NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Industry Webinar
Order No. 754 – Data Request

The Study of Single Point of Failure
Draft 2 Posting

June 7, 2012

RELIABILITY | ACCOUNTABILITY




Introductions

- North American Electric Reliability Corporation (NERC)
  - Scott Barfield-McGinnis, Moderator
  - Howard Gugel, Project Manager
  - Phil Tatro, Technical Advisor
- System Analysis and Modeling Subcommittee (SAMS)
  - Mark Byrd, Progress Energy Carolinas (Chair)
  - Bill Harm, PJM Interconnection, LLC (Member)
- System Protection and Control Subcommittee (SPCS)
  - Jonathan Sykes, PG&E (Chair)
  - Bill Miller, ComEd (Vice Chair)
  - Rich Quest, Midwest Reliability Organization (Member)

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Important Notes

- This webinar, associated slides, and feedback provided in the Question and Answers session are intended to help entities meet their obligations under the Order No. 754 Data Request
- Many slides contain paraphrased information; therefore, entities should always refer to the actual Order No. 754 Data Request document and template for full details

Overview

- Summary of FERC Order No. 754
- Approaches to address the Order No. 754
- NERC Rules of Procedure (ROP), Section 1600
- Draft 2 Modifications
- Data Request Details
- Posted for Informal Comment
- Questions and Answers Session

Summary of Order No. 754

- Order No. 754[1]
  - Commission's approval of Project Interpretation of TPL-002-0b — PacifiCorp (Project 2009-14[2])
  - Commission has a concern (P19)
    - Study of a single point of failure on protection systems
  - Commission issued a directive (P20)
    - FERC staff to meet with NERC and appropriate SMEs
      - Explore the reliability concern
    - NERC to make an informational filing in six months (March 15, 2012)
      - Explain whether there is a further system protection issue and, if so:
      - What forum to address the issue?
      - What priority based on current initiatives?

[1] http://www.ferc.gov/whats-new/comm-meet/2011/091511/E-4.pdf

[2] http://www.nerc.com/filez/standards/Project2009-14_Interpretation_TPL-002-0_PacifiCorp.html

Approaches

- Approaches decided at the October 24-25, 2011 Technical Conference held at FERC
  - Data Request – A small group should develop a proposal to the joint SPCS/SAMS committees
  - Interpretation Request – A small group should develop a proposal to the joint SPCS/SAMS committees
  - Project 2009-07 – To be considered later after the review of the first two bullets above

NERC ROP

- Section 1600 – Request for Data or Information
  - Authority
    - FPA, Section 215
    - FERC, Section 39.2(d) regulations
  - Criteria
    - Describe why data is needed, its use and collection method
    - Identify the functional entity(ies)
    - Estimate of the burden on reporting entities
    - A schedule for reporting
    - Must not have a compliance use
  - Posting for Comment (45 days)
  - Board of Trustee Approval Required

Data Request Goals

- Meet the criteria of Order No. 754 and NERC ROP, 1600
  - Avoid “Compliance” space
  - Assess the burden on entities
- Establish a clear data collection process
- Obtain quality data
  - Sufficient sample size
  - Data across all voltages > 100 kV
  - Define potential concern:
    - Potential impact on system performance
    - Risk based on attributes of protection systems

Data Request Needs

- Identify whether there is a reliability concern associated with the assessment of single points of failure on protection systems
- Enable NERC to:
  - Assess whether there is a reliability concern, and if so
  - Determine whether it is related to specific protection system components
- Cover the following subjects:
  - Responsibility
  - Method
  - Rationale
  - Schedule and Data Reporting

Data Request Draft 2

Draft 2 Modifications

- Extended the reporting timeline
- Included Distribution Provider
- Revised the method (provided an alternative option)
  - Simplified and clarified:
    - Table A: Criteria for Buses to be Tested
    - Table B: Protection System Attributes to be Evaluated
    - Table C: Performance Measures
    - Table D: Station DC Supply Attributes to be Reported
- Additional Rationale, Examples, and Figures
- Provided more detail regarding the Burden to Entities
- New reporting schedule

Timeline

- Extension is responsive to comments
- Extended from 12 to 24 months
- Includes a tiered approach by voltage class
- Rationale
  - Focus first on protection systems which may have the greatest impact on reliability
  - Allow for better integration into transmission planning assessment cycle
  - Aid in resource allocation
  - Provide additional time for fiscal budgeting

Entities

- Reporting entity
  - Transmission Planner (TP)
- Supporting entities
  - Distribution Provider (DP)
  - Generator Owner (GO)
  - Transmission Owner (TO)
- Rationale for adding DP
  - Distribution Providers may own:
    - Transmission lines operated at 100 kV or higher
    - Step-down transformers that step voltage down from a voltage 100 kV or higher to a voltage below 100 kV

Method – Step 1

- Each Transmission Planner will develop a "List of Buses to be Tested," including each bus[9] in its transmission planning area that meets the criteria in Table A, "Criteria for Buses to be Tested."

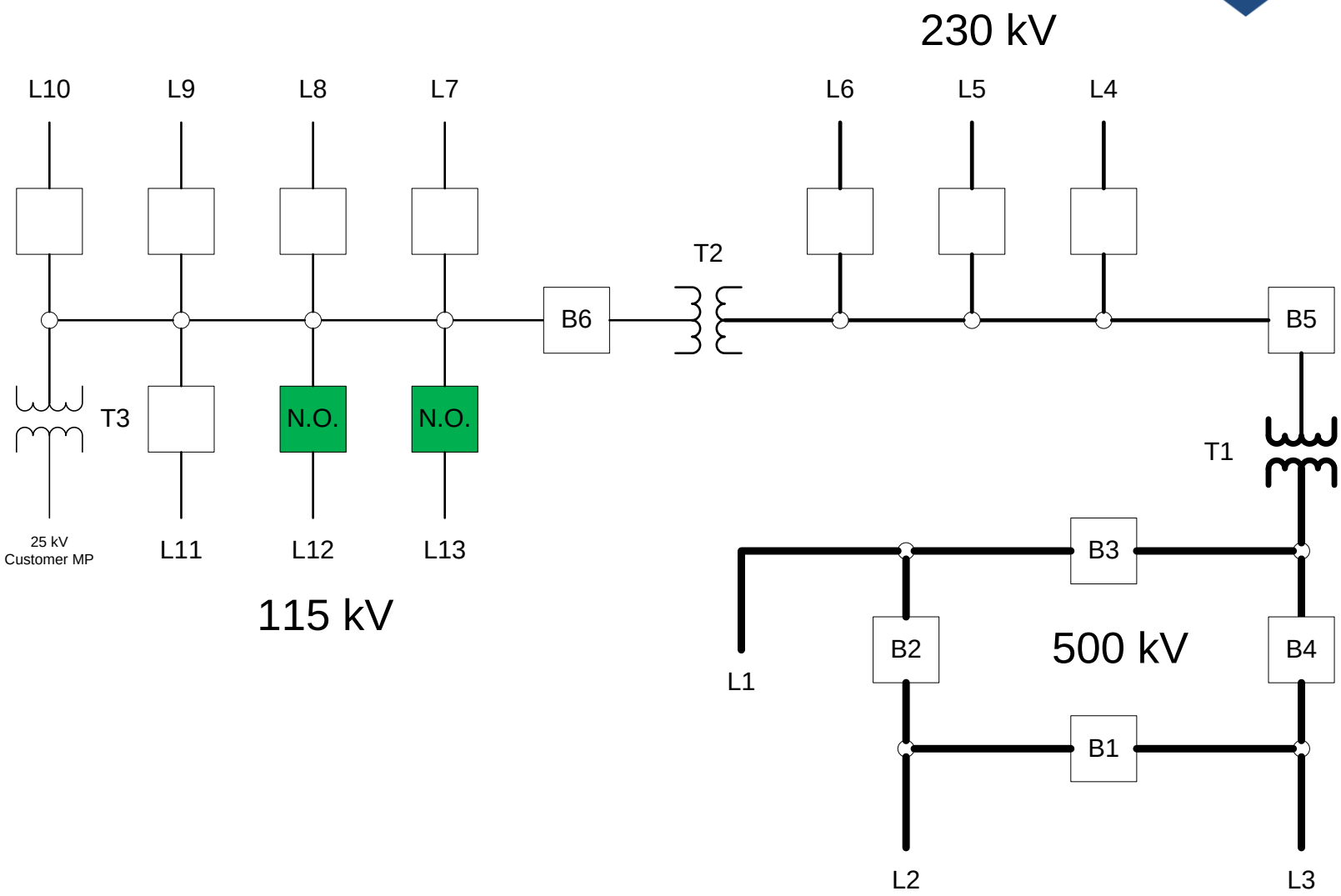
[9] For the purposes of this testing, all bus configurations will be treated as a straight bus (single-breaker) configuration. For example, a fault simulated on a ring bus configuration is modeled as though the fault is on a straight bus, and not on the terminals of any of the elements connected in the ring bus configuration. A fault simulated on a breaker-and-a-half configuration is modeled as though the two buses are a single straight bus.

Table A Change Summary

Table A: Criteria for Buses to be Tested
Buses operated at 200 kV or higher with 4 or more circuits
Buses operated at 100 kV to 200 kV with 6 or more circuits
Buses directly supplying off-site power to a nuclear generating station
Any additional buses the Transmission Planner believes are necessary for the reliable operation of the bulk power system

- Criteria for Buses to be Tested
  - Removed
    - Item related to loss of 300 MW of load
    - Item related to loss of 1,000 MW aggregate generation

Figure 1-2


230 kV
L10
L9
L8
L7
L6
L5
L4
T2
B6
B5
T3
N.O.
N.O.
T1
25 kV
Customer MP
L11
L12
L13
115 kV
B3
B2
500 kV
B4
L1
B1
L2
L3

Example Step 1

- **Example Illustrating Application of the Method**
  - A Transmission Planner identifies that it has 800 buses operated at 100 kV or higher
  - Of these 800 buses, 522 meet the criteria in Table A for "Criteria for Buses to be Evaluated"

Initial Buses			**Step 1**	
115 kV	465		115 kV	240
138 kV	20		138 kV	12
161 kV	15		161 kV	10
230 KV	290		230 KV	250
500 kV	10		500 kV	10
Total	800		Total	522

Step 2

- Each TP will coordinate with each DP, GO, and TO in its transmission planning area to identify:
  - Transformers with through-fault protection that have at least one winding connected at a bus to be tested
  - Any bus from the list developed in step 1, that can be excluded from testing on the basis that the protection system(s) for all Elements connected to the bus and for the physical bus(es), if any, meet the attributes for all categories of components in Table B based on the owner's knowledge of the protection system(s). Each TP will create an initial "List of Buses to be Evaluated" by removing from these bus from the "List of Buses to be Tested"

Table B Change Summary

- Protection System Attributes to be Evaluated
  - Protective Relays
    - Removed “for the element” for clarity
  - Communication Systems
    - Added the phrasing “for communication-aided protection functions (i.e., pilot relaying systems)” for clarity
  - AC Current and Voltage Inputs
    - Added clarifying language about CT installations
  - DC Control Circuitry
    - Added for clarity: “*For the purpose of this data request the DC control circuitry does not include the station DC supply, but does include all the DC circuits used by the protection system to trip a breaker, including any DC distribution panels, fuses, and breakers*.”

Table B

Table B: Protection System Attributes to be Evaluated
Protective Relays: The protection system includes two independent protective relays that are used to measure electrical quantities, sense an abnormal condition such as a fault, and respond to the abnormal condition.
Communication Systems: The protection system includes two independent communication channels and associated communication equipment when such communication between protective relays for communication-aided protection functions (i.e., pilot relaying systems) is needed to satisfy system performance required in NERC Reliability Standards TPL-002-0b and TPL-003-0a.
AC Current and Voltage Inputs: The protection system includes two independent AC current sources and related inputs, except that separate secondary windings of a free-standing current transformer (CT) or multiple CTs on a common bushing can be used to satisfy this requirement; and includes two independent AC voltage sources and related inputs, except that separate secondary windings of a common capacitance coupled voltage transformer (CCVT), voltage transformer (VT), or similar device can be used to satisfy this requirement.
DC Control Circuitry: The protection system includes two independent DC control circuits with no common DC control circuitry, auxiliary relays, or circuit breaker trip coils. For the purpose of this data request the DC control circuitry does not include the station DC supply, but does include all the DC circuits used by the protection system to trip a breaker, including any DC distribution panels, fuses, and breakers.

Example Step 2

- **Example Illustrating Application of the Method**
  - After coordinating with its DP, GO, and TO, the TP is able to eliminate 147 buses based on the asset owners' knowledge confirming that the protection systems for the Elements connected to the buses and for the physical bus(es), if any, meet the attributes for all categories of components in Table B

Step 1			**Step 2**	
115 kV	240		115 kV	220
138 kV	12		138 kV	10
161 kV	10		161 kV	8
230 KV	250		230 KV	132
500 kV	10		500 kV	5
Total	522		Total	375

Step 3

- Each TP will simulate a three-phase (3Ø) fault on each bus[12] in its transmission planning area on the "List of Buses to be Evaluated" (step 2). The 3Ø fault is simulated based on the following parameters:
  - Use most recent assessment-stressed system conditions
  - Maximum expected clearing time
    - Trip remote terminals
    - Trip transformers with through fault protection
  - Table C
    - Duration will be long enough to confirm if simulation exhibits one or more adverse impact
    - Evaluate the system response against the criteria

Table C Change Summary

Table C: Performance Measures	
1.	Loss of synchronism of generating units totaling greater than 2,000 MW or more in the Eastern Interconnection or Western Interconnection, or 1,000 MW or more in the ERCOT or Québec Interconnections
2.	Loss of synchronism between two portions of the system
3.	Negatively damped oscillations

- Performance Measures
  - Had clarity issues regarding terminology
  - Completely rewritten

Step 4

- Each TP will revise its initial “List of Buses to be Evaluated” developed in step 2, by removing any buses at which the simulated performance in step 3 does not exhibit any of the adverse impacts identified in Table C, “Performance Measures,” and inform each DP, GO, and TO of each of its buses remaining on this intermediate “List of Buses to be Evaluated.”

Example Steps 3 and 4

- **Example Illustrating Application of the Method**
  - The TP simulates a 3Ø fault on each bus in step 3 and identifies that for 215 buses the simulated system performance does not exhibit any of the adverse impacts identified in Table C

Step 3		**Step 4**	
115 kV	220	115 kV	55
138 kV	10	138 kV	5
161 kV	8	161 kV	3
230 KV	132	230 KV	92
500 kV	5	500 kV	5
Total	375	Total	160

Steps 5 and 6

- The DP, GO, and TO will review documentation of its protection system(s) at each bus on the "List of Buses to be Evaluated," developed by the TP in step 4. The DP, GO, and TO will identify and inform the TP of any bus at which the protection system(s) for all Elements connected to the bus and for the physical bus(es), if any, meet the attributes for all categories in Table B, "Protection System Attributes to be Evaluated."
- The TP will revise the "List of Buses to be Evaluated" by removing the buses identified in step 5 at which the protection system(s) for all Elements connected to the bus and for the physical bus(es), if any, meet the attributes for all categories in Table B, "Protection System Attributes to be Evaluated."

Example Steps 5 and 6

- **Example Illustrating Application of the Method**
  - The DP, GO, and TO review protection systems at the buses remaining on the "List of Buses to be Evaluated" and identify that 95 of the buses have at least one Element connected for which the protection does not meet the attributes in Table B

Step 4		**Step 6**	
115 kV	55	115 kV	45
138 kV	5	138 kV	4
161 kV	3	161 kV	2
230 KV	92	230 KV	42
500 kV	5	500 kV	2
Total	160	Total	95

Steps 7, 8, and 9

- The TP will consult with the DP, GO, and TO regarding actual clearing times[13] for all Elements that will trip for a fault on each bus identified on the "List of Buses to be Evaluated" as revised in step 6.
- The TP will simulate a 3Ø fault, on each bus identified on the "List of Buses to be Evaluated" (step 6) in accordance with the method described step 4 with actual clearing time by the DP, GO, and TO.

Steps 7, 8, and 9 Continued

- The TP will update the "List of Buses to be Evaluated" from step 6, removing each bus for which the simulated system performance in step 8 does not exhibit any of the adverse impacts identified in Table C and will inform each DP, GO, and TO of each of its buses on this final "List of Buses to be Evaluated."

Example Steps 7, 8, and 9

- **Example Illustrating Application of the Method**
  - The TP obtains actual clearing times and simulates a 3Ø fault on each bus in step 8 and identifies that 30 buses based on actual clearing times do not exhibit any of the adverse impacts identified in Table C

Step 6		**Step 9**	
115 kV	45	115 kV	28
138 kV	4	138 kV	2
161 kV	2	161 kV	1
230 KV	42	230 KV	32
500 kV	2	500 kV	2
Total	95	Total	65

Step 10

- The DP, GO, and TO assess their protection systems and provide data to the TP:
  - For each bus evaluated in step 9, whether the protection systems meet each of the attributes listed in Table B, “Protection System Attributes to be Evaluated,” for each protection system component category
  - The attributes of the station DC supply listed in Table D, “Station DC Supply Attributes to be Reported,” for each bus that meets the criteria in Table A, “Criteria for Buses to be Evaluated”

[SB1] I think this word is missing.

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Table D Change Summary

Table D: Station DC Supply Attributes to be Reported
The protection system includes two independent station DC supplies
The protection system includes one station DC supply that is centrally monitored; if the station DC supply is a battery the monitoring includes alarms for both low voltage and a battery open condition
The protection system includes one station DC supply that is centrally monitored; the station DC supply is a battery and the monitoring does not include alarms for both low voltage and a battery open condition
The protection system includes one station DC supply that is not centrally monitored

- Station DC Supply Attributes to be Reported
  - Clarifications made to 2 of 4 attributes
    - For a station DC supply that is centrally monitored and is a battery, the monitoring includes alarms for low voltage and battery open
    - For a station DC supply that is centrally monitored and is a battery, the monitoring does not include alarms for low voltage and battery open

Step 11

- The TP will provide the following information in accordance with the data request reporting template.[14]
  - Statistics concerning the buses evaluated
  - Statistics concerning the attributes of the protection system(s) associated with each identified Element
  - Statistics concerning the attributes of the station DC supply at selected buses in each transmission planning area

Template Example

- **Row 1 (Initial Buses)**

115 kV	465
138 kV	20
161 kV	15
230 KV	290
500 kV	10
Total	800

- **Row 2 (Step 1)**

115 kV	240
138 kV	12
161 kV	10
230 KV	250
500 kV	10
Total	522

- **Row 3 (Step 6)**

115 kV	45
138 kV	4
161 kV	2
230 KV	42
500 kV	2
Total	95

- **Row 4 (Step 9)**

115 kV	28
138 kV	2
161 kV	1
230 KV	32
500 kV	2
Total	65

Buses Evaluated						
		≥100 kV - <200 kV	≥200 kV - <300 kV	≥300 kV - <400 kV	≥400 kV - <600 kV	≥ 600 kV
1.	Total number of buses in the transmission planning area:	500	290	0	10	0
2.	Total number of buses in the transmission planning area that meet the criteria in Table A, "Initial Criteria for Buses to be Tested":	262	250	0	10	0
3.	Total number of buses evaluated by the Transmission Planner based on actual clearing times:	51	42	0	2	0
4.	Total number of buses evaluated by the Transmission Planner based on actual clearing times that resulted in system performance exhibiting any adverse impact defined in Table C, "Performance Measures":	31	32	0	2	0
5.	Comments:					

Rationale

- Enhanced to provide more understanding
  - Voltage Thresholds and Facility Selection Criteria
    - Basis for Table A selection criteria
    - Relevance to facilities operated below 100 kV
  - Protection System Components and Attributes
    - Level of detail necessary to:
      - Assess whether a reliability gap exists and, if so
      - Develop appropriate measures tailored to address the concern
  - Performance Measures
    - Revised measures indicative of potential for instability, uncontrolled separation, or cascading outages
  - Simulation Fault Type
    - Assessments based on SLG faults may understate reliability risk
    - Avoid compliance space

Burden on Entities

- Based on the example
  - Transmission Planners

	Estimated time	# of buses	Total time
Step 1	24 h	800	24 h
Step 3	2 h/bus	375	750 h
Step 8	3 h/bus	95	285 h
Step 11	24 h	65	24 h
Total			1083 h

  - DP, GO, and TO (Aggregate in the TP's area)

	Estimated time	# of buses	Total time
Step 2	24 h	800	24 h
Step 3	0.5 h/bus	375	188 h
Step 5	2 h/bus	160	320 h
Step 7	1 h/bus	95	95 h
Step 10	4 h /bus	65	260 h
Total			887 h

Schedule

Period*	Activity
End of 1st month	Transmission Planners must acknowledge the request for data
End of 6th month	Transmission Planners must submit a status report stating percent of work complete
End of 12th month	Transmission Planners must report data for buses operated at 300 kV or higher
End of 18th month	Transmission Planners must report data for buses operated at 200 kV or higher and below 300 kV
End of 24th month	Transmission Planners must report data for buses operated at 100 kV or higher and below 200 kV

***Period** is the first calendar day of the month number following BOT approval, except as noted otherwise.

Posted for Comment

- Informal Comment Period
  - 45-day, ending June 25, 2012
  - Use website for submitting comments
  - Summary consideration of comments
  - Seeking BOT approval in August
- Feedback questions
  - Method, Template, Schedule, and any other items
- If submitting as a group . . .
  - “We support the comments of entity ABC” or
  - “We support the comments of entity ABC, except for…”
  - “We support the comments of entity ABC, and additionally…”

Questions and Answers

- Please submit your questions via the chat feature in ReadyTalk
  - Please reference Step #, Slide # or Data Request Page #
- The presenters will respond to as many questions as possible during remainder of the scheduled webinar