NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Technical Rationale for Reliability Standard FAC-011-4

April 2021

FAC-011-4 – System Operating Limits Methodology for the Operations Horizon

Requirement R1

R1. Each Reliability Coordinator shall have a documented methodology for establishing SOLs (i.e., SOL methodology) within its Reliability Coordinator Area.

Rationale R1

The three subparts in Requirement R1 in currently-effective Reliability Standard FAC-011-3 are either not necessary for reliability, or they are addressed through other mechanisms in FAC-011-4 and therefore are not included as part of Requirement R1.

Requirement R1 Part 1.1 in currently-effective FAC-011-3 requires the SOL methodology "be applicable for developing System Operating Limits (SOLs) used in the operations horizon." The revised Requirement R1 is applicable to the Operations Planning Time Horizon. Accordingly, there is no reliability-related need to have a requirement specifying that the Reliability Coordinator's (RC's) SOL methodology is applicable for developing SOLs used in the operations horizon. Additionally, the purpose of the standard references SOLs used in the reliable operation of the BES.

Requirement R1 Part 1.2 in currently-effective FAC-011-3 requires the SOL methodology to "state that SOLs shall not exceed associated Facility Ratings." Facility Ratings to be used in operations as SOLs are addressed through FAC-011-4 Requirement R2 and therefore, is not addressed as a subpart of R1.

Requirement R1 Part1.3 in currently-effective FAC-011-3 requires the SOL methodology to "include a description of how to identify the subset of SOLs that qualify as IROLs." This language is preserved in Requirement R7.

Requirement R2

R2. Each Reliability Coordinator shall include in its SOL methodology the method for Transmission Operators to determine which owner-provided Facility Ratings are to be used in operations such that the Transmission Operator and its Reliability Coordinator use common Facility Ratings.

Rationale R2

The reliability objectives of Requirement R2 are 1) to ensure the owner-provided Facility Ratings that are selected for use in operations are determined in accordance with the RC's SOL methodology, and 2) to ensure the consistent use of applicable Facility Ratings between RCs and their Transmission

Operators (TOP). For example, if a Transmission Owner (TO) provides three levels of Facility Ratings pursuant to Reliability Standard FAC-008-3, and another TO provides five levels of ratings, the RC will establish the method for the TOPs to determine which of those Facility Ratings will be utilized in common with the TOP and the RC for monitoring and assessments.

The intent of Requirement R2 is not to change, limit, or modify Facility Ratings determined by the equipment owner. The equipment owner is still the functional entity responsible for determining Facility Ratings per FAC-008. The intent is to use those owner-provided Facility Ratings in a consistent manner between RCs and their TOPs during operations.

Requirement R3

R3. Each Reliability Coordinator shall include in its SOL methodology the method for Transmission Operators to determine the System Voltage Limits to be used in operations. The method shall:

3.1. Require that each BES bus/station have an associated System Voltage Limits, unless its SOL methodology specifically allows the exclusion of BES buses/stations from the requirement to have an associated System Voltage Limit;

3.2. Require that System Voltage Limits respect voltage-based Facility Ratings;

3.3. Require that System Voltage Limits are greater than or equal to in-service BES relay settings for under-voltage load shedding systems and Undervoltage Load Shedding Programs;

3.4. Identify the minimum allowable System Voltage Limit;

3.5. Define the method for determining common System Voltage Limits between the Reliability Coordinator and its Transmission Operators, between adjacent Transmission Operators, and between adjacent Reliability Coordinators within an Interconnection;

Rationale R3

System Voltage Limits (SVLs) are intended to provide reliable pre- and post-contingency System performance for operations within each RC Area. The proposed definition of System Voltage Limits includes normal and emergency voltage limits, and can also include time-based voltage limits, depending on what the RC requires. It is expected that the RC would require a set of System Voltage Limits to cover the entire BES system within its RC Area for voltage-based Facility Ratings, voltage instability, voltage collapse and misactuation of relay elements.

Both maximum and minimum limits are required. Maximum limits tend to be associated with equipment/facility limitations. Minimum limits are often used to prevent phenomena associated with minimum voltages such as system instability, voltage collapse, and potential misactuation of relay elements. Identifying the set of “System Voltage Limits”, both maximum and minimum, assures that all voltage limits associated with a particular bus or station, or the equipment connected to it, have been considered and the most limiting are used. The terms maximum and minimum are used through the standard, rationale and definitions with regard to voltage limits however it is common in industry to use the terms low, lowest, high and highest as synonyms for maximum and minimum and such usage is acceptable.

While all BES buses/stations have equipment related voltage ratings, there may be reasons that certain buses/stations do not require a System Voltage Limit. Part 3.1 allows RCs to identify certain buses/stations that may be excluded from having an associated System Voltage Limit. The identification of such buses/stations could be documented by citing the type of buses/stations (based on voltage level or area of the System) as opposed to a more detailed list of individual buses/stations which are exempt.

Buses or stations may not require System Voltage Limits when the voltage at the station has no material impact on System performance and associated SOLs. For example, System Voltage Limits at neighboring/nearby stations may be sufficient to protect the facilities from maximum voltage, and the System from instability, voltage collapse, and misactuation of relay elements.

Part 3.5 requires that the SOL methodology define a method for determining common System Voltage Limits between RCs and TOPs. RC and TOPs may independently identify System Voltage Limits which if not coordinated could create reliability issues. An example could be where one TOP A chooses very wide System Voltage Limits on its equipment but TOP B could have much tighter System Voltage Limits even within the same substation. TOP A may operate equipment that are within its System Voltage Limits but cause an exceedance of TOP B's equipment. Coordinating the System Voltage Limits in these circumstances can prevent unnecessary exceedances of the System Voltage Limits.

Part 3.2 provides that in establishing System Voltage Limits, the SOL methodology shall respect any voltage-based Facility Ratings established by the Generation Owner or TO under FAC-008. Recognizing that voltage limits are difficult to reflect by facility, the System Voltage Limits provided for stations/buses should reflect any voltage-based Facility Ratings for facilities that terminate at, or are adjacent to the stations/buses with System Voltage Limits.

FERC Order No. 818 issued November 19, 2015, states that Undervoltage Load Shedding Programs (UVLS) should not be triggered for an N-1 Contingency. As such, under Part 3.3, the SOL methodology shall ensure System Voltage Limits are not set at values less than UVLS settings to avoid UVLS operation following N-1 Contingencies.

Requirement R4

R4. Each Reliability Coordinator shall include in its SOL methodology the method for determining the stability limits to be used in operations. The method shall:

4.1. Specify stability performance criteria, including any margins applied. The criteria shall, at a minimum, include the following:

4.1.1. steady-state voltage stability;

4.1.2. transient voltage response;

4.1.3. angular stability; and

4.1.4. System damping.

4.2. Require that stability limits are established to meet the criteria specified in Part 4.1 for the Contingencies identified in Requirement R5 applicable to the establishment of stability limits that are expected to produce more severe System impacts on its portion of the BES.

4.3. Describe how the Reliability Coordinator establishes stability limits when there is an impact to more than one Transmission Operator in its Reliability Coordinator Area or other Reliability Coordinator Areas.

4.4. Describe how stability limits are determined, considering levels of transfers, Load and generation dispatch, and System conditions including any changes to System topology such as Facility outages;

4.5. Describe the level of detail that is required for the study model(s); including the extent of the Reliability Coordinator Area, as well as the critical modeling details from other Reliability Coordinator Areas, necessary to determine different types of stability limits.

4.6. Describe the allowed uses of Remedial Action Schemes and other automatic post-Contingency mitigation actions in establishing stability limits used in operations.

4.7. State that the use of underfrequency load shedding (UFLS) programs and Undervoltage Load Shedding Programs are not allowed in the establishment of stability limits.

Rationale R4

Reliability Standard FAC-011-3 currently requires the System to demonstrate transient, dynamic, and voltage stability for both pre- and post-contingent states, but does not provide specifics. By requiring specific stability criteria within the SOL methodology, the standard is improved and provides greater clarity and uniformity on practices across the industry. The set of commonly used stability criteria specified in Requirement R4 Part 4.1 is based upon information provided by standard drafting team members and observers, including many RCs and TOPs. Industry input from areas with significant experience managing stability issues led to the inclusion of System damping.

Also included in Part 4.1 is language requiring the SOL methodology to include descriptions of how margins are applied. This language was added to explicitly capture the practices in use by RCs for off-line or on-line calculated stability limits, including any margin used in the application of the stability limits. It is left to the RC what type of margin to use (a percentage of the limit or a fixed MW value, for example), if it uses one at all.

Requirement R4 Part 4.2 provides the link to the Contingencies which must be respected in operations. Many stability tools will consider a subset of contingencies that are applicable to the area in study and are expected to produce more severe System impacts rather than every single potential contingency to set the limits conservatively while minimizing the time it takes to complete the solution, which is reflected in the phrase “applicable to the establishment of stability limits that are expected to produce more severe System impacts on its portion of the BES”. In response to industry comments, Contingency specifications were moved to a separate requirement.

Requirement R4 Part 4.3 was introduced to preclude ambiguity in the resolution of stability limits when multiple TOPs within an RC's footprint are impacted. For example, the SOL methodology could describe which TOP or RC has the responsibility to determine stability SOLs impacting multiple TOPs, and could also determine how to choose between stability limits derived by multiple TOPs for the same stability limit exceedance. Additionally, Requirement R4 Part 4.3 addresses when there is an impact to other Reliability Coordinator Areas.

Requirement R4 Parts 4.4, 4.5 and 4.6 require that the SOL methodology provide a description of the key parameters that must be considered and monitored when performing analyses to determine the stability limits. The intent of these parts is to help ensure that the SOL methodology provides guidance such that the process/method used by the RC to determine stability limits may be repeated, successfully, by anyone reading the SOL methodology. For example, the SOL methodology could state that stability limits will be determined for any combination of all facilities in and single facility out conditions, for all valid transfer conditions for the highest allowable thermal transfer condition (i.e. winter ratings), plus a flow margin of 10 percent, to account for potential emergency transfer conditions. This level of detail would allow TOPs and other entities to consistently duplicate results from study to study. Part 4.5 combines FAC-011-3 Requirement R3 Parts R3.1 and R3.4 into a single part while providing flexibility to the extent of the RC Area (including other RC Areas) that must be modeled to reflect the varying needs for different types of stability limits (e.g. local single unit stability up to wide area or inter area instability). By recognizing that some types of localized stability issues do not require the modeling of the entire Reliability Coordinator Area to establish a stability limit, this revision aligns with and promotes the ability to monitor these localized areas with real time stability analysis tools.

Requirement 4 Part 4.4 is specifically intended to address the need for the SOL methodology to identify the method for ensuring stability limits are "valid" (i.e. provide stable operations pre- and post-Contingency) for the Operational Planning Analysis (OPA) and Real-time Assessments (RTA) for which they will be used. Since stability limits may vary based on the system topology, load, generation dispatch, etc., and the current definitions for OPA and RTA include "An evaluation of … system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for ….operations", the stability limits used in OPA/RTA should be "valid" for those system conditions.

As described within PRC-006-2 in alignment with FERC Order No. 763, underfrequency load shedding (UFLS) programs are designed "to arrest declining frequency, assist recovery of frequency following underfrequency events and provide last resort system preservation measures." In the establishment of stability limits under Requirement R4 Part 4.7, UFLS programs or UVLS Programs are expressly prohibited from being considered as an acceptable post-Contingency mitigation action in order to preserve the intended availability of UFLS programs and UVLS Programs as measures of "last resort system preservation".

Requirement R5

R5. Each Reliability Coordinator shall identify in its SOL methodology the set of Contingency events for use in determining stability limits and the set of Contingency events for use in performing

Operational Planning Analysis (OPAs) and Real-time Assessments (RTAs). The SOL methodology for each set shall:

5.1. Specify the following single Contingency events:

5.1.1. Loss of any of the following either by single phase to ground or three phase Fault (whichever is more severe) with Normal Clearing, or without a Fault:

- generator;
- transmission circuit;
- transformer;
- shunt device; or
- single pole block in a monopolar or bipolar high voltage direct current system.

5.2. Specify additional single or multiple Contingency events or types of Contingency events, if any.

5.3. Describe the method(s) for identifying which, if any, of the Contingency events provided by the Planning Coordinator or Transmission Planner in accordance with FAC-014-3, Requirement R7, to use in determining stability limits.

Rationale R5

Requirement R5 combines both the requirements for single Contingencies (formerly in Requirement R2 Part 2.2 of FAC-011-3) and for multiple Contingencies (formerly in Requirement R3 Part 3.3 of FAC-011-3) for ease of interpretation.

Furthermore, Requirement R5 continues to maintain the flexibility that existed in FAC-011-3 Requirement R2 Part 2.2 and Requirement R3 Part 3.3 for each RC to determine which additional single and multiple Contingencies to respect given the uniqueness of their system. Through both the feedback received as a result of the July 2016 informal posting and the May 2016 technical conference it was evident that both the drafting team and industry agree that sufficient flexibility is required for each RC to determine its own methodology for addressing Contingencies other than single Contingencies.

Requirement R5 mandates that the RC specify which types of Contingencies (both single and multiple) are used for determining stability limits as well as those used in the evaluation of post-Contingency state in OPAs and RTAs (thermal and voltage). The SOL methodology is the best place to communicate which Contingencies the RC is respecting in their footprint such that all TOPs and any neighboring RCs understand one another's internal and interconnection-related reliability objectives.

Requirement R5 Part 5.1.1 identifies the types of single Contingency events that, at a minimum, must be used for stability limit analysis and for performing OPAs and RTAs. However, other types of single Contingency events, such as inadvertent breaker operation and bus faults, may be considered if the probability of such an event is relevant. These Contingencies, if any, must be specified in the RC's methodology as per Requirement R5 Part 5.2.

Requirement R5 Part 5.3 compliments the proposed Requirement R8 in FAC-014-3 by ensuring the RC's methodology describes how the Contingency event information from the Planning Coordinator is used in deriving stability limits used in operations.

Requirement R5 establishes the contingency events for use in determining stability limits, in performing Operational Planning Analysis (OPAs), and in performing Real-Time Assessments (RTAs). The standard requirement is not meant to imply that all TOPs within the RC footprint must use that identical list spanning the entire RC region but may use a reduced list that at least covers the area they are responsible for the most limiting Contingencies.

Requirement R6

R6. Each Reliability Coordinator shall include the following performance framework in its SOL methodology to determine SOL exceedances when performing Real-time monitoring, Real-time Assessments, and Operational Planning Analyses:

6.1. System performance for no Contingencies demonstrates the following:

6.1.1. Steady state flow through Facilities are within Normal Ratings; however, Emergency Ratings may be used when System adjustments to return the flow within its Normal Rating could be executed and completed within the specified time duration of those Emergency Ratings.

6.1.2. Steady state voltages are within normal System Voltage Limits; however, emergency System Voltage Limits may be used when System adjustments to return the voltage within its normal System Voltage Limits could be executed and completed within the specified time duration of those emergency System Voltage Limits.

6.1.3. Predetermined stability limits are not exceeded.

6.1.4. Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur.[1]

6.2. System performance for the single Contingencies listed in Part 5.1 demonstrates the following:

6.2.1. Steady State post-Contingency flow through Facilities within applicable Emergency Ratings. Steady state post-Contingency flow through a Facility must not be above the Facility's highest Emergency Rating.

6.2.2. Steady state post-Contingency voltages are within emergency System Voltage Limits.

6.2.3. The stability performance criteria defined in Reliability Coordinator's SOL methodology are met.

[1] Stability evaluations and assessments of instability, Cascading, and uncontrolled separation can be performed using real-time stability assessments, predetermined stability limits or other offline analysis techniques.

6.2.4. Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur[1].

6.3. System performance for applicable Contingencies identified in Part 5.2 demonstrates that: instability, Cascading, or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur.

6.4. In determining the System's response to any Contingency identified in Requirement R5, planned manual load shedding is acceptable only after all other available System adjustments have been made.

Rationale R6

Requirement R6 addresses BES performance criteria, which is addressed in the currently effective FAC-011-3 Requirement R2 Parts 2.1 and 2.2. The proposed requirement has some differences in the manner in which the performance criteria are addressed and in the level of detail reflected in the requirement when compared to the existing requirement. Those differences are discussed here.

Currently effective FAC-011-3 Requirement R2 states that the "*RC's SOL methodology shall include a requirement that SOLs provide BES performance consistent with the following.*" The subsequent subparts to FAC-011-3 Requirement R2 further describe pre-Contingency performance criteria (in Requirement R2 Part 2.1), the post-Contingency performance criteria (in Requirement R2 Part 2.2), and describe other rules related to the establishment of SOLs in the remaining subparts. The language in Requirement R2 indicates that the SOLs established in accordance with Requirement R2 are expected to "provide" a level of pre- and post-Contingency reliability described in the subparts of Requirement R2. Accordingly, the assessments of the pre-Contingency state and the post-Contingency state are expected to be performed as part of the SOL establishment process, yielding a set of SOLs that "provide" for meeting the performance criteria denoted in FAC-011-3 Requirement R2 and its subparts.

Pursuant to the construct in the currently-effective TOP/IRO Reliability Standards, the pre- and post-Contingency states are assessed on an ongoing basis as part of Operational Planning Analyses (OPAs) and Real-time Assessments (RTAs). Any SOL exceedances that are observed are required to be mitigated per the respective Operating Plans. Under this construct, it is the OPA, the RTA, and the implementation of Operating Plans that "provide" for reliable pre- and post-Contingency operations through the application of the minimum performance criteria specified in FAC-011-4 requirement R6 and subparts. Under this construct, the assessments of the pre-Contingency state and the post-Contingency state are expected to be performed as part of the OPA and RTA for Facility Rating and System Voltage Limits. Stability limits are either established prior to the OPA/RTA or established and assessed during the OPA and RTA.

Requirement R6 works together with proposed TOP-001-5 Requirement R25 and IRO-008-3 R7 to support reliable operations for pre- and post-Contingency operating states. TOP-001 Requirement R25 states, *"Each Transmission Operator shall use the applicable RC's SOL methodology when*

determining SOL exceedances for Real-time Assessments, Real-time Monitoring, and Operational Planning Analysis." IRO-008-3 Requirement R7 states*, "Each Reliability Coordinator shall use its SOL methodology when determining SOL exceedances for Real-time Assessments, Real-time Monitoring, and Operational Planning Analysis."* The above noted requirements in TOP-001 and IRO-008 ensure that the performance framework identified in the SOL methodology is used to determine SOL exceedances consistently between the RC and its associated TOPs during Real-time Assessments, Real-time Monitoring, and Operational Planning Analysis."

FAC-011-4 Requirement R6 Parts 6.1.1 and 6.1.2 are intended to prescribe the appropriate use of Emergency Ratings and Emergency System Voltage Limits when actual (or OPA no Contingency) flows or voltages exceed Normal Ratings or fall outside normal System Voltage Limits, respectively.

The language in Part 6.1.1 reflects the concepts in Figure 1 of the Project 2014-03 Whitepaper (NERC SOL Whitepaper) with regard to Facility Rating performance. Part 6.1.1 states, *"Steady state flow through Facilities are within applicable Emergency Ratings, provided that System adjustments to return the flow within its Normal Rating can be executed and completed within the specified time duration of those Emergency Ratings."* This is intended to allow, as an example, for the use of the 4-hour Emergency Rating and the 15-minute Emergency Rating consistent with the bullet descriptions in Figure 1. As is described in Figure 1, the use of the Emergency Ratings is governed by the amount of time it takes to execute the Operating Plan to mitigate the condition. The portion of Part 6.2.1 that states, *"Steady state post-Contingency flow through a Facility must not be above the Facility's highest Emergency Rating"* is intended to specifically address the operating state highlighted in yellow in Figure 1. In this operating state, the System Operator may have insufficient time to implement post-Contingency mitigation actions (i.e., actions that are taken after the Contingency event occurs); therefore, pre-Contingency mitigation actions consistent with the Operating Plan must be taken as soon as possible to reduce the calculated post-Contingency flow. However, as noted in the NERC SOL Whitepaper, pre-Contingency load shed may not be necessary or appropriate when assessment identifies that the impact is localized.

Requirement 6 applies only to those contingencies specified by the Reliability Coordinator for monitoring in the Transmission Operators RTA and OPA. If the Transmission Operators monitors additional contingencies beyond the subset required by the Reliability Coordinator, they are not required to meet the performance metrics in Requirement 6. As an example, if a TOP chooses to monitor loss of an entire substation as a contingency within their contingency analysis this section does not require that system performance following that event must meet these performance requirements. If the loss of a substation was not a defined contingency in the RC's SOL methodology, and no other defined contingency could cause loss of the entire substation, then the TOP could define what performance criteria, if any, to apply to this contingency. Said simply, R6 specifically applies only to the events and conditions described in R5.

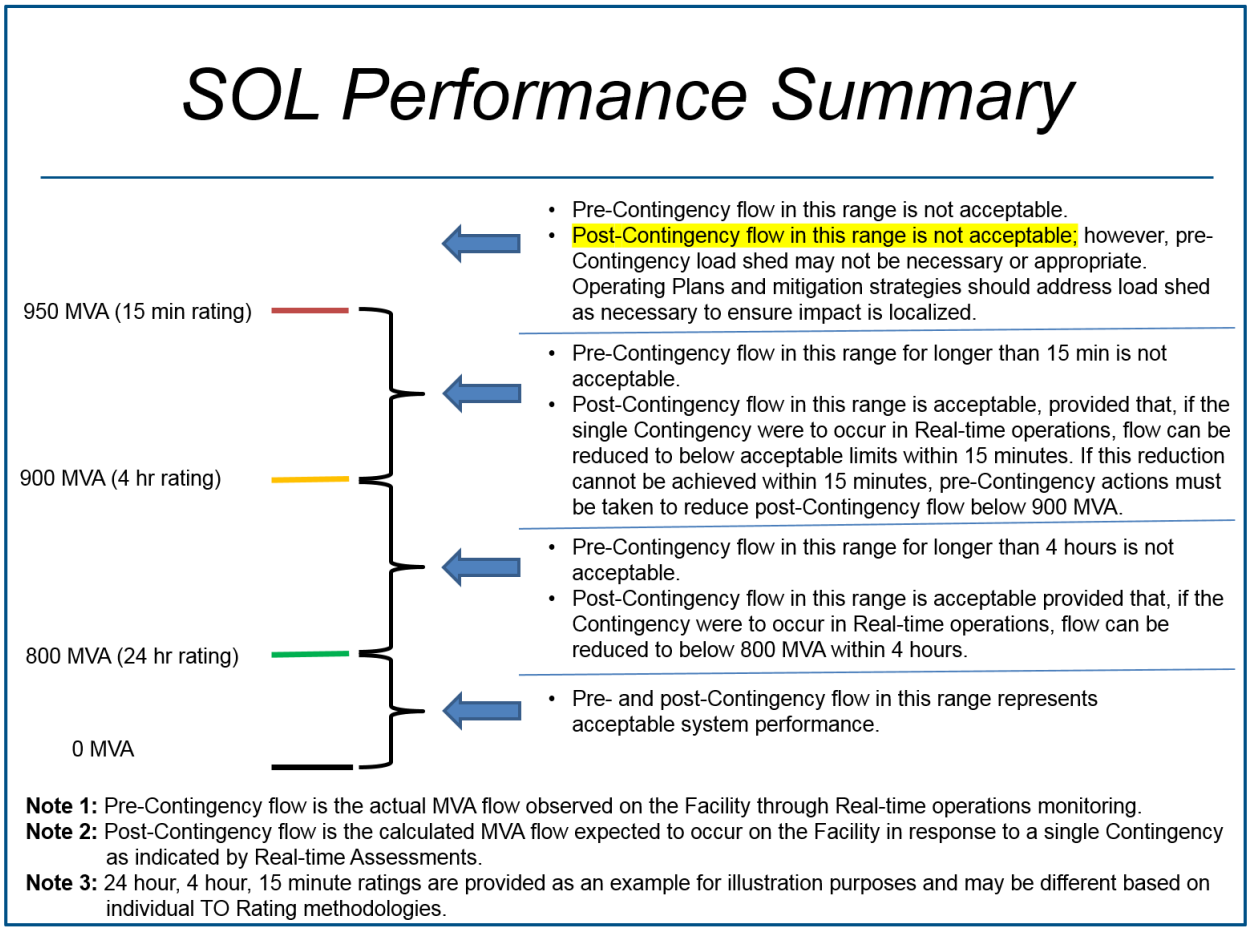

Figure 1 of the NERC SOL Whitepaper

The footnote referenced in Parts 6.1.4 and 6.2.3 states, "*Stability evaluations and assessments of instability, Cascading, and uncontrolled separation can be performed using real-time stability assessments, predetermined stability limits or other offline analysis techniques.*" This helps to provide clarity that there are multiple methods to assessing if System performance demonstrates that Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur. Some entities determine stability limits across a variety of operating conditions and apply the appropriate limit to the operating condition in the OPA, RTA and Real time monitoring. Other entities may utilize tools that run at the time of the study to assess for acceptable performance or determine stability limits at the time of the OPA or RTA. Others may yet utilize other offline analysis techniques.

Part 6.3 recognizes the potential for regional differences and is intended to describe the minimum performance criteria for Contingency events that are more severe than the single Contingency events listed in Requirement R5 Part 5.1.1 for OPAs and RTAs (i.e., Contingencies identified in Part 5.2). Per Part 6.3, if any of these more severe Contingency events were to occur, at a minimum the System is expected to remain stable, there should be no Cascading, and there should be no uncontrolled separation that adversely impact the reliability of the Bulk Electric System.

Part 6.4 maintains the concept identified in FAC-011-3 Requirement R2 Part 2.3.2 and intent of FERC Order No. 705, where FERC determined that load shedding shall only be utilized by system operators as a measure of last resort to prevent cascading failures. Part 6.4 clarifies that load shedding as a remedy in the operating plan should only be allowed by the RC's methodology after other options are exercised without regard for financial impact. The term "planned manual load shedding" refers to the inclusion of planned post-Contingency shedding of load either manually or by automated methods in an Operating Plan. This Operation Plan is developed in response to SOL exceedances identified in its Operating Planning Analysis including for contingencies identified in Requirement R5 against the transmission system under study and would apply to the Operational Planning Analysis. While those plans guide an operator's response to an event in Real-time monitoring or a Real-time Assessment, Part 6.4 would not directly apply to the actions taken by the operator in real time.

For clarity, the following examples of pre- or post-Contingency actions are provided to expand on the term "all other available System adjustments" that should have been made prior to planning to utilize load shedding:

- Generation commitment and re-dispatch regardless of economic cost, when the generation has a significant impact on the SOL exceedance.
- Curtailment and adjustment of Interchange regardless of economic cost, when the Curtailment or adjustment of Interchange has a significant impact on the SOL exceedance.
- Transmission re-configuration (only if studies shows that the re-configuration does not put more load at risk or create other unacceptable system performance)

Transmission re-configuration that does place more load at risk or create other unacceptable system performance issues is not required to be used prior to planned manual load shedding. As an example the reconfiguration of a looped network into a series of radial connections to avoid planned post contingency manual load shedding could be a re-configuration that puts more load at risk. In those circumstances the TOP and RC must select that option that best fits their operating conditions and Requirement R6 Part 6.4 is not intended to prescribe one approach over the other. Planned "manual" load shedding would be load shed plans, as part of an Operating Plan, and is load that would be shed as part of an Operator Instruction or taking action to shed the load in Real-time. Reconfiguration of a system in Real-time to avoid or lessen the amount of planned manual load shed or reconfiguration of a system in Real-time that creates additional "consequential" load loss is not part of "planned manual load shedding". Furthermore, the "all other available System adjustments" would apply only to those adjustments studied by the TOP or RC at the time of the Operating Planning Analysis and not to system adjustments that might be found during a post event review days or weeks later. Part 6.4 is an addition to the RC's SOL methodology and the RC can provide additional clarity as appropriate to their circumstances.

Planned manual load shedding in the context of Requirement R6 Part 6.4 is specific to what could be considered "firm" load, and would not include non-firm load, interruptible load, or any other load that has an arrangement that allows the load to be shed or interrupted when needed.

Requirement R7

R7. Each Reliability Coordinator shall include in its SOL methodology a risk-based approach for determining how SOL exceedances identified as part of Real-time monitoring and Real-time Assessments must be communicated and if so, the timeframe that communication must occur. The approach shall include:

7.1. A requirement that the following SOL exceedances will always be communicated, within a timeframe identified by the Reliability Coordinator.

7.1.1. IROL exceedances

7.1.2. SOL exceedances of stability limits;

7.1.3. Post-contingency SOL exceedances that are identified to have a validated risk of instability, Cascading Outages, and uncontrolled separation

7.1.4. Pre-contingency SOL exceedances of Facility Ratings

7.1.5. Pre-contingency SOL exceedances of normal minimum System Voltage Limits.

7.2. A requirement that the following SOL exceedances must be communicated, if not resolved within 30 minutes, within a timeframe identified by the Reliability Coordinator.

7.2.1. Post-contingency SOL exceedances of Facility Ratings and emergency System Voltage limits

7.2.2. Pre-contingency SOL exceedances of normal maximum System Voltage Limits.

Rationale R7

The changes in proposed FAC-011-4 help to provide clarity by requiring a performance framework for determining SOL exceedances in the RC's SOL methodology. This provides better uniformity in determining what is and isn't an SOL exceedance. This clarity may increase the instances of what is determined to be an SOL exceedance and thus increase the instances of communications that are required consistent with TOP-001-4 Requirement R15 (as well as IRO-008-2 Requirements R5 and R6) which states, "*Each Transmission Operator shall inform its Reliability Coordinator of actions taken to return the System to within limits when a SOL has been exceeded.*"

Concerns were raised as to the effect on Real-time System Operators being required to communicate every SOL exceedance, especially those which were considered short duration SOL exceedances (e.g. less than 15 min, 30 min). This could be a significant increase for entities that historically performed RTAs more frequent than the required 30 minutes. Proposed FAC-011-4 Requirement R7 addresses this concern by requiring the RC to include in its SOL methodology a risk-based approach for determining how SOL exceedances identified as part of Real-time monitoring and Real-time Assessments must be communicated and if so, with what priority. This will ensure consistency within an RC's area between the RC and its TOPs.

Part 7.1 requires that the risk based approach require that "IROL exceedances, SOL exceedances of stability limits, post-contingency SOL exceedances that are identified to have a validated risk of

instability, Cascading Outages, and uncontrolled separation and pre-contingency SOL exceedances of Facility Ratings and pre-contingency Minimum System Voltage Limits will always be communicated". While typically less frequent, these subset of SOL exceedances were determined to be of a higher risk and must always be communicated between TOP's and RC's. The RC must identify the priority of communications during circumstances where multiple SOL exceedances may exist.

Part 7.2 requires that the risk based approach require that "Post-contingency SOL exceedances of Facility Ratings and System Voltage limits and pre-contingency Normal Maximum System Voltage Limits must be communicated, if not resolved, within a timeframe identified by the RC which cannot exceed 30 minutes". While typically more frequent, these subset of SOL exceedances were determined to be of a lower risk allow the RC to identify a timeframe which cannot exceed 30 minutes whereby if the SOL exceedance is mitigated (no longer an SOL exceedance) within the identified timeframe (e.g. 15min, 30 min, etc.), the SOL exceedance would not be required to be communicated to the TOP or RC. The RC must identify the priority of communications during circumstances where multiple SOL exceedances may exist.

Nothing prohibits an RC from requiring all or an additional subset of SOL exceedances than what is identified in Part 7.1 from being communicated. Nothing prohibits a Real-time System Operator from communicating beyond what is required or in line with other good utility practice (e.g. troubleshooting or communicating). These provisions are meant to ensure that a risk based approach can be applied to prevent low risk or after the fact communications from distracting System Operators from other higher priority tasks.

This proposed requirement is coordinated with proposed changes to TOP-001-5 Requirement R15 which states "*Each Transmission Operator shall inform its Reliability Coordinator of actions taken to return the System to within limits when a SOL has been exceeded* ***in accordance with its Reliability Coordinator's SOL methodology.***" and with proposed IRO-008-3 Requirements R5 and R6 which state, **"***Each Transmission Operator shall inform its Reliability Coordinator of actions taken to return the System to within limits when a SOL has been exceeded* ***in accordance with its Reliability Coordinator's SOL methodology****."* and **"***Each Reliability Coordinator shall notify****, in accordance with SOL methodology****, impacted Transmission Operators and Balancing Authorities within its Reliability Coordinator Area, and other impacted Reliability Coordinators as indicated in its Operating Plan, when the System Operating Limit (SOL) or Interconnection Reliability Operating Limit (IROL) exceedance identified in Requirement R5 has been prevented or mitigated.****",** respectfully.

Requirement R8

R8. Each Reliability Coordinator shall include in its SOL methodology:

8.1. A description of how to identify the subset of SOLs that qualify as Interconnection Reliability Operating Limits (IROLs).

8.2. Criteria for determining when exceeding a SOL qualifies as exceeding an IROL and criteria for developing any associated IROL T_V.

Rationale R8

The two IROL related requirements in FAC-011-3 were preserved under Requirement R8. Part 8.2 utilizes terminology consistent with proposed FAC-011-4, and the IRO/TOP NERC Reliability Standards by replacing "violating" with "exceeding". It also inserts "exceeding" before the IROL to better harmonize with proposed FAC-011-4, and the IRO/TOP NERC Reliability Standards.

Requirement R9

R9. Each Reliability Coordinator shall provide its SOL methodology to:

9.1. Each Reliability Coordinator that requests and indicates it has a reliability-related need within 30 days of a request.

9.2. Each of the following entities prior to the effective date of the SOL methodology:

9.2.1. Each adjacent Reliability Coordinator within the same Interconnection;

9.2.2. Each Planning Coordinator and Transmission Planner that is responsible for planning any portion of the Reliability Coordinator Area;

9.2.3. Each Transmission Operator within its Reliability Coordinator Area; and

9.2.4. Each Reliability Coordinator that has requested to receive updates and indicated it had a reliability-related need.

Rationale R9

Requirement R9 preserves the reliability objective of providing the SOL methodology to the appropriate entities from Requirement R4 of FAC-011-3. Requirement R8 Part 8.1 mandates that an RC provide its SOL methodology to any requesting RC that indicates a reliability-related need within 30 calendar days of such request rather than prior to the effective date of the SOL methodology. Additionally, requirement 9 Part 9.2 enforces provision to those entities that would require notification of an update or change to the RC's SOL methodology.

In Requirement R9 Part 9.2.2, Planning Coordinator (PC), not Planning Authority, was used to be consistent with the Functional Model as well as to be consistent with TPL-001. Requirement R9 Part 9.2.2 also uses "responsible for planning" instead of "models any portion of" to distinguish those PCs and Transmission Planners (TPs) who have a reliability-related need from a PC/TP who simply has acquired a model that contains a portion of the RC Area, but does not plan for that area. Requirement R9 Part 9.2.4 differs from Requirement R9 Parts 9.2.1 through 9.2.3 in that it mandates provision of the SOL methodology to non-adjacent RCs that have specifically requested to receive updates, and indicated they had a reliability-related need.