

Order 754 - Single Point of Failure

Technical Meeting Notes | October 24-25, 2011

FERC Technical Meeting

Administrative

The following notes are general comments and discussion of attendees of the October 24-25, 2011, Technical Meeting, "Order 754 — The Study of Single Point of Failure on Protection Systems". Refer to [NERC's Project Page](#)¹ for additional information on activities concerning the Commission's [Order 754](#)². Questions or comments should be directed to the NERC project manager, Scott Barfield-McGinnis via [email](#) or by telephone at (404) 446-9689.

Summary

1. Opening Remarks

a. Introductions

Attendee (First/Last)	Representing
Syed Ahmad	Federal Energy Regulatory Commission
Kal Ayoub	Federal Energy Regulatory Commission
Scott Barfield-McGinnis	North American Electric Reliability Corporation
Edward Beglin	Federal Energy Regulatory Commission
Eugene Blick	Federal Energy Regulatory Commission
Tom Bradish	Federal Energy Regulatory Commission
Neil Burbure	Federal Energy Regulatory Commission
Mark Byrd	Progress Energy Carolinas
Jay Carriere	PacifiCorp
Marcus H. Chong Tim	Bonneville Power Administration
Andy Dressel	North American Electric Reliability Corporation
Mark Gray	Edison Electric Institute
William Harm	PJM Interconnection, LLC
E. Nick Henery	Federal Energy Regulatory Commission
Anne Juterbock	FirstEnergy

¹ http://www.nerc.com/filez/standards/order_754.html

² <http://www.ferc.gov/whats-new/comm-meet/2011/091511/E-4.pdf>

Attendee (First/Last)	Representing
Ruth Kloecker	ITC Holdings
Dmitry Kosterev	Bonneville Power Administration
Ron leComte	Federal Energy Regulatory Commission
Chris Mak	Federal Energy Regulatory Commission
Paul McCurley	National Rural Electric Cooperative Association
Bill Miller	Exelon — ComEd
David A. Miller	Lodestone Enterprises
Allen Mosher	American Public Power Association
Keith O'Neal	Federal Energy Regulatory Commission
Willie Phillips	North American Electric Reliability Corporation
Cynthia Pointer	Federal Energy Regulatory Commission
Herb Schrayshuen	North American Electric Reliability Corporation
Hari Signh	Xcel Energy
Robert Snow	Federal Energy Regulatory Commission
Jonathan Sykes	Pacific Gas & Electric Company
Matthew Tackett	Midwest Independent System Operator
Phil Tatro	North American Electric Reliability Corporation
David Taylor	North American Electric Reliability Corporation
Thomas Wiedman	Wiedman Consulting LLC
Philip Winston	Southern Company
Bing Young	HydroOne
Hamid Zakery	Calpine Corporation

b. Purpose of the meeting — Order 754

Opening remarks began with Keith O’Neal followed by Herb Schrayshuen emphasizing that the discussion did not necessarily need to result in a standard. Only 5 of 133 events were related to system protection issues. NERC issued an industry alert to address single point of failure in 2009. The issue is an asset management issue.

General items included Keith O’Neal reminding the group that FERC staff do not speak on behalf of the Commission. Kal Ayoub provided basic logistical information for the group and noted presentations should be limited to fifteen minutes. Scott Barfield-McGinnis read the NERC Anti-Trust guidelines and meeting disclaimer.

2. **Frame the Reliability Issue**

Eugene Blick kicked off the purpose of the meeting off with reading paragraphs P19 and P20 from Order 754.

P19. We agree with the Trade Associations that there may be a system protection issue that merits further exploration by technical experts. The comments received in response

to the Commission's NOPR and Commission staff outreach discussions indicate that there may have been a misunderstanding that the Commission's proposed interpretation would have established a full redundancy requirement for all primary protection systems. The Commission clarifies that it did not intend to require full redundancy. Rather, the Commission believes that there is an issue concerning the study of the non-operation of non-redundant primary protection systems; e.g., the study of a single point of failure on protection systems. The Commission agrees with commenters that this issue does not have to be addressed in TPL-002-0, Requirement R1.3.10.

P20. Accordingly, consistent with the supplemental comments of the Trade Associations, we direct Commission staff to meet with NERC and its appropriate subject matter experts to explore this reliability concern, including where it can best be addressed, and identify any additional actions necessary to address the matter. Further, we direct NERC to make an informational filing within six months of the date of the issuance of this Final Rule explaining whether there is a further system protection issue that needs to be addressed and, if so, what forum and process should be used to address that issue and what priority it should be accorded relative to other reliability initiatives planned by NERC³.

Eugene Blick noted the Commission did not say "full redundancy" and have not formed an opinion based on the recent interpretation approval regarding single point of failure.

3. Discussion

NOTE: "The following comments are technical input or opinion of the subject matter expert and may or may not reflect the entity's official response or position."

Presentation 1

The first slides were presented by Phil Tatro regarding the NERC 2009 Industry Advisory, "Protection System Single point of Failure". Click [here](#) for slides. Eugene Blick asked the question, "Could there be other cases like the three events (i.e. Westwing, Broad River, PacifiCorp)?" [TPL-001-2](#)⁴ (a.k.a "new standard") was the recently filed (October 11, 2011) with FERC for approval. Based on slide 4, Eugene Blick also asked if "N-1" was addressed in the new standard⁵ (i.e. Normal clearing, Category B or N-1). Thomas Wiedman commented that Single Point of Failure (SPF) is not defined. Hamid Zakery asked if events were categorized by type of failure (i.e. Maintenance, Design, Settings, Failure, Dependability, or Security). Phil Tatro said NERC does not have that level of granularity and took an action item to look into the data⁶.

³ This filing requirement has been approved by the Office of Management and Budget under FERC-725, OMB Control No. 1902-0225. This filing does not change the existing burden or reporting requirements imposed on NERC under FERC-725.

⁴ Standard TPL-001-2 — Transmission System Planning Performance Requirements. NERC Website: <http://www.nerc.com/files/TPL-001-2.pdf>

⁵ Ibid, TPL-001-2

⁶ Action Item (Tatro) - What is the failure mode of events (Dependability vs. Security).

Philip Winston expanded on the advisory that the industry should make sure the same design is not in their systems. Herb Schrayshuen asked if it was reasonable to have entities go look at everything. Kal Ayoub asked about the survey that was supposed to have been performed in the Industry Advisory. Phil Tatro responded the survey didn't happen because the Reliability Standard Development Plan (RSDP) lowered the [Project 2009-14](#)⁷ SAR to a lower level of priority. Jonathan Sykes mentioned that the industry needed to be careful about design changes affecting dependability and security.

Presentation 2

The second presentation was made by Dmitry Kosterev based on an [IEEE Paper](#)⁸ regarding the Westwing Outage occurring June 14, 2004 in the Western Interconnection. The presentation walked through the timeline of the event showing illustrations of what protection systems responded to clear the fault. Eugene Blick noted from the NERC 2009 Industry Advisory the Westwing outage was causal. Matthew Tackett noted in the discussion about the schemes that differential relaying does not provide backup protection. Jonathan Sykes noted that Arizona added phase protection to the transformer because of the event. Chris Mak wanted to know if phase backup was included in the Westwing scheme.

Chris Mak was concerned about system aspects (i.e. load, frequency, and number of elements). What could have happened if the event occurred on system peak and Under-Frequency Load Shedding (UFLS) had occurred? That would have been in the range of 59.5 and 59.3 Hz and how would load have impacted UFLS? Some discussion ensued, but with no definitive answer. Herb Schrayshuen questioned to what extent did the SPCTF technical paper⁹ address the issues about Westwing.

Presentation 3

Phil Tatro made his second presentation on the early planning standards (1997). Click [here](#) for slides. Basically, the protection engineer and planning engineer should be given the flexibility to determine what is required to meet performance. Herb Schrayshuen reiterated it is a situation of prescriptive versus flexible. Allen Mosher asked if newer substations (Westwing?) have been influenced by the guides? Herb Schrayshuen asked what the regional perspectives are. Hamid Zakery asked how many elements greater than 100 kV have single protection systems and should redundancy be by voltage class. Most agreed that voltage class should not drive decisions and performance should. Herb Schrayshuen posed, was "having greater latitude better", consensus point. The group had consensus that performance based was preferred over prescriptive¹⁰.

⁷ NERC Website: http://www.nerc.com/filez/standards/Project2009-14_Interpretation_TPL-002-0_PacifiCorp.html

⁸ IEEE Technical Paper, "Model Validation Studies for a Disturbance Event That Occurred on June 14 2004 in the Western Interconnection", Baj Agrawal and Dmitry Kosterev, 2007.

⁹ Transmission System Phase Backup Protection (DRAFT), A technical guide, NERC System Protection & Control Subcommittee, December 2010, NERC Website: [http://www.nerc.com/files/Backup%20Protection%20Systems_Aproved%20to%20Post%20for%20Comment_20101208%20\(2\).pdf](http://www.nerc.com/files/Backup%20Protection%20Systems_Aproved%20to%20Post%20for%20Comment_20101208%20(2).pdf)

¹⁰ Consensus Point 1: Performance based issue, not full redundancy issue.

Presentation 4

Following the afternoon break, Mark Byrd presented material regarding the current planning standards (TPL-003-0a). Click [here](#) for slides. Mark Byrd addressed requirements R1.3.10 and R1.5 applicable to Category C events. Also discussed was the recently filed (October 11, 2011) NERC Reliability Standard new standard¹¹ referencing the contents of Table 1, P5 and footnote 13 of the standard. Matthew Tackett agreed that new standard¹² is much clearer than previous versions. Mark Byrd concurred also noting the bar had been raised by including specific cases for evaluation over 300 kV. Eugene Blick noted the last bullet of slide 8:

“If system performance falls below the appropriate TPL requirements, then Transmission planners and Protection System engineers must work together to find and implement the most effective solution”

Eugene Blick asked if the planner specifically studied single point of failure. Jonathan Sykes noted that protection engineering studies include applicable Categories; and that some entities do more than what is required. Chris Mak echoed everything cannot be redundant. Keith O’Neal posed the question, what do operators do for single point of failure in the short term. Group comments noted those issues were real time operations, not planning issues.

Presentation 5

Jonathan Sykes presented information from the SPCTF technical paper¹³. Click [here](#) for slides. Questions came up about security and dependability. Jonathan Sykes responded that security is generally less of a problem than dependability. Matthew Tackett noted that system monitoring has improved and may mitigate issues (e.g. batteries). Herb Schrayshuen commented that monitoring is better than maintenance because monitoring brings awareness to an issue much more timely than discovery on a maintenance cycle. Philip Winston brought awareness to the fact that the TPL standards are “by exception”. Not every scenario is evaluated. The planning and protection engineers look at study areas and when problems are revealed, a more thorough evaluation is made. Bill Miller noted that maintenance will not eliminate all failures, monitoring is not a 100% solution. Before concluding the day, Keith O’Neal wanted to know more about the 5 of 133 events (between 2004-2010) leading to an action item¹⁴. The information is good about the industry addressing issues, but does not tell the group the extent to which the issue remains (single point of failure). Do we need a survey to confirm the situation?

¹¹ Ibid, TPL-001-2

¹² Ibid, TPL-001-2

¹³ Protection System Reliability – Redundancy of System Protection Elements, NERC System Protection & Control Task Force (SPCTF), November 2008.

¹⁴ Action Item:

Day 2

Presentation 6

The second day began with a presentation about Regional practices and criteria, but not specifically represented by Regional Entity staff. The first regional presenter was Bing Young talking about NPCC practices. Click [here](#) for slides. Beyond the slides, Bing Young notes that the determination a facility's inclusion into the Bulk Power System (BPS) is determined by a performance based approach, not voltage. Eugene Blick referring to slide 5 wanted to know if there was a difference between a single-phase (SLG) and three-phase fault. Bing Young responded that three-phase fault was the worst case. HydroOne used a two-pass approach, conditions for remote backup and uncleared faults. Eugene Blick questioned how single point of failure is determined in the approach. Bing Young responded the process starts with the protection group not being available (i.e. failed). Eugene Blick referring to slide 9, how does HydroOne address adjacent loads? Bing Young responded that Regional neighbors follow the same NPCC directories and HydroOne holds planning coordination meetings with other non-NPCC Regions. Tom Bradish questioned what are the benefits of the process? Bing Young noted that the process revealed that BPS systems required redundancy to meet the performance. Redundancy provided other asset management benefits like being able to address customer needs, testing of equipment and transferring load. Additionally, redundancy has helped HydroOne and Independent Electricity System Operators (IESO) with scheduling Generator Owners (GO) and Independent Power Producers (IPP). Herb Schrayshuen asked when is single point of failure studied at HydroOne? Bing Young, when a facility becomes defined as a BPS facility, HydroOne addresses single point of failure through implementation schedule/plan.

Kal Ayoub redirected the group back the goals and issues on the whiteboards. Keith O'Neal asked if gaps have been assessed. Hamid Zakery followed with are there inconsistencies across the Regions? Chris Mak noted what did the study for Westwing reveal? Philip Winston rephrased the question is the study being done? Yes, Philip Winston is confident studies are being conducted because the planning and protection engineers are in frequent contact with each other. Keith O'Neal, questioned: are the standards sufficient to tell the planning and protection engineers what to do? Thomas Wiedman responded to Keith O'Neal's question are there gaps. Consider the NERC 2009 Industry Advisory as an indicator there is an issue. Keith O'Neal wanted to know how does FERC get reassurance there is not another Westwing event waiting to happen. Thomas Wiedman thought contacting the Regions to assure a common understanding would be a good starting point and the new standard¹⁵ helps.

Matthew Tackett echoed Thomas Wiedman's remarks and asked, is there a difference in expectations between Regions? Jonathan Sykes commented that PG&E uses a variety of tools (i.e. SPCS, IEEE, etc.) which drives PG&E toward redundancy; however, he didn't know if it is an issue

¹⁵ Ibid, TPL-001-2

across the industry, but has some concern. Jonathan Sykes commented taking the new standard¹⁶ and applying the same rigor as the existing TPL standards, may or may not yield a different result. Keith O'Neal wanted to know how we (group) know the extent of the issue. Keith O'Neal identified there seems to be a lot of concern and wanted the group to focus on the concepts. Hari Singh, Xcel Energy, expressed from a planning perspective planners had to study the failure of the protection system whether considering single or multiple points of failure. Bill Miller noted that the new standard¹⁷ made the requirements clearer by removing the "or" between "(stuck breaker failure or system protection failure)" in Table 1, Category C. Bill Miller speculated that maybe planners in general have missed the intent where some do "either" and some do both. Chris Mak reminded the group those were solutions and not the goal of the meeting. Chris Mak sees the concern and noted that if the planner tests for Category C, planners will not necessarily meet Category B.

Eugene Blick notes it appears that not every entity is following guidelines. What can provide the level of assurance (to FERC) that the planning assessments are sufficiently comprehensive¹⁸? Hamid Zakery pointed out that could be an enforcement issue. Matthew Tackett noted based on the discussion that the new standard¹⁹ requires more based on what his peers have brought up in discussion. Thomas Wiedman thought the Regions should go and review the Reliability Standard Audit Worksheets (RSAW) to look for gaps in the planning standards. Most disagreed with that approach. Keith O'Neal presented the thought of having an interpretation to pose the question, are planning assessments addressing single points of failure²⁰. Bill Harm believed the new standard²¹ increases the ferocity of the assessment. Thomas Wiedman disagreed because the assessment only requires the analysis for single line to ground (SLG) faults. Eugene Blick posed the question, what is sufficient? Thomas Wiedman responded that all faults should be considered in the analysis. Jonathan Sykes spoke out that addressing all faults is not the consensus of the group and would lead to making everything redundant. It's about performance. Redundancy would push us (entities) way over the bar at what cost. Tom Bradish directed attention to the SPCTF technical paper²², 1997 planning standards²³ that "Protection System redundancy" did not make it into Version 0. Also, there is no reliability standard requirement for the protection engineer to talk to the planning engineer. Keith O'Neal noted Thomas Wiedman's comment about the RSAW would not be effective and that maybe an interpretation would be better.

Presentation 7

The second Regional presentation was presented by Jonathan Sykes on the Western Electricity Coordinating Council (WECC) practices. Click [here](#) for slides. The slides were based on post

¹⁶ Ibid, TPL-001-2

¹⁷ Ibid, TPL-001-2

¹⁸ Consensus Point 2: Existing approved standards address requirement to assess single points of failure.

¹⁹ Ibid, TPL-001-2

²⁰ Consensus Point 3: Assessments of single point of failure of non-redundant primary protection (including backup) systems need to be sufficiently comprehensive.

²¹ Ibid, TPL-001-2

²² Ibid, Page 4.

²³ NERC Planning Standard, Section III — System Protection and Control, September 1997

Westwing event. Auxiliary Relays shall not be the same for breaker failure. Chris Mak pointed out that “all faults” are cleared regarding slide 3, PRC-004-WECC-1. Also, that slide 3 “only applies to path” and should be clearer on what is a comprehensive assessment²⁴. Phil Tatro asked if the WECC standard was a “mis-operation” standard. Jonathan Sykes responded it was and it provides direction on what may be done if a failure occurs.

Presentation 8

The third and last Regional presentation was made by Bill Miller on practices of the Midwest Region(s) which included the Midwest Reliability Organization (MRO), ReliabilityFirst Corporation (RFC) and Southwest Power Pool (SPP) Regions. Click [here](#) for slides. Some material was based on legacy “ECAR” and “MAIN” documents that have not been updated to match the current organizations. Chris Mak notes that two systems are high speed. Bill Miller points out that one could be high speed and the other something else, not necessarily both high speed. Chris Mak also observes the ECAR requirements as being more rigorous.

4. **Review and Recap**

Wrap-up

The group reviewed their documented consensus points and began working on a problem statement. The problem statement started out quite lengthy adding additional details which were essentially stating a solution. By majority input, these items were retracted from the problem statement resulting in a statement that more clearly outlines the issue.

Consensus Points

1. Performance based issue, not full redundancy issue.
2. Existing approved standards address requirements to assess single point of failure.
3. Assessments of single point of failure of non-redundant primary protection (including backup) systems need to be sufficiently comprehensive.
4. Lack of sufficiently comprehensive assessments of non-redundant primary protection systems is a reliability concern.

Problem Statement

“The group perceives a reliability concern regarding the comprehensive assessment of potential protection system failures by registered entities. The group agrees on the need to study if a gap exists regarding the study and resolution of a single point of failure on protection systems.”

Next Steps

1. Interpretation Request - A small group should develop a proposal to be presented to the joint TIS/SPCS committees Dec 6-7, 2011. Proposed by Keith O’Neal.

²⁴ Consensus Point 4: Lack of sufficiently comprehensive assessments of non-redundant primary protection systems is a reliability concern.

2. Data Request - A small group should develop a proposal to the joint TIS/SPCS committees Dec 6-7, 2011. Proposed by Herb Schrayshuen with key points/ideas:
 - a. Could see how many single points of failure are out there
 - b. Industry does not like surveys done through Industry Alerts
 - c. Industry prefers NERC to request data through Rules of Procedure, Section 1600
 - d. The first draft could be presented to the joint SPCS/TIS meeting in December
 - e. Data request would be posted for industry comment
 - f. Deliver to the Board of Trustees for approval as early as February 2012
 - g. Use the new standard²⁵ to stay out of the compliance space
3. Project 2009-07 - To be considered later after the review of items A and B.
4. Make an informational filing to the Commission by NERC on or before March 15, 2012.

Parking Lot Items

1. Define: Single Point of Failure (Thomas Wiedman)
2. Are the single points of failure detectable upon a review?
3. Categorize the types of events which would be classified as “causal”
4. Security versus Dependability
5. Look at what extent to which new [SPCS Guideline](#)²⁶ mitigates phase backup protection issues.
6. For a given event (e.g. Westwing), how should this event be modeled and analyzed (i.e. Category A, B or C)? (Eugene Blick)
7. Are the new TPL Standards addressing the situation at hand better than the existing TPL Standards? (Herb Schrayshuen)
8. Define protection system terms to be used in TPL standards (Jonathan Sykes)
9. Define what a normal and cascading event is (Herb Schrayshuen)
10. Define operators immediate actions (Keith O’Neal)
11. Ranking of the issue

²⁵ Ibid, TPL-001-2

²⁶ Transmission System Phase Backup Protection (DRAFT), A technical guide, NERC System Protection & Control Subcommittee, December 2010, NERC Website: [http://www.nerc.com/files/Backup%20Protection%20Systems%20Approved%20to%20Post%20for%20Comment%20101208%20\(2\).pdf](http://www.nerc.com/files/Backup%20Protection%20Systems%20Approved%20to%20Post%20for%20Comment%20101208%20(2).pdf)

Action Items

Scott Barfield-McGinnis – Issue email to initiate a Project (Order 754).

Scott Barfield-McGinnis – Form two groups, one for the data request and the other for the interpretation.

Phil Tatro - What is the failure mode of events (Dependability vs. Security).

Phil Tatro – Prepare a straw man data request outline for the focus group.

Phil Tatro – Work with Jonathan Sykes and Mark Byrd to get the subject matter on the agenda for the joint SPCS/TIS meeting in Fort Worth, Texas, December 6-8, 2011.

5. Close