and generation loss might be more important then the amount for assessing the critically the impact of losing 1000MW in a middle of a large city could be much different from a loss of a 1000MW in a remote rural area.)

[Excel] We feel this paragraph needs further clarification, due to the statements "Similarly, Reliability Standards TPL-001-0 through TPL-004-0 require annual system assessments to determine if the system meets performance requirements,..." and "In the Commission's view, protective relay settings of both primary and backup systems implemented in accordance with PRC-023-1 are subject to these requirements and must be considered as part of performing a valid assessment." It is unclear if the intent is to have Transmission Planning Departments evaluate protective relay systems set per PRC-023-1, to see how they respond when performing their annual TPL assessments, or if the intent is for the Protective Relay groups to verify that relays set per PRC-023-1 will accommodate the load levels expected from Transmission Planning's annual TPL assessments.

Paragraph 33

The Commission also emphasizes that the requirements of PRC-023-1 apply to all protection system as described in Attachment A that provide protection to the facilities defined in section 4.1.1 through 4.1.4 of PRC-023-1, regardless of whether the protection systems provide primary or backup protection and regardless of whether the protection systems provide primary or backup protection and regardless of their physical location. This is because protective relays are always applied to protect specific system elements, such that when PRC-023-1 states that it governs certain protection systems "applied to" certain facilities, it means that the specified protection systems must be set according to its requirements if they are applied to protect the specified facilities. Consequently, transmission owners, generator owners, and distribution providers with protective relays applied to protect the facilities defined in section 4.1.1 through 4.1.4 of PRC-023-1 must set the relays according to PRC-023-1's requirements. For example, a protective relay physically installed on the low-voltage side of a generator step-up transformer with the purpose of providing backup protection to a transmission line operated above 200 kV must be set in accordance with the requirements of PRC-023-1 because it is applied to protect a facility defined in the PRC-023-1.

Preliminary PRC-023-1 NOPR Comments

Does the standard support this interpretation or is the commission grabbing at straws? If the Commission believes this to be the case then it would also be applied if this standard is lowered to 100 kV. (Therefore, the 69 kV system would be brought into the picture.)

Paragraph 35

The Commission seeks comment on PRC-023-1's applicability with respect to: (1) TOs, GOs and DPs with facilities operated between 100 kV and 200 kV and facilities operated below 100 kV that are designated as critical to the reliability of the bulk electric system, and (2) generator step-up and auxiliary transformers.

FERC is asking for input on lowering the criteria for the applicable facilities for the standard to 100 kV. This request would require the industry to perform a large amount of additional analysis and record keeping to provide with very little or no additional reliability to the BES.

NERC's justification:

- a) Protection of circuits above 200 kV is considerably demanding of the most protective relays, and it is therefore customary that most modern protective relays are applied to circuits above 200 kV.
- b) Communication-based relaying, which can detect faults over the entire length of a circuit as well as provide communication-based backup protection is much more common at 200 kV and above
- c) Substation bus arrangements at 200 kV and above diminish the need for relays at remote locations that will detect faults in the event of protective equipment failure.

Paragraph 40, 43

40. The Commission believes that the approach in Requirement 3 may not result in a comprehensive study to identify applicable facilities and, at the outset, will effectively exempt a large percentage of bulk system facilities that should otherwise be subject to the Reliability Standard.

43. The Commission expects that a comprehensive process to determine which facilities are critical to the reliability of the BES should necessarily identify nearly every facility operated at or above 100 kV.

The Blackout Report recommended that all TOs evaluate the zone 3 relay settings "operating at 230 kV and above." In addition 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."

Preliminary PRC-023-1 NOPR Comments

Although NERC provided some justification on why this should be limited to 200 kV and above the Commission does not believe that NERC provided a technical analysis to support their position.

Paragraph 44

In 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 BES must include the same system simulations and assessments that are required by TPL Reliability Standards for reliable operation for all Category of Contingencies used in transmission planning.

The Commission supposes that the standard also applies to lower facilities (Below 200 kV and not determined as critical) if their protection takes into account above 200 kV facilities. (If their zone 2 or 3 looks at the 200 kV system then those system are also included in the standard)

Paragraph 51

The Task Force identified fourteen 345 kV and 138 kV transmission lines that disconnected during the 2003 blackout because of zone 3/zone 2 relays applied as remote circuit breaker failure and backup protection.⁸¹ Among the relays that operated unnecessarily were several zone 2 relays in Michigan that overreached their protected lines by more than 200 percent and operated without a time delay.⁸² The Task Force stated that although these and the other relays operated according to their settings, they operated so quickly that they impeded the natural ability of the electric system to hold together and did not allow time for operators to try to stop the cascade.

[Excel] line 3: The statement "...and operated without a time delay" is missing the reason for tripping without a delay. This may be due to communication failures in blocking schemes instead of over reaching adjacent zones without time coordination. This point should be clarified.

Paragraph 52

The Commission is concerned that zone 3/zone 2 relays will operate because of line load or overload in extreme contingency conditions even in the absence of a fault. The large setting of zone 3/zone 2 relays makes them susceptible to operating in the absence of a fault under abnormal system conditions. This is because under abnormal system conditions, such as very high loading and large, but stable power swings, the current and voltage as measured by the impedance relay may fall within the very large magnitude and phase setting of the relay. When this occurs, the relay is susceptible to operation.

[Excel] In regard to FERC's concerns over Z3 relays to cover breaker failures, no exemption from Requirement 1 is given to relays which are set to cover adjacent lines in the event of breaker failure. In our opinion, the standard does not need to identify any

Preliminary PRC-023-1 NOPR Comments

maximum reach allowable outside of the impact on loadability. Distance elements which over reach adjacent lines and trip with insufficient delay have coordination issues, not loadability issues. Additionally, we feel the maximum reach of Z2/Z3 relays is already adequately addressed in R1 of PRC-023-1 standard (MAXIMUM reach set to 150% current and 0.85 p.u. voltage at a 30 degree load angle). No specific maximum reach needs to be defined. If remote back-up Z2/Z3 relays cannot provide adequate breaker failure coverage and still comply with PRC-023-1, then local breaker failure relaying must be applied.

Paragraph 53

“ . . . it is the Commission’s view that the ERO should develop a maximum allowable relay reach for zone 3/zone 2 relays applied as remote circuit breaker failure and backup protection.”

[Excel] FERC wants to direct NERC to set a maximum Zone2/Zone 3 reach. The proposal would set an artificial maximum limit which would prevent setting a wider zone regardless of the results of a protection coordination study

Paragraph 58, 59, 60

58. While zone 3/zone 2 relays operated during the 2003 blackout according to their settings and specifications, the inability of these relays to distinguish between a dynamic, but stable power swing and an actual fault contributed to the cascade. Because PRC-023-1 addresses only the unnecessary operation of protective relays caused by high loading conditions, and does not address unnecessary operation caused by stable power swings, the Commission is concerned that relays set according to PRC-023-1 could still operate unnecessarily because of stable power swings.

59. Because PRC-023-1 address only the unnecessary operation of protective relays caused by high loading conditions, and does not address unnecessary operation caused by stable power swings, the Commission is concerned that relays set according to PRC-023-1 could sill operate unnecessarily because of stable power swings.

60. In the Commission’s view, 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. Consequently, the Commission seeks comment on whether it should direct the ERO 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 phase out protective relay systems that cannot meet this requirement.

Preliminary PRC-023-1 NOPR Comments

[ATC] Transmission entities should develop a clear understanding of their current exposure to this proposal, as well as their exposure if the scope of the standard is lowered to 100 kV.

[Excel] We feel that the proposed PRC-023 standard will go a very long way in preventing operation during stable swings. With that said, we feel that relay performance during power swings is a very complex subject, and should be considered outside of a loadability standard. While out of step tripping and blocking relays need to be set to comply with PRC-023-1 to prevent tripping or blocking on heavy loading, we feel the entire subject of relay performance during power swings (stability-related) does not belong in the scope of a standard on loadability.

[Excel] The protection schemes mentioned as not susceptible to power swings, created a major disturbance in MRO region on 9/18/07 due to problems with communication circuits. This seems to suggest these schemes are superior, but they are prone to misoperations due to loss of communication or timing difference in transmit and receive communication path.

Paragraph 66

Requirement R1.10 establishes criteria for applicable entities to set transformer fault protective relays and transmission line relays on transmission lines that terminate in a transformer. For this system configuration, protective relays would be set such that the transformer fault protective relays and transmission line relays do not operate at or below the greater of 150 percent of the applicable maximum transformer name-plate rating (expressed in amperes), including the forced cooled ratings corresponding to all installed supplemental cooling equipment, or 115 percent of the highest owner-established emergency transformer rating.

[Excel] We do not agree that FERC's concerns with R1.10 merit any modifications. Any transformer requiring overload protection should have it specifically applied, regardless of transmission line protection, or system configuration. Overload protection of a transformer should be done independently and cautiously; we feel that operator intervention is the best approach.

Paragraph 69

Consequently, the Commission 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. If the facility owner can not verify that ability, the facility owner should apply either different protection systems or change the topology to avoid this configuration to be in compliance with PRC-023-1. The Commission seeks comments on this proposal.

[Excel] We feel that the commission's proposal to "direct the ERO to submit a modification that requires any entity that implements Requirement R1.10 to verify that

Preliminary PRC-023-1 NOPR Comments

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” is not necessary. IEEE Standard C57.109-1993 (R2008) titled “IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration” establishes the thermal damage curve for transformers above 30 MVA, and allows 25 times rated transformer current for two seconds. Since zone 2 time-delayed operation is typically, if not always, set to less than 1 second, the proposed requirement is inherently met.

Paragraph 70-73

70. Requirement R1.12 establishes relay loadability criteria when the desired transmission line capability is limited by the requirement to adequately protect the transmission line. In these cases, the line distance relays are still required to provide adequate protection, but the implemented relay settings will limit the desired loading capability of the circuit. NERC states that in the event an essential fault protection imposes a more constraining limit on the system, the limit imposed by the fault protection is reflected within the facility rating.⁹⁶

71. NERC claims that PRC-023-1 should cause no undue negative effect on competition or restrict the grid beyond what is necessary for reliability.⁹⁷ It explains that, with the exception of those relays that legitimately define and restrict the facility rating, PRC-023-1 removes arbitrary limits related to relay loadability that cause transmission capability limitations. NERC further points out that no market-based entity is required to comply with PRC-023-1.

72. The Commission is concerned that Requirement R1.12 allows entities to technically comply with PRC-023-1 but not achieve its stated purpose. Since protective relay settings are allowed to limit the load carrying capability of a transmission line, that line is not being utilized to its full potential in response to sudden increases in line loadings or power swings, i.e., the natural response of the Bulk-Power System will be less robust in response to system disturbances.

73. 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. Consequently, the Commission seeks comment on whether use of such a protection system is consistent with the reliability objectives of PRC-023-1, and whether the Commission should direct a modification that would require that entities that employ such a system use a different protection relay system that would meet the reliability objective of the Reliability Standard.

[Excel] We do not feel that FERC’s proposal on R1.12 would have much impact. It seems to be directed toward piloted schemes on three terminal lines. If those schemes are permissive in nature, there should be no concern. If not, they can be modified.

Paragraph 74, 75

74. Requirement R3 requires planning coordinators to designate which transmission lines and transformers with low-voltage terminals operated or connected between 100 kV and 200 kV are critical to the reliability of the bulk

Preliminary PRC-023-1 NOPR Comments

electric system and therefore subject to Requirement R1. Sub-Requirements R3.1 and R3.1.1 specify that planning coordinators must determine these facilities through a process that considers input from adjoining planning coordinators and affected reliability coordinators. Sub-Requirements R3.2 and R3.3 require planning coordinators to maintain a list of designated facilities and provide it to reliability coordinators, transmission owners, generator owners, and distribution providers within 30 days of its initial establishment, and within 30 days of any subsequent change.

75. In light of the Commission's proposal to direct the ERO to modify PRC-023-1 to make it applicable to all facilities operated at or above 100 kV, with the possibility of case-by-case exceptions, and to all facilities operated below 100 kV that are designated by the Regional Entity as critical to the reliability of the bulk electric system, the Commission proposes to direct the ERO to revise Requirement R3 and Sub-Requirement R3.2 to require that the planning coordinator maintain a list that reflects the Commission's proposal. Moreover, it is Commission's view that the Regional Entity should know which facilities in its area are subject to the Reliability Standard. Accordingly, the Commission proposes to direct the ERO to modify Requirement R3.3 to add the Regional Entity to the list of entities that receive the list as required by Requirement R3.2

[Excel] We feel that expanding the applicability of PRC-023 to all circuits above 100kV will include many lines which are not operationally significant. In effect, we feel it would divert limited resources inappropriately, quite probably to the detriment of reliability. The current requirements of R3 require Planning Coordinators to determine which lines below 200kV are to be covered by PRC-023. We feel this is the best approach for reliability. We are not convinced that there would be an increase in reliability by including all lines/terminals between 100kV and 200kV. If there were an overall resulting increase in reliability, we do not feel it would be enough to merit the resource and financial impact on our ratepayers. Additionally, we feel that the proposal to shorten the implementation time frame from 39 months after applicable regulatory approval, to 18 months for all circuits below 200 kV is not practical in application. Even if resource constraints were of no issue, we feel that 18 months is still too aggressive and 24-36 months would be necessary.

Paragraph 77

Section (2) of Attachment A states that the “[S]tandard includes out-of-step blocking schemes which shall be evaluated to ensure that they do not block trip for fault during the loading conditions defined within the requirements.” This obligation, however, is not included as a requirement in the proposed Reliability Standard. Instead, it is included in Attachment A. Requirements should be in the requirements section of a Reliability Standard to ensure compliance. Since the ERO intends to require the evaluation of out-of-step blocking applications, language to this effect should be included as a requirement and not as a statement in an Attachment. Consequently, the Commission proposes to direct the ERO to modify PRC-023-1 by adding the statement in section (2) of

Preliminary PRC-023-1 NOPR Comments

Attachment A as an additional requirement with the appropriate violation risk factor and violation severity level assignments

[Excel] We feel that section 2 of Attachment A, assuring that Out of Step relays or functions do not prevent relays from tripping for faults within their intended zone, is appropriate within Attachment A. Attachment A is a compilation of the types of transmission line relays or relay schemes that are impacted by this standard. Out-of-step blocking relays are “transmission line relays”, which are addressed in requirement R1.

Paragraph 80

The Commission seeks comment on whether the exclusions in section 3 are technically justifiable and whether the Commission should direct the ERO to modify PRC-023-1 by deleting specific subsections in section 3. The Commission also seeks comment on whether it should direct the ERO to modify subsection 3.1 to clarify that it does not exclude from the requirements of PRC-023-1 such protection systems as described above.

[Excel] We feel that the exceptions referenced in section 3 of Attachment A, with the exception of the second bullet under 3.1, are appropriate and technically justifiable.