

# Project 2015-10 Single Points of Failure

## TPL-001

### Cost Effectiveness

#### Known Outages FERC Order No. 786

FERC Order No. 786 Paragraph 40 directs a change to address the concern that the six month threshold could exclude planned maintenance outages of significant facilities from future planning assessments. See paragraphs 33-45 for the discussion on planned maintenance outages.

#### Overview of Commission Determination (Paragraphs 40-45)

The commission stated in Order No. 786 Paragraph 41:

- For the reasons discussed below, the Commission finds that planned maintenance outages of less than six months in duration may result in relevant impacts during one or both of the seasonal off-peak periods.
- Prudent transmission planning should consider maintenance outages at those load levels when planned outages are performed to allow for a single element to be taken out of service for maintenance without compromising the ability of the system to meet demand without loss of load.
- We agree with commenters such as MISO and ATCLLC that certain elements may be so critical that, when taken out of service for system maintenance or to facilitate a new capital project, a subsequent unplanned outage initiated by a single-event could result in the loss of non-consequential load or may have a detrimental impact to the bulk electric system reliability.
- A properly planned transmission system should ensure the known, planned removal of facilities (i.e., generation, transmission or protection system facilities) for maintenance purposes without the loss of non-consequential load or detrimental impacts to system reliability such as cascading, voltage instability or uncontrolled islanding.

The Commission Disagreed with the following:

- Order No. 786 Paragraph 44: The existing TPL-001-4 for Category P3 covers generator maintenance outages, Category P6 covers transmission maintenance outages.
- Order No. 786 Paragraph 45: Planned outages of less than one year in duration should be addressed operationally by determining new operating limits and taking other actions to mitigate the planned outage.
- Order No. 786 Paragraph 45: Planned outages of less than six months is unnecessary since...10 year time frame.

### Options Considered By Standard Drafting Team to Satisfy FERC Order

The following options considered by the NERC Standard Drafting Team for Requirement R1 Part 1.1.2 include (refer to SAMS recommendations):

#### *Option 1 (SAMS recommendation from Order No. 754 Report):*

Requirement R1, Part 1.1.2 Known outage(s) of generation or Transmission Facility(ies) ~~with a duration of at least six months~~, as selected in consultation with the Reliability Coordinator for the Near-Term Planning Horizon for analyses pursuant to Requirement R2, parts 2.1.3 and R. 2.4.3.

#### *Option 2*

Requirement R1, Part 1.1.2 Known outage(s) of generation or Transmission Facility(ies) ~~with a duration of at least six months~~.

#### *Option 3*

Requirement R1, Part 1.1.2 Known outage(s) of generation or Transmission Facility(ies) with a duration of at least ~~six months~~ three months.

#### *Option 4*

Requirement R1, Part 1.1.2 Known outages(s) of generation or Transmission Facility(ies) with duration of at least ~~six~~ four months and any other significant planned outages of generation or Transmission Facility(ies) with a duration of less than four months that are expected to produce more severe System impacts on its portion of the BES. These outage coordinations are required to be performed for the season/load-levels that outages are normally planned at and shall be performed only in the Near-Term Transmission Planning Horizon.

### Standard Drafting Team Proposal for Requirement R1 Part 1.1.2

The following is the option (Option 1) selected by the standard drafting team which satisfies the FERC Order. The following 1 option selected and in general aligns with the SAMS recommendation.

#### *Option 1 (SAMS recommendation from Order No. 754 Report):*

Requirement R1, Part 1.1.2 Known outage(s) of generation or Transmission Facility(ies) ~~with a duration of at least six months~~, as selected in consultation with the Reliability Coordinator for the Near-Term Planning Horizon for analyses pursuant to Requirement R2, parts 2.1.3 and R. 2.4.3.

### Spare Equipment Strategy FERC Order No. 786

FERC Order No. 786 Paragraph 89 the Commission believes that a similar spare equipment strategy for stability analysis should exist that requires studies to be performed for P0, P1 and P2 categories with the conditions that the system is expected to experience during the possible unavailability of the long lead time equipment. See Paragraph 85 through 89 of Order No. 786 for a discussion on spare equipment strategy.

## Overview of Commission Determination (Order No. 786 Paragraphs 88-89)

The commission stated in Order No. 786:

- Order No. 786 Paragraph 88: The commission agrees that NERC has met the spare equipment strategy directive for steady state analysis under TPL-001-4 R2, Part 2.1.5.
- Order No. 786 Paragraph 88: The Commission finds that a spare equipment strategy for stability analysis is not addressed under category P6.
- Order No. 786 Paragraph 89: The commission is not persuaded by the explanation of NERC and others that a similar spare equipment strategy for stability analysis would cause unjustified burden because stability analysis is already required under category P6.

## Options Considered By Standard Drafting Team to Satisfy FERC Order No. 786

Since the FERC Order in Paragraph 89 was very specific, there was only one option considered by the standard drafting team that met the requirements of the FERC Order Paragraph 89 request.

### *Option 1 Addition of Part 2.4.5*

Requirement R1, Part 1.1.2 When an entity's spare equipment strategy could result in the unavailability of major Transmission equipment that has a lead time of one year or more (such as a transformer), the impact of this possible unavailability on System performance shall be ~~studied~~ assessed. ~~The studies~~ Based upon this assessment, an analysis shall be performed for the selected P1 and P2 ~~categories~~ category events identified in Table 1 for which the unavailability with the conditions that the System is expected to produce more severe System impacts on its portion of the BES. The analysis shall simulate the conditions that the System is expected to experience during the possible unavailability of the long lead time equipment.

## Single Point of Failure of the Protection System

Based on Order No. 754 directive of September 15, 2011; NERC informational filing dated March 15, 2012; Section 1600 data request; and the 2<sup>nd</sup> NERC informational filing dated October 30, 2015, the SPCS/SAMS report to address the concern of Single Point Of Failure of a protection system:

- For Table 1 – Steady State & Stability Performance Planning Events, Category P5:
  - Replace “relay” with “component of a Protection System,” and
  - Add superscript “13” to reference footnote 13 for the replaced term under the “Category” column.
- For Table 1 – Steady State & Stability Performance Extreme Events, under the Stability column, No. 2:
  - Remove the phrase “or a relay failure” from items a, b, c, and d to create distinct events only for stuck breakers.
  - Append four new events for the same items a, b, c, and d in the above bulleted item to create distinct events replacing “a relay failure” with “a component failure of a Protection System.”

- Replace footnote 13 in TPL-001-4 with, “The components from the definition of “Protection System” for the purposes of this standard include (1) protective relays that respond to electrical quantities, (2) single – station DC supply that is not monitored for both low voltage and open circuit, with alarms centrally monitored (i.e., reported within 24 hours of detecting an abnormal condition to a location where corrective action can be initiated), and (3) DC control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.”
- Modify TPL-001-4 (Part 4.5) so that extreme event assessments must include evaluation of the three phase faults the described component failures of a Protection System that produce the more severe system impacts. For example, add a new second sentence that reads “[t]he list shall consider each of the extreme events in Table 1 – Steady State & Stability Performance Extreme Events; Stability column item number 2.”

### **Options Considered By Standard Drafting Team to Satisfy FERC Order**

Since some of the recommendations from the SPCS and SAMS report were so specific, there were no other options considered for the following:

- For Table 1 – Steady State & Stability Performance Planning Events, Category P5:
  - Replace “relay” with “component of a Protection System,” and
  - Add superscript “13” to reference footnote 13 for the replaced term under the “Category” column.
- For Table 1 – Steady State & Stability Performance Extreme Events, under the Stability column, No. 2:
  - Remove the phrase “or a relay failure” from items a, b, c, and d to create distinct events only for stuck breakers.
  - Append four new events for the same items a, b, c, and d in the above bulleted item to create distinct events replacing “a relay failure” with “a component failure of a Protection System.”

Different options were considered for footnote 13 language. These options are:

#### ***Option 1 Footnote 13***

The Standard Drafting Team for TPL-001 considered revising footnote 13 to include all five components. In the NERC glossary of terms, a Protection System include five components. These are:

Protection System –

- Protective relays which respond to electrical quantities,
- Communications systems necessary for correct operation of protective functions
- Voltage and current sensing devices providing inputs to protective relays,

- Station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply), and
- Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.

### ***Option 2 Footnote 13***

The second option was to have footnote 13 list four of the five components of a protection system but limit “communications systems” to only those that are not monitored or alarmed. The following is language for Footnote 13<sup>1</sup>:

13. For the purposes of P5 of this standard, components of a Protection System include the following:
- a. A single protective relay which responds to electrical quantities, without an alternative that provides comparable Normal Clearing times, e.g. sudden pressure relaying;
  - b. A single communications system, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing, which is not monitored or not reported;
  - c. A single dc supply associated with protective functions, and that single station dc supply is not monitored or not reported for both low voltage and open circuit;
  - a.d. A single control circuitry associated with protective functions including the trip coil(s) of the circuit breakers or other interrupting devices.

### ***Option 3 Footnote 13***

- a. The components from the definition of Protection System” for the purposes of this standard include:
- b. protective relays that respond to electrical quantities,
- c. single – station DC supply that is not monitored for both low voltage and open circuit, with alarms centrally monitored (i.e., reported within 24 hours of detecting an abnormal condition to a location where corrective action can be initiated), and
- d. control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.

## **Standard Drafting Team Proposal for Table 1 Footnote 13:**

The Standard Drafting Team selected Option 2 which expands Protection System components to be considered to determine the impact to the BES if that component failed when a fault occurs.

---

<sup>1</sup> Failure of voltage and current sensing device would result in a breaker operation without a fault which was considered not a reliability risk to the BES.

### ***Option 2 Footnote 13***

The second option was to have footnote 13 list four of the five components of a protection system but limit “communications systems” to only those that are not monitored or alarmed. The following is language for Footnote 13<sup>2</sup>:

For the purposes of P5 of this standard, components of a Protection System include the following:

- a. A single protective relay which responds to electrical quantities, without an alternative that provides comparable Normal Clearing times, e.g. sudden pressure relaying;
- b. A single communications system, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing, which is not monitored or not reported;
- c. A single dc supply associated with protective functions, and that single station dc supply is not monitored or not reported for both low voltage and open circuit;
- a-d. A single control circuitry associated with protective functions including the trip coil(s) of the circuit breakers or other interrupting devices.

### **Addition of Corrective Action Plan for Extreme Event Three – Phase Faults:**

The SPCS and SAMS report for Order No. 754 recommended that three phase faults involving single points of failure of a protection system be addressed. Additionally, the standard drafting team recognized that the Order No. 754 data requirement collected data for a three-phase fault and not a single-line-ground fault. The Order No. 754 data collection and report indicated a risk to the BES for three phase faults involving single points of failure of a protection system.

### **Options Considered By Standard Drafting Team to Satisfy FERC Order**

#### ***Option 1:***

Do not add anything for extreme event three-phase faults with protection failure.

#### ***Option 2:***

Addition of Requirement 4 Part 4.2.1 and 4.2.2 as follows:

4.2. Studies shall be performed to assess the impact of the extreme events which are identified by the list created in Requirement R4, Part 4.5.

- 4.2.1. If the analysis concludes there is Cascading caused by the occurrence of extreme events, excluding extreme events 2e-2h in the stability column, an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences of the event(s) shall be conducted.

---

<sup>2</sup> Failure of voltage and current sensing device would result in a breaker operation without a fault which was considered not a reliability risk to the BES.

4.2.2. If the analysis concludes there is Cascading caused by the occurrence of extreme events 2e-2h in the stability column, an evaluation of possible actions designed to prevent the System from Cascading shall:

4.2.2.1. List System deficiencies, the associated actions needed to prevent the System from Cascading, and the associated timetable for implementation~~List System deficiencies, the associated actions, and an associated timetable for implementation needed to prevent the System from Cascading.~~

4.2.2.2. Be reviewed in subsequent annual Planning Assessments for continued validity and implementation status.

### **Standard Drafting Team Proposal**

The standard drafting team selected Option 2 which was to add a requirement to require a Corrective Action Plan if a three-phase fault followed by a protection failure causes cascading.

#### ***Option 2:***

4.2. Studies shall be performed to assess the impact of the extreme events which are identified by the list created in Requirement R4, Part 4.5.

4.2.1. If the analysis concludes there is Cascading caused by the occurrence of extreme events, excluding extreme events 2e-2h in the stability column, an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences of the event(s) shall be conducted.

4.2.2. If the analysis concludes there is Cascading caused by the occurrence of extreme events 2e-2h in the stability column, an evaluation of possible actions designed to prevent the System from Cascading shall:

4.2.2.1. List System deficiencies, the associated actions needed to prevent the System from Cascading, and the associated timetable for implementation~~List System deficiencies, the associated actions, and an associated timetable for implementation needed to prevent the System from Cascading.~~

4.2.2.2. Be reviewed in subsequent annual Planning Assessments for continued validity and implementation status.