

Meeting Notes

Project 2010-13.3 – Relay Loadability: Stable Power Swings

Standard Drafting Team

March 7, 2014
Noon-2:00 p.m. Eastern

Conference Call

Administrative

1. Introductions and chair remarks

The meeting was brought to order by Bill Middaugh, chair, at 12:02 p.m. Eastern Friday, March 7, 2014. He thanked everyone for joining. Mr. Barfield took roll of members and observers. Those in attendance were:

Name	Company	Member/ Observer
Bill Middaugh, P.E.	Tri-State Generation & Transmission Association, Inc.	Chair
Kevin W. Jones, P.E.	Xcel Energy, Inc.	Vice Chair
David Barber, P.E.	FirstEnergy	Member
Steven Black	Southern Company Services	Member
Ding Lin	Manitoba Hydro	Member
Fabio Rodriguez	Duke Energy - Florida	Member
John Schmall	Electric Reliability Council of Texas (ERCOT)	Member
Matthew H. Tackett, P.E.	Midcontinent Independent System Operator (MISO)	Member
Scott Barfield-McGinnis (Standard Developer)	North American Electric Reliability Corporation (NERC)	Observer
William Edwards (Counsel)	North American Electric Reliability Corporation	Observer

Name	Company	Member/ Observer
Michael Gildea (Reliability Standards Advisor)	North American Electric Reliability Corporation	Observer
Phil Tatro (Technical Advisor)	North American Electric Reliability Corporation	Observer
David Youngblood	Consultant (Luminant Energy)	Observer

2. Determination of quorum

The rule for NERC Standard Drafting Team (SDT or team) states that a quorum requires two-thirds of the voting members of the SDT. Quorum was achieved as eight of the nine members were present.

3. NERC Antitrust Compliance Guidelines and Public Announcements

NERC Antitrust Compliance Guidelines and public disclaimer were reviewed by Mr. Barfield. There were no questions. Mr. Barfield also referred everyone to the two new NERC policies and demonstrated where to find them on the NERC website. The policies are related to use of the email listserv and standard drafting team meeting conduct.

4. Review team roster

Mr. Barfield noted that the roster is posted on the NERC project page is the initial roster approved by the Standards Committee. No changes have been made.

5. Review meeting agenda and objectives

Mr. Barfield reviewed the meeting agenda and objectives.

Agenda

1. Previous business and action items

Mr. Middaugh noted that we should go ahead with the Needs, Goals, and Objectives (NGO). Mr. Barfield reminded the team they had not discussed Mr. Phan's comments sent via the listserv during the March 5, 2014 call. This was tabled until Mr. Phan could be available to discuss with the team. Mr. Barfield will reach out to Mr. Phan to join the next call. The team wanted to hear more on the Reliability Coordinator being suggested in the applicability.

2. Continue with Standard Development

The team focused on pieces of what will be in the standard by continuing the discussion of the objectives (NGO) starting with removing the first three items listed in the objectives that would not be the actions or tasks to accomplish the need or goal. Those included, for example, "draft a new standard," "use of protection systems that differentiate between faults and stable power swings," and "identify facilities susceptible to power swings. The third item "identify..." changed to "have the

Planning Coordinator (PC) and Transmission Planner (TP) identify Facilities based on the SPCS Report,¹ that is the five bullets on page 21 of the report. Mr. Tackett asked if the standard could be along the lines of requiring the entity to develop a criteria (e.g., PRC-023). Screening criteria for filtering out Facilities may be useful. Mr. Barfield suggested that Mr. Tatro provide the team background on his point of view on the SPCS's intent and approach to power swings in the SPCS Report. Mr. Tatro responded that the SPCS and System Analysis and Modeling Subcommittee (SAMS) members had spent a number of years attempting to create such a screening approach. Furthermore, that most of that work is embodied in the Appendices of the SPCS Report and that the criteria established depend on a lot of factors. For example, the thought was that if a generating plant had a stability limit, stability constraint, or a Special Protection System (SPS) that it had already been determined that the electrical center would pass through transmission system or generating plant if it became an unstable power swing. The thought is that the PC or TP would apply SPCS Report criteria (i.e., the five bullets on page 21) as a method to identify a list of Facilities. The last bullet would be a "catch all" so the entity is afforded other information to assess which Facilities are challenged by power swings. Mr. Tatro noted it is important to include the criteria in the standard and not require the entity to develop a criteria in order to avoid the appearance of creating a "fill-in-the-blank" standard² which could lead to inconsistent application. Mr. Middaugh noted that in the previous meeting that the PC or TP would use their annual Planning Assessment to reveal the Facilities rather than create additional work and burden.

Mr. Middaugh directed the team back to the five bullets in the NGO objectives. Mr. Youngblood suggested that the first bullet concerning generators should not be all-inclusive. Mr. Lin asked if the SPCS Report is only targeting generators with generating plant stability constraint is addressed by an operating limit or Special Protection System (SPS) (including line - out conditions). Mr. Tatro noted that transmission configuration plays a significant role in whether the power swing travels through the plant. He further noted that the SPCS Report was initially transmission focused. There are two points to consider, (1) which Facilities are applicable and (2) for requirements, which protection systems would be in play. Mr. Lin had a question if it is clear to the PC and TP what generating facilities to include. Mr. Tatro noted that it was clear to him as a former planner, but perhaps that is a question that should be asked when conducting outreach prior to posting.

Mr. Middaugh proposed in the NGO (five bullets) to replace the word "Lines" with "Elements" for clarity. Mr. Schmall noted the team needs to agree on a fundamental aspect of the standard. For example, concerning protection system margins that you would want to trip on some stable swings to make sure that you don't fail to trip for unstable swings. Mr. Tatro noted that "preventing" tripping that was definitive as used in the Orders (i.e., 733). He also points out that the Orders included other qualifiers. For example, the Commission doesn't expect that all contingencies are addressed as in the Category D in TPL-001. He theorized that the Order supports Mr. Schmall's point that the protection systems should not compromise the ability to trip for faults. This includes protecting equipment from

¹ NERC System Protection and Control Subcommittee, Protection System Response to Power Swings, August 2013
http://www.nerc.com/comm/PC/System%20Protection%20and%20Control%20Subcommittee%20SPCS%20/SPCS%20Power%20Swing%20Report_Final_20131015.pdf

² FERC Order No. 693, March 16, 2007 (<http://www.ferc.gov/whats-new/comm-meet/2007/031507/e-13.pdf>)

damage. Mr. Tatro thought that the need and goal statements may need a word other than “prevent.” He also noted that the SPCS is revising the technical reference document, *Power Plant and Transmission Protection Coordination*, Revision 1, July 2010.³ The SPCS is clarifying intent that the Generator Owner has to coordinate, especially when relays have to be set a certain way protect equipment and that others may need to adjust on their settings accordingly. Mr. Tatro was concerned that “prevent” may not be achievable, but as long as the team understands what they are trying to achieve is fine. Mr. Schmall did not necessarily have a problem with “prevent.” Mr. Barfield noted that “prevent” does suggest a level of performance. Also, if considering the SPCS’s recommendation of a risk-based approach, would it be better to say “to reduce the likelihood.” A note was made to revisit the concern about saying “prevent.”

Mr. Lin asked if the Elements for a generator include the generator step-up (GSU) transformer and not the generating unit. His thought that if a protection system used impedance relays on the GSU transformer, they would apply. Mr. Schmall would rather the standard focus on transmission Elements because of the lack of clarity on ownership in generating plants. For example, a Transmission Owner may own the GSU transformer and not the Generator Owner. Mr. Tackett echoed agreement because it is best not to trip the generator unless absolutely necessary. He believes the team would have to define what a stable power swing for a generator is and may complicate the standard. Mr. Tatro noted that is consistent with the thoughts that went into the SPCS Report. Mr. Jones is concerned that if a generating unit has an impedance relay (#21) enabled that it may be challenged by a stable power swing. Mr. Tackett was amenable to only looking at the 21 function of the relay.

Mr. Youngblood noted that PRC-025-1 – Generator Relay Loadability (currently NERC Board adopted) does not address dynamic concerns of impedance relaying and only addresses steady state operation. He further noted that the PRC-025-1 team understood that the power swing issue would be addressed in this standard and therefore avoided subject. Mr. Tatro agreed that PRC-025-1 does not address the dynamic aspects of power swings. Also, Mr. Youngblood noted that PRC-025-1 does not look into plant from a loadability standpoint. He believes that certain plants should be included in the standard because of the differences in the standard. He explained that Luminant had a plant where it was recommended to have out-of-step (OOS) protection; however, the transmission system configuration changed at a later date and OOS was no longer needed.

To Mr. Youngblood’s point, Mr. Tatro stresses that the applicability may have two components because power swings may go through the transmission Elements and GSU transformer, but not the generating unit itself and those which go through the generating unit. In either case, the generator needs to be aware of the impacts to the generating unit relays susceptible to power swings through the transmission interconnection Elements. He also notes this is consistent with the SPCS Report that if generating units can detect power swings, they should be included. Mr. Youngblood wondered if someone could take the IEEE AC Guide for Generator Protection (C37.102-2006) document and identify the susceptible relays as a basis for including them in the standard. Mr. Barber added that he had done some angular stability analysis that went into the fourth quadrant that were stable and challenged the loss of excitation relay. It was generally due to a close-in fault. His analysis was aimed

³ <http://www.nerc.com/docs/pc/spctf/Gen%20Prot%20Coord%20Rev1%20Final%2007-30-2010.pdf>

at determining if the loss of excitation relay provided OOS protection. The engineer could see if the swing went through the relay characteristic and for how long. Mr. Middaugh asked if the loss of excitation is a relay that the team may need to consider. Mr. Youngblood agreed. Mr. Tackett questioned that for generating plant Elements if the analysis should be done on an Element by Element basis. He agrees impedance relays are important. Mr. Barber noted that loss of excitation relays are impedance relays. Mr. Black noted that the question was, would an OOS relay be sufficient for tripping on unstable power swings. Mr. Tatro noted that has been his past experience. Mr. Lin questioned if the group would rather have the generating unit trip during a stable power swing or stay connected. Mr. Schmall noted that you don't want to trip a unit and create more problems and change the system impedances unnecessarily. Mr. Barber added that the loss of generation on the receiving end would add to the problem. Mr. Schmall noted the generation sending end would see greater power swings, but either end could see a power swing. Mr. Barber noted that the team is looking at this more from a design basis and not an operational basis. He questioned if the team wants a design basis where that a relay would trip on a stable power swing, but that is not the goal of the standard.

Mr. Lin noted he was not familiar with generating units using power swing elements to block the impedance elements. Mr. Middaugh suggested adding "including the generating unit(s) if an impedance-based protection scheme is used" to the first bullet in the objectives (NGO). Several agreed. Mr. Tatro expressed caution mixing terms "elements" and "functions" with regard to protection systems. Mr. Tackett asked for clarification that the first bullet does not apply to transmission. Mr. Middaugh confirmed the bullet is generation only. Mr. Tatro noted that the five bullets should focus on the places that need to be of concern (i.e., Applicability).

Mr. Middaugh asked the attendees familiar with generator activities if the first bullet objective was satisfactory for protecting the generator. Mr. Tackett noted the first bullet says "Elements terminating" and wondered if that is limited to impedance-based protection, and if so, does that create a gap. For example, if there is an overcurrent scheme should it be included. Mr. Schmall suggested adding "generating unit." Overcurrent relays could be in play on transmission lines and GSU transformers.

With no issues concerning bullets two through four, Mr. Middaugh went to the last bullet that is considered the "catch all" for including other identified Elements. Mr. Schmall suggested starting with "Additional Elements..." Mr. Barfield noted that if written into the requirements that it must be measurable. Mr. Tackett noted the first four bullets sound like required items and the last bullet is optional. He asked the team for thoughts. Mr. Barfield noted that if the PC and TP identified other Elements, the asset owners would be required to set relays. Mr. Tatro noted that the SPCS Report intended the last bullet to capture any other items that the first four bullets did not capture. For example, the way PRC-023-2, Attachment B is structured. Items B1-B4 are similar to the team's first four bullets and B5⁴ relates to the fifth bullet to serve as a way to capture what the first four might have missed. Mr. Tackett pointed out the majority of transmission planners don't model the impedance characteristics, but if a PC and TP modeled these it may end up identifying more power

⁴ PRC-023-3 – Transmission Relay Loadability, Attachment B, B5: The circuit is selected by the Planning Coordinator based on technical studies or assessments, other than those specified in criteria B1 through B4, in consultation with the Facility owner.

swings. Mr. Tatro noted that the SPCS considered having the relay owner provide the planner protection information for further modeling; however, he was not sure if this thought was documented in the SPCS Report. He personally believes the goal is not to miss places where stable power swings may impact system reliability.

Mr. Tackett noted it was his understanding that once a generating unit was found to pull out of synchronism that the planner had to study that area deeper. Mr. Middaugh questioned if the standard should require the planner to identify these. The concern is opening the FERC approved TPL-001-4 and requiring additional work by the PC and TP. Mr. Jones pointed out in TPL-001-4, R4's sub-parts require the planner to test what happens upon the loss of a generating unit. He further questioned if the planner tests zone 1 or 2 characteristics during modeling and if the apparent impedance passes through it, then study it further. Mr. Tackett doesn't believe that modeling protection systems on every line is practical. Mr. Tatro noted that during the SPCS Report development, the SPCS discussed this and several other approaches that are listed in the SPCS Report appendices. Practicality was a primary reason the report developers converged on the bullet points without creating significant work on the planners.

Mr. Middaugh questioned whether the TPL-001-4, R4 subparts imply that the planners are to adequately capture power swings that cause tripping. If so, it is not adding to any additional work on the planner's part. Also, that the first four NGO objective bullets are the Facilities and the last bullet provides a generic reference to the Planning Assessments should other Facilities be identified for inclusion. Mr. Tackett (TPL-001-4, R4.3.1.3) notes it appears the planner has to identify where tripping occurs on stable power swings. Mr. Schmall notes that the evaluation of a transmission line that does not have a negative impact, it may not need to go in the power swing standard (PRC-026-1). Mr. Middaugh thought it would be good to include if the transmission line is known to have stable power swing. He further noted that the team needs to agree to what extent things should be added. The goal is to understand how the TPL-001-4, R4 can refine the last bullet of the NGO to catch any important Elements that are listed in the first four bullets of the NGO.

Mr. Tackett asked if the last bullet in the NGO objectives need to have stable and unstable power swing listed. Mr. Tatro noted that it would be a good rule to make sure the team refers to "power swings" in the general sense when referring to Elements. When describing the performance to insert "stable" in front of power swings to make the needed distinction. Mr. Schmall thought there should be a reference to the impact of the trip because, if there is no impact, there should not be a special assessment on Elements under what will be PRC-026-1. Mr. Middaugh agreed because the directive said to phase out relays where they can't meet the standard for the main applicable Elements. He added that the standard should not prescribe phasing out relays where there is no impact. Mr. Tatro cautioned against saying that a transmission line that experiences a power swing without an impact would not be subject to the standard. He recommended having it applicable, but leaving opportunities to make the right judgment in the Requirements. Mr. Schmall referred back to the goal of minimizing the burden on entities. Mr. Tatro noted that not including in Elements that do not have impacts may lead to impacts for unstudied events. He and Mr. Middaugh believed that not addressing situations where power swings occur with no tripping would be minimal work to address.

Mr. Barfield noted that he heard two items in the discussion, (1) collaboration between the protection and planning engineers is needed to pinpoint the specific location or Element to address,

and (2) that the Element identified may not necessarily include the desired outcome. For example a Corrective Action Plan the TP or PC would address what Elements and where the settings need to be applied to prevent tripping for a stable power swing.

3. Review of the schedule

Mr. Barfield reviewed the schedule reminding team members to add a placeholder to their calendars for a 2nd or 3rd week of June in-person meeting to respond to comments from the 45-day ballot.

4. Action items or assignments

Team-

- Consider whether the word “prevent” too strong of a word in the need and goal statements.
- Determine if an OOS relay is sufficient for tripping on unstable power swing.
- Understand how the TPL-001-4, R4 can refine the last bullet of the NGO to capture missed Elements that need to be protected.
- Make sure the PC and TP understand the expectation with regard to identifying generation Facilities.
- Confirm understanding of the NERC adopted standard TPL-001-4 (R4) that the studies identify tripping of Elements on stable power swings.

Mr. Tatro –

- Review TPL-001-4 that provides the language that will allow the team to reference the Planning Assessment.

Mr. Barfield –

- Issue conference call notice to plus list.
- Contract Mr. Phan to join the team regarding his comments
- Develop a matrix of the team’s background

5. Next steps

Discuss TPL-001-4 again to make certain it can be a basis for the standard (Mr. Youngblood’s request).

6. Future meeting(s)

Conference call at 1:00 p.m. Eastern on Monday, March 10, 2014.

Conference call at 2:00 p.m. Eastern on Thursday, March 13, 2014.

7. Adjourn

The conference call adjourned at 2:11 p.m. ET on March 7, 2014.

NEEDS, GOALS, and OBJECTIVES

Needs: Prevent relays from tripping during a stable power swing because it is perceived as a fault, thus unnecessarily removing facilities from service.

Goals: Prevent undesirable tripping of elements that are susceptible to stable power swings. (733, P153)

1. Develop acceptable criteria for identifying facilities that are susceptible/applicable to stable power swings.
2. Ensure relays that protect Elements that are susceptible to power swings don't operate during non-fault stable power swings. (e.g., Order states that all conditions cannot be covered).
3. Minimize the burden on planners and asset owners through effective use of resources by using existing studies and taking a focused approach to facilities at risk.
4. Aim for risk-based approach (rather than competency- or performance-based) See RBS concepts.
5. Avoid modifying other standards, unless absolutely necessary (time constraints and added complexity).
6. Avoid diminishing the ability of relays to trip reliably for faults, and for unstable power swings where islanding is necessary.
7. Consider the five bullets in the SPCS document discussing the limiting of the applicability to only those transmission lines (and generating stations) on which protective relays are most likely to be challenged during stable power swings.

Purpose: (Should describe the need and the goal).

Objectives:

1. Have the PC/TP identify Facilities based on the SPCS report (5 bullets as modified below)
 - Elements terminating at a generating plant, where a generating plant stability constraint is addressed by an operating limit or Special Protection System (SPS) (including line-out conditions), including the generating unit(s) if an impedance-based protection scheme is used
 - Elements that are associated with a System Operating Limit (SOL) that has been established based on stability constraints identified in system planning or operating studies (including line-out conditions)
 - Elements that have tripped due to power swings during system disturbances
 - Elements that form a boundary of the Bulk Electric System that may form an island. (See NERC Reliability Standard PRC-006 – Automatic Underfrequency Load Shedding, Requirement R1)
 - Additional Elements that are identified as tripping for power swings in Planning Assessments (e.g., TPL-001-4)
2. Ensure relays protecting identified Facilities don't trip on stable power swings- RISK-BASED

3. Allow Protection Systems to trip for faults and unstable power swings where islanding is necessary.
4. PRC-023-3 focuses on steady state and PRC-026-1 will focus on stability.
5. Do not defeat other protection means, such as, those used for emergency protection of equipment (733, P139).
6. Do not allow modifications to accommodate non-fault related transient overloads might leave system elements exposed to excessive loading longer than is prudent (733, P140)
7. Make certain that any phasing out of relays do not leave the electric system without any reliable backup for transmission lines with failed communication or other equipment failures (733, P141).
8. Consider “islanding strategies” in conjunction with out-of-step blocking (or tripping) requirements (733, P142).
9. Consider SPCS’s recommendations on Applicability and Requirements.
10. Do not address contingency conditions beyond Planning Assessments due to the inability to study all scenarios.

DRAFT