

Orders 881/881-A Position Paper

SPCWG Presentation to NERC RSTC

Background

The NERC System Protection and Control Working Group (SPCWG) has reviewed FERC orders 881 and 881-A and has found some ambiguity in them regarding requirements for protection system loadability. Order 881 was directed in part to transmission providers to implement ambient-adjusted ratings (AAR) on the transmission lines over which they provide transmission service. This paper addresses how the protection system settings can comply with the orders and with PRC-023-4, "Transmission Relay Loadability," and any of its future revisions.

Order 881

Order 881 requires transmission providers (ultimately transmission owners) to use (at least four) seasonal line ratings (P211) when evaluating longer-term point-to-point transmission service ending more than 10 days in the future. It also requires that AARs be determined for at least every hour (P89) for near-term (10 days into the future based on predicted ambient temperatures) requests for point-to-point and network service. Those AARs must be calculated for both day and night with the knowledge that there is no solar heating during the nighttime calculations (P147).

Order 881 states that the commission believes that settings changes will not be required to "thousands" of relays (P99) to comply with PRC-023 because "PRC-023-4 related relay settings are currently calculated based on practical limitations which in the majority of cases should not exceed AAR values." (P99) (Order 881-A stated that this is an error by the Commission and should be "...should exceed AAR values"). The AAR must be implemented by transmission providers on all transmissions over which they provide transmission service (Summary).

Order 881-A

Subsequent to Order 881, FERC issued Order 881-a to provide additional context of their initial order. "We clarify two aspects of the AAR requirements related to transmission providers' transmission protection relay settings. First, if a transmission provider establishes higher transmission line ratings, it will have to evaluate or reevaluate its applicable protection systems for that facility. Second, we clarify that in a majority of situations the relay setting should exceed AAR values." (P24)

Edison Electric Institute stated that Order No. 881 requires transmission providers to evaluate or reevaluate "all transmission protective relay settings to ensure worse case line ratings will not limit transmission loadability under Reliability Standard PRC-023-4." (P25) FERC correctly points out that PRC-023 applies only to phase protection. However, phase protection comprises 70–90% of transmission line relays.

Paragraph 26 states that "a transmission provider must evaluate its applicable protection systems for that facility in order to comply with PRC-023-4 and prevent protection systems from limiting transmission

loadability” as a result of favorable ambient conditions. P26 does not claim that the PRC-023 needs to change to address AAR values and can be interpreted to mean that the transmission line rating increases must refer to newly required seasonal ratings since those are the pertinent ratings in PRC-023. The winter seasonal rating will generally be the highest of the four or more seasonal ratings and therefore would be used to evaluate loadability as required by PRC-023. The protection system settings can allow transmission loadability for AAR without meeting the more stringent requirements of PRC-023.

SPCWG Position

Several utilities provided information regarding how orders 881 and 881-A might impact their practices regarding protection system settings.

Utility A

Utility A currently has four seasonal ratings and uses 41°F to calculate seasonal ratings used to evaluate loadability as required by PRC-023. The utility’s initial assessment of historical temperatures shows that it may need to calculate AAR for temperatures as low as 15°F. The utility found that this change would increase transmission line ratings less than 10%.

Utility B

Utility B currently bases its seasonal winter rating on a temperature of 50°F. The utility calculated ratings for three of its 345 kV lines using a historical low temperature of -20°F and found that ratings increased by 13–20%.

Utility C

Utility C currently has only one seasonal rating and its compliance with PRC-023 is based on that seasonal rating. Utility C has drafted proposed seasonal ratings in accordance with order 881, and the winter rating will increase nearly all ratings with some as high as 70%. Re-evaluation of its protection system loadability with PRC-023 applicability will be required under the current version of the standard.

Utility D

Utility D currently calculates winter ratings based on a temperature of 32°F with some wind. These ratings are used for PRC-023 compliance. New ratings calculated at -30°F with wind are 5–18% higher than the current ratings.

Key Points

Protection systems that are required to comply with PRC-023 are a subset of protection systems to which Orders 881 and 881-A apply. It is unknown how many additional systems will need to be reviewed to ensure that the protection systems meet those orders, but a survey of some entities suggested that the relays covered by PRC-023-04 are only 20–60% of the relays that will now need to be evaluated to meet the new loadability requirement in the orders.

The SPCWG acknowledges that relays should allow some margin above the maximum loadability required by new AARs to ensure that the relays won’t trip under load.

Based on the evaluations shown above, entities that have historically calculated winter season ratings for transmission lines subject to PRC-023 will likely have at least 20% margin above the AAR loadability requirements, so phase protection elements will not trip for maximum calculated AAR values. Furthermore, it is believed that sufficient margins will be achieved for lines that are within the scope of FERC Order 881 but not subject to PRC-023.

Based on these findings, the SPCWG believes that no changes to PRC-023 are necessary, and protection systems that are presently applicable and compliant with PRC-023 based on winter seasonal ratings do not need to be revised to meet the margin required in PRC-023 for the AAR that are determined by the entities (Order 881-A, P24 above). However, the SPCWG does recommend that entities review loadabilities for all protection systems applicable to transmission lines that fall under the orders, including those to which PRC-023 applies, to ensure that there is a sufficient margin above anticipated normal and emergency AARs.

SPCWG provides the following examples of how entities can address Orders 881 and 881-A while maintaining PRC-023 compliance:

- **Example #1:** An entity's highest seasonal rating for a 230 kV transmission line is 1,200 Amps for an ambient temperature of 41°F. The entity sets transmission line relays so that they do not operate for loading up to 160% of a highest seasonal rating (i.e., 1,920 Amps) and comply with PRC-023, R1, Criterion #1. The anticipated normal and emergency AAR for 5°F ambient temperature increases to 1,440 Amps and 1,580 Amps, respectively. In this case, there is a sufficient margin (21.5%) between relay loadability and anticipated normal/emergency AARs.
- **Example #2:** An entity has only one seasonal rating for its BES transmission lines based on an ambient temperature of 104°F. The entity sets transmission line relays so that they do not operate for loading of at least 150% of the seasonal rating and all relay loadabilities comply with PRC-023, R1, Criterion #1 when applicable. To comply with the orders, the entity will need to develop at least three other seasonal ratings based on expected temperatures. The entity's transmission line protection systems will need to be evaluated at the highest seasonal rating determined. All line protection systems to which PRC-023 applies will need to be adjusted to comply, and entities will need to ensure that protection system settings have a sufficient margin for anticipated normal and emergency AARs.
- **Example #3:** An entity owns 400 transmission circuits that are used to provide transmission service, i.e., applicable to orders 881 and 881-A. Out of 400 transmission circuits, the PRC-023 standard applies to 240 transmission circuits. Entity's seasonal rating is unaffected due to the orders. Hence, entity does not have to do anything for PRC-023 compliance. However, entity will have to ensure that load responsive elements within protection system are set to have sufficient margin above anticipated normal and emergency AARs for all 400 transmission circuits.

The SPCWG believes that Orders 881 and 881-A will require most entities to expend significant resources to ensure that protection system loadabilities will accommodate newly required seasonal ratings and AAR. While the SPCWG is not able to identify specific workload and cost increases, it has shown that entities, depending on their existing practices, will need to review and possibly change settings on up to 70% of

existing transmission line protection systems. Post review, additional workload and cost increases associated with setting changes, such as file modification, settings review, field implementation of new settings, and relay replacements could possibly be required in some instances. The necessary time required to complete this effort, including resetting up to 70% of existing relays, is likely to exceed the implementation time frame allowed in 881 and 881-A. Associated setting modifications are likely if large margins, such as 150% above maximum AARs, are required; however, setting modifications are significantly less likely to be required if lower margins above maximum AARs are acceptable. Lower margins will alleviate unnecessary costs to the industry while still ensuring that relays will not trip in the rare event that load increases to maximum AAR levels.

Conclusion

It is the SPCWG's position that no changes to PRC-023 are necessary, and protection systems that are presently applicable and compliant with PRC-023 based on winter seasonal ratings do not need to be set to meet the margin required in PRC-023 for the AARs determined by the entities (Order 881-A, P24 above). The SPCWG does recommend that entities review loadabilities for all protection systems applicable to transmission lines that fall under the orders, including those to which PRC-023 applies, to ensure that there is a sufficient margin above anticipated normal and emergency AARs. If the intent of FERC 881/881-A is for industry to reach the margins specified in the chosen criteria of PRC-023 to be maintained for AARs, then the expected necessary implementation time frame would be consistent with the initial implementation timeframe for PRC-023.