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Welcome!

Project 2015-09 System Operating Limits Technical Conference

May 4-5, 2016

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It is NERC's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws.

Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition.

Notice of Open Meeting

Participants are reminded that this technical conference is public. The dial-in information was widely distributed. Speakers should keep in mind that the listening audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.

Opening Remarks

- Technical conference objectives
- Discussion topics
- Format

Project 2015-09 SOL Background Information

- Introduction of Standard Drafting Team (SDT) members
- Project 2015-03 – Periodic Review of FAC Standards
  - July 2015: Periodic Review Team completed work
  - August 2015: Standard Authorization Request (SAR) submitted to Standards Committee (SC)
- Project 2015-09 – System Operating Limits
  - August 2015: SAR approved by SC and Project 2015-09 authorized to post SAR for informal comment
  - December 2015-March 2016: SDT meetings (December 1-2, 2015; January 13-14, 2016; February 23-25, 2016; and March 15-16, 2016)
  - May 4-6 2016: Technical conference and SDT meeting
  - May 24-26: SDT meeting (Denver, CO)

Project 2015-09 Objectives

- Address issues with establishing and communicating System Operating Limits (SOLs) and Interconnection Reliability Operating Limits (IROLs)
- Enhance consistency with Transmission Operations (TOP) and Interconnection Reliability Operations (IRO) Reliability Standards
- Retire planning horizon SOL requirements in FAC-010 and FAC-014 to eliminate overlap with TPL-001-4 requirements

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Revised TOP and IRO Reliability Standards

Vic Howell, Peak Reliability

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Recent Reliability Standards Changes

- Revised TOP and IRO Reliability Standards:
  - TOP-001-3, TOP-002-4, TOP-003-3
  - IRO-001-4, IRO-002-4, IRO-008-2, IRO-010-2, IRO-014-3
- Revised Glossary Definitions:
  - Operational Planning Analysis (OPA)
  - Real-time Assessment (RTA)
- Project 2014-03 – Revisions to TOP/IRO – White paper entitled "System Operating Limit Definition and Exceedance Clarification"
- TPL-001-4 - Effective January 1, 2016

TOP / IRO Drafting Team: SOL white paper

- Industry effort to promote clarity, consistency, and a common understanding of the concepts associated with:
  - establishing SOLs,
  - exceeding SOLs, and
  - using Operating Plans to address SOL exceedance
- Served as a conceptual basis for revisions to the TOP and IRO Reliability Standards
- Takes into account the time-based nature of Facility Ratings
- Distinguish operating practices and strategies from the SOL itself
- Describes SOL exceedance

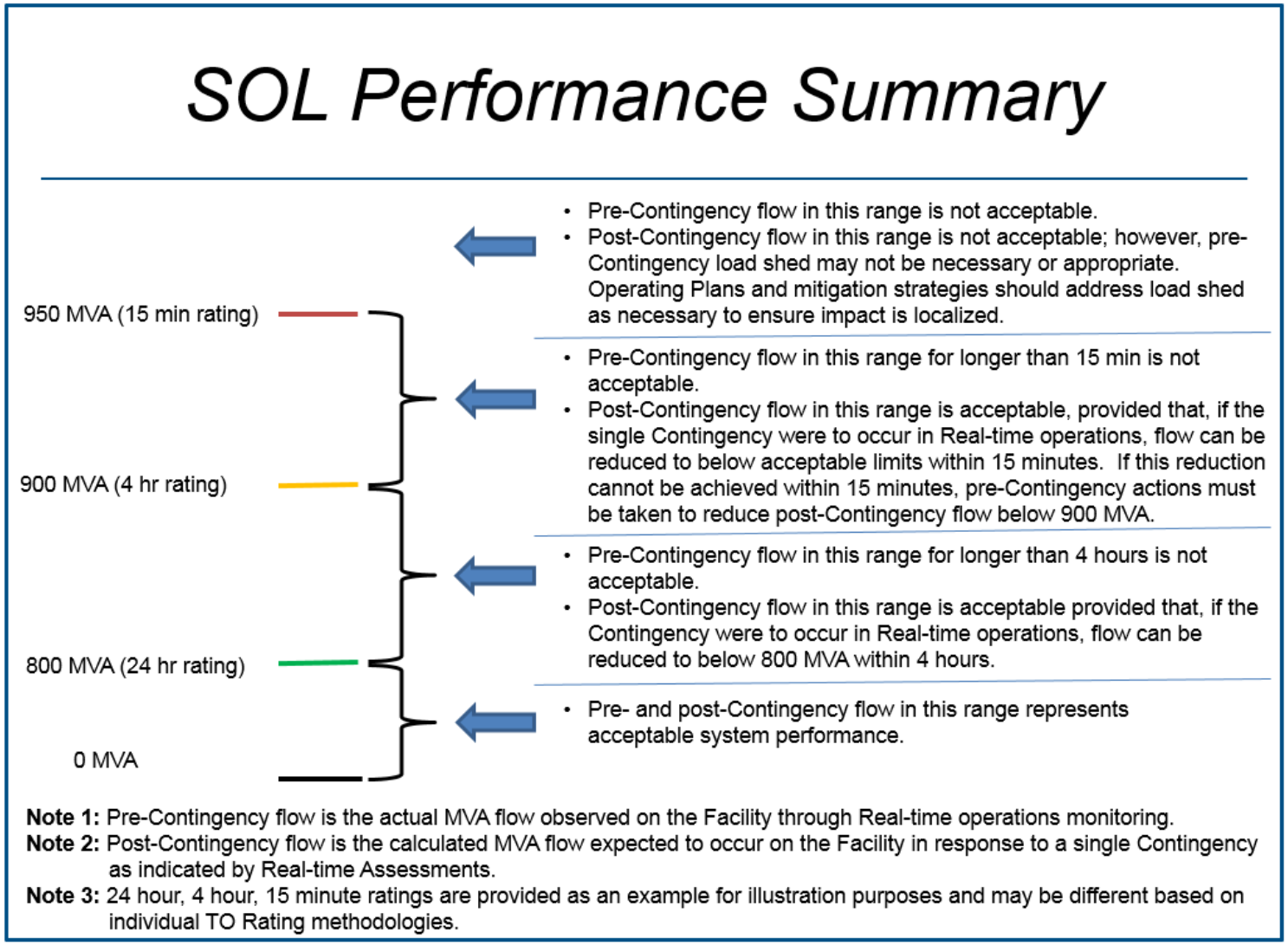
SOL white paper

Page 3, Paragraph 1:

"Some have interpreted the language in approved FAC-011-2, Requirement R2 to imply that the objective is to perform prior studies to determine a specific MW flow value (SOL) that ensures operation within the criteria specified in approved FAC-011-2, Requirement R2 sub-requirements, the assumption being that if the system is operated within this pre-determined SOL value, then all of the pre- and post-Contingency requirements described in approved FAC-011-2, Requirement R2 will be met. The SDT believes this approach may not capture the complete intent of the SOL concept within approved FAC-011-2, which is both:

1. Know the Facility Ratings, voltage limits, transient Stability limits, and voltage Stability limits, and
2. Ensure that they are all observed in both the pre- and post-Contingency state by performing a Real-time Assessment."

Facility Rating Exceedance



Facility Rating System Operating Limit Performance Summary (SOL white paper)

TOP and IRO Reliability Standards

TOPs and RCs perform the following in the Operations Planning time horizon:

- Have an Operational Planning Analysis (OPA) to identify SOL exceedances (TOP-002-4 R1, IRO-008-2 R1)
- Have Operating Plan(s) to address potential SOL exceedances identified in the OPA (TOP-002-4 R2, IRO-008-2 R2)
- Notify entities identified in the Operating Plan(s) to their role in those plan(s) (TOP-002-4 R3, IRO-008-2 R3)
- Provide its Operating Plan(s) for next-day operations to its RC (TOP-002-4 R6)

TOP and IRO Reliability Standards

TOPs and RCs perform the following in Real-time:

- Ensure that a Real-time Assessment (RTA) is performed at least once every 30 minutes (TOP-001-3 R13, IRO-008-2 R4)
- Initiate its Operating Plan to mitigate an SOL exceedance identified as part of its Real-time monitoring or RTA (TOP-001-3 R14, IRO-008-2 R5 RC to notify)

Operational Planning Analysis

Glossary Definition

Operational Planning Analysis (OPA): An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect applicable inputs including, but not limited to, load forecasts; generation output levels; Interchange; known Protection System and Special Protection System status or degradation; Transmission outages; generator outages; Facility Ratings; and identified phase angle and equipment limitations. (Operational Planning Analysis may be provided through internal systems or through third-party services.)

- Requirements to perform OPA are in IRO-008-2 and TOP-002-4

Real-time Assessment

Glossary Definition

Real-time Assessment (RTA): An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions. The assessment shall reflect applicable inputs including, but not limited to: load, generation output levels, known Protection System and Special Protection System status or degradation, Transmission outages, generator outages, Interchange, Facility Ratings, and identified phase angle and equipment limitations. (Real-time Assessment may be provided through internal systems or through third-party services.)

- Requirements to **perform** RTA are in IRO-008-2 and TOP-001-3

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Topic 1: Definitions: System Operating Limits (SOL) and "SOL Exceedance"

Vic Howell, Peak Reliability

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SOL Definition Issues

1. The NERC Glossary term System Operating Limit (SOL) is used extensively in the Reliability Standards; however, there is confusion with – and many widely varied interpretations and applications of – the SOL term. The widely varied application of SOL can adversely impact reliability.
2. The new TOP and IRO Reliability Standards use the phrase "SOL exceedance" extensively; however, there is no clear or common understanding of what constitutes SOL exceedance outside the SOL white paper.

NERC Glossary definition of SOL

The value (such as MW, MVar, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. System Operating Limits are based upon certain operating criteria. These include, but are not limited to:

- Facility Ratings (Applicable pre- and post-Contingency equipment or facility ratings)
- Transient Stability Ratings (Applicable pre- and post-Contingency Stability Limits)
- Voltage Stability Ratings (Applicable pre- and post-Contingency Voltage Stability)
- System Voltage Limits (Applicable pre- and post-Contingency Voltage Limits)

Other Glossary Definitions

- Stability – The ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or disturbances.

- Stability Limit – The maximum power flow possible through some particular point in the system while maintaining stability in the entire system or the part of the system to which the stability limit refers.

FAC-011-3 Requirement R2

R2. The Reliability Coordinator's SOL Methodology shall include a requirement that SOLs provide BES performance consistent with the following:

R2.1. In the pre-contingency state, the BES shall demonstrate transient, dynamic and voltage stability; all Facilities shall be within their Facility Ratings and within their thermal, voltage and stability limits…

R2.2. Following the single Contingencies identified in Requirement 2.2.1 through Requirement 2.2.3, the system shall demonstrate transient, dynamic and voltage stability; all Facilities shall be operating within their Facility Ratings and within their thermal, voltage and stability limits; and Cascading or uncontrolled separation shall not occur.

FAC-011-3 Requirement R2 (cont)

R2.3. In determining the system's response to a single Contingency, the following shall be acceptable:

R2.3.1. Planned or controlled interruption of electric supply to radial customers or some local network customers connected to or supplied by the Faulted Facility or by the affected area.

R2.3.2. Interruption of other network customers, (a) only if the system has already been adjusted, or is being adjusted, following at least one prior outage, or (b) if the real-time operating conditions are more adverse than anticipated in the corresponding studies

R2.3.3. System reconfiguration through manual or automatic control or protection actions.

R2.4. To prepare for the next Contingency, system adjustments may be made, including changes to generation, uses of the transmission system, and the transmission system topology.

Issues with the Definition of SOL

Both the definition of SOL and the FAC Reliability Standards presume an operations paradigm characterized by the following:

1. A study, assessment, or analysis needs to be performed ahead of time to establish an SOL (and IROL as needed) that achieves acceptable BES system performance per FAC-011-3 Requirement R2.
2. The established SOL is then communicated and coordinated with operators and other impacted entities prior to implementation.
3. Operators are then given Operating Plans to operate below the SOL with the presumption that doing so will result in acceptable pre- and post-Contingency system performance in Real-time operations.

Issues with the Definition of SOL

- Misalignment with today's environment, the new TOP and IRO Reliability Standards, and the revised definitions of OPA and RTA.
- It is unclear whether the SOL is the actual operating parameter or a different value that is calculated ahead of time to provide for acceptable system performance as described in FAC-001-2 Requirement R2.
- It is unclear whether every Facility "has" an SOL or not. Some entities may interpret and apply the approved SOL definition in such a way to limit the number SOLs on their system. This poses risks to reliability.
- SOLs are often confused with mechanisms for ensuring acceptable system performance (see SOL white paper).
- The approved definition of SOL combined with how the term is used in FAC-011-3 intermingles "what the limits are" and "how the system should be operated."

SDT Direction

- Revise definition of SOL – simplified and clarified
- Create new definition of "SOL Exceedance" – consistent with SOL white paper
- Revise requirements needed to address acceptable system performance
- SDT direction aligns with the TOP and IRO Reliability Standards, definitions of OPA and RTA, and the SOL white paper
- This approach distinguishes and clarifies:
  - What a SOL is (and isn't)
  - What it means to exceed one
  - What it means to operate (and to plan to operate) the system reliably

SDT Direction

Proposed revision to SOL definition:

Reliability limits used for operations, to include Facility Ratings, System voltage limits, and any identified stability limitations

Proposed new definition for SOL Exceedance:

When any of the following occur or are observed as part of Real-time monitoring or a Real-time Assessment:

- actual flow on a Facility is above the Normal Rating
- calculated post-Contingency flow on a Facility is above the Emergency Rating(s)
- actual bus voltage is outside normal System voltage limits
- calculated post-Contingency bus voltage is outside emergency System voltage limits
- operating parameters are beyond identified stability limitations

SOL Definition Questions

- Do you believe that the proposed SOL definition improves clarity?
- Does the SDT approach cause any reliability concerns?
- Should the SOL definition include a reference to the time-horizon in which the limit is being used (*i.e.*, "used for operations")?
- Currently SOL includes thermal, voltage, and stability. Are there other types of limits that don't fall under these three categories?

SOL Exceedance Definition Questions

- Do you believe that defining SOL Exceedance would be beneficial, considering its use in the TOP and IRO Reliability Standards?
- Should timing issues (how long it is acceptable to exceed an SOL) be addressed in the "SOL Exceedance" definition, or should timing issues be addressed as part of the Operating Plan?
- The proposed SOL definition revision uses the language "stability limitations" rather than the Glossary term Stability Limits. Do you believe the Glossary term should be used? Why or why not?

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Topic 2: Establishing SOLs in the Operations Horizon

Jason Smith, Southwest Power Pool

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Topic 2A: Defining Acceptable System Performance Criteria for Operations

Dede Subakti, California ISO

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Current State

- Reliability Coordinators (RCs) are required to have a methodology that prescribes how the TOP should establish SOLs
- Acceptable system performance requirements stated in FAC-011-3 Requirement R2 must be reflected in the RC SOL Methodology
- TOPs are required to establish SOLs consistent with the RC SOL Methodology (FAC-014-2 Requirement R2)

Background

- SDT direction – Facility Ratings and System voltage limits addressed outside RC SOL Methodology
- Facility Ratings and system voltage limits are direct inputs into tools and study processes (OPA and RTA). However, stability limitations must be "established" through further analysis before becoming an input into reliability tools
- "SOL exceedance" defined and covered in TOP and IRO Reliability Standards that address:
  - Performing OPAs
  - Developing and communicating Operating Plans for SOL exceedances identified in OPAs
  - Performing RTAs
  - Implementing Operating Plans when SOL exceedance is observed in Real-time monitoring and RTAs

Issues with the Current State

- The approved set of performance requirements in FAC-011-3 Requirement R2 and portions of Requirement R3 include:
  - BES performance
  - Contingencies to be evaluated
  - Actions in operations that are acceptable to meet that performance

Performance Requirement Issues

- Some of the performance requirements R2 are addressed through the proposed new definition of SOL exceedance; however, many operations centric requirements under R2 and R3 are addressed neither in the proposed definition nor in the TOP or IRO Reliability Standards.
  - Example – which Contingencies (single or multiple) are expected to be observed when performing OPAs and RTAs to determine SOL exceedance, or are expected to be used when deriving stability limitations
- Several of the requirements in FAC-011-3 speak to what is acceptable from a system response perspective

SDT Direction

- The SDT is considering revising requirements that pertain to how the system should be operated, and is considering whether to propose the requirements be moved outside the family of FAC Reliability Standards.
- Options discussed:
  - Remove performance requirements in FAC-011-3 R2 and R3 that are already covered by definitions and in other standards
  - Develop a baseline set of requirements for establishing stability limitations for FAC-011 (as discussed in Issue 3), and/or develop performance criteria for establishing stability limitations for the FAC-011 guideline section
  - Determine a baseline set of operations centric performance requirements applicable to developing Operating Plans to be placed in either a TOP standard; or criteria to be used in a TOP guideline

Questions

- How prescriptive should the requirements be for establishing acceptable system performance?
  - Planning prescribes which Contingencies need to be studied and what is allowable for each
- Where is the appropriate place to address acceptable performance requirements for operations?
  - In the RC's SOL Methodology? In a different Reliability Standard? In a guideline within a Reliability Standard?
- What baseline for operation performance requirements need to be specified?

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Topic 2B: System Stability Limitations

Dede Subakti, California ISO

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Stability SOLs Current State

- **FAC-011-2** requires establishment of SOLs, including stability SOLs, in the operations horizon (**FAC-011-2 R1.1**)
  - **FAC-011-2 R2.1.** The … methodology … shall include…a requirement that SOLS provide BES performance consistent with the following:
    - **FAC-011-2 R2.1.** In the pre-contingency state, the system shall demonstrate transient, dynamic and voltage stability; all Facilities shall be within their . . . stability limits.
    - **FAC-011-2 R2.2.** Following single contingencies . . . , the BES shall demonstrate transient, dynamic and voltage stability; all Facilities shall be within their . . . stability limits.
- Current language allows RC full flexibility in determining the criteria used for establishing stability limits. Is greater specificity needed?

Stability SOLs Current State

- Examples of current stability limit criteria used or considered by RCs and TOPs:
  - Angular stability (single machine)
  - System damping
  - Post-fault voltage dip/recovery
  - Sub-synchronous resonance
  - Angle across open branch terminals (*i.e.*, breaker, for reclosing)
  - Short circuit strength (for proper control functionality)
- Some examples for voltage stability
  - Determine voltage collapse point and operate a given MW level or percentage of transfer away from collapse point
  - Use transfer limit at voltage limits if before collapse point
  - Operate to minimum allowed reactive reserve

SDT Direction

- SDT suggests maintaining a similar approach to today:
  - Current defined Contingency list as is (single element)
  - RC to have a process for determining the multiple Contingencies to be considered when establishing stability limits for use in operations
  - Planning Coordinators to continue to provide stability-related multiple Contingencies (currently provided via FAC-014-2 R6)
- SDT did not reach consensus with respect to common criteria, but surveyed the current criteria used by each entity
- SDT considered a list of criteria for use in a guideline within a revised standard

Questions

- Currently, there is no industry-wide stability limit criteria, and the standard gives the RC flexibility to define what acceptable stability performance is for its RC Area.
  - Does this flexibility support reliability?
  - Is greater specificity needed?
  - What is the best way to maintain RC flexibility, but yet create some uniformity or minimum criteria that must be identified by the RC?
- How are studied Contingencies different between Planning and Operations time horizons? Do the differences impact reliability?
- Which Contingencies should be considered when establishing stability SOLs for operations?
- How are stability limitations communicated? Challenges?

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Topic 2C: System Voltage Limits

David Bueche, CenterPoint Energy

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System Voltage Limit Issues

- There is no Reliability Standard that specifically requires establishment and communication of System voltage limits in the operations time horizon
- However, System voltage limits are used in the approved (and proposed) definition of SOL and are an important aspect of reliable operations
- Inconsistent use of System voltage limits in operations

Voltage Limit Current State

- Unclear who is responsible for establishing and communicating System voltage limits unless it is specifically addressed in the RC's SOL Methodology
- "system voltage limits" is not defined in the Glossary
- It is not clear whether System voltage limits respect equipment voltage ratings
- Unclear whether all System voltage limits are considered as SOLs

SDT Direction

- It is important for the Reliability Standards to assign responsibility for the establishment and communication of System voltage limits
- It is important for TOPs and RCs to use the same set of System voltage limits throughout all operations processes
- Consider the value of having a requirement that TOP-established System voltage limits respect equipment voltage ratings
- Consider whether to define “System Voltage Limits”
- Like Facility Ratings, the SDT considering whether the establishment and communication of System voltage limits is best addressed by the TOP outside of the RC’s SOL Methodology

Questions

- Is there a need for a requirement to establish and communicate System voltage limits?
- Are System voltage limits clearly understood? Should a definition be developed?
- What inputs are needed to determine System voltage limits?
  - Equipment Voltage Ratings
  - Operating Practices and Historical Performance
  - Professional Reference Documents (ANSI, IEEE, etc.)
- How are System voltage limits used and regarded in operations? Are pre- or post-Contingency System voltage limit exceedances considered to be SOL exceedances? What about high voltage limit exceedances?

Questions

- Which System voltage limits should be established?
  - Normal and Emergency low System voltage limits
  - Normal and Emergency high System voltage limits
- How are equipment voltage ratings considered when determining System voltage limits?
  - Communicated through FAC-008
- What are the challenges associated with the establishment and communication of System voltage limits for use in operations?
- Given the TOP and IRO Reliability Standards, the SDT direction with the SOL definitions, and the SDT direction with Facility Ratings, do you agree that System voltage limits should be addressed outside the RC's SOL Methodology?

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Question & Answer Session

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Conclusion of Day 1

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Topic 2D: Facility Ratings

David Hislop, PJM Interconnection

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Facility Ratings Background

Glossary definitions

Facility Rating: The maximum or minimum voltage, current, frequency, or real or reactive power flow through a facility that does not violate the applicable equipment rating of any equipment comprising the facility.

Equipment Rating: The maximum and minimum voltage, current, frequency, real and reactive power flows on individual equipment under steady state, short-circuit and transient conditions, as permitted or assigned by the equipment owner.

Facility Ratings Background

- Source from GO/TO (FAC-008-3)
- Respect the most limiting applicable Equipment Rating of the individual equipment that comprises the Facility (FAC-008-3 R2.3 and R3.3)
- Include, at a minimum, Normal and Emergency Ratings (FAC-008-3 R2.4.2 and R3.4.2)
- Facility Ratings for jointly owned Facilities consistent with the associated methodology (FAC-008-3 R6)
- Facility Ratings provided to associated RC, PC, TP, TO, TOP upon request (FAC-008-3 R7 and R8)

Facility Ratings Issues

- Facility Ratings established by TOs and GOs consistent with their own FAC-008-3 Facility Ratings methodology are communicated to TOPs and to RCs upon request
- TOPs and RCs interpret those Facility Ratings and implement them into their tools and processes
- There is a risk that TOPs and RCs may be using differing sets of Facility Ratings in outage coordination studies, Operational Planning Analyses (OPA), and Real-time Assessments (RTA) depending on how these entities interpret the Facility Ratings provided by the TO and GO

SDT Direction

- The SDT believes it is important for TOPs and RCs to use the same set of Facility Ratings throughout the operations processes
- This could be addressed by requiring TOPs to:
  - Implement Facility Ratings for use in operations into their tools and processes (OPA and RTA) as provided by TOs
  - Communicate the Facility Ratings they are using in operations to their associated RCs
  - Update Facility Ratings in their tools and processes upon receipt of communication by the TO and GO and communicate those updates to their associated RCs
- In turn, the RC would use the Facility Ratings provided by TOPs in the RC operations tools and processes
- The SDT is considering whether the establishment and communication of Facility Ratings is better addressed by TOPs outside the RC's SOL Methodology

Questions

- FAC-008-3 implementations vary. What issues, if any, does this variation cause for TOPs and RCs?
- Is there a reliability issue if the TOPs and RCs are not using the same Facility Ratings? (*i.e.*, 2 hour emergency limit vs. 4 hour emergency limit.)
- What are some of the practical challenges TOPs and RCs face with communication and use of Facility Ratings in operations?
  - Ever-changing Facility Ratings updates
  - Awareness of Facility Rating time-values?
  - Challenges with dynamic ratings?

Questions

- Does FAC-008-3 adequately address establishment and communication of Facility Ratings for use in operations, or is there a need to address consistency of Facility Rating used by TOPs and RCs in operations?
- Who should be responsible to ensure that Facility Ratings are consistent between the TOPs and the RC?
- Given the new TOP and IRO Reliability Standards and the SDT direction with the SOL definitions, do you agree that Facility Ratings are better addressed outside the RC's SOL Methodology?

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Topic 3: Establishing Interconnection Reliability Operating Limits (IROLs)

Stephen Solis, Electric Reliability Council of Texas

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Establishing IROLs

Establishing IROLs - Issues

- The approved definition of IROL (in isolation of FAC-011-3), could be construed to mean that any instability would require the establishment of an IROL to prevent that instability from occurring. Whereas, FAC-011-3 Requirement R1 and Requirement R3 allow the RC to identify in its SOL Methodology which specific SOLs qualify as IROLs, an approach which is in practice throughout industry.

- FERC has noted there are regional differences in the criteria for determining which subset of SOLs are IROLs, and has requested identification of these differences for the purpose of evaluating any potential reliability impacts.

Establishing IROLs - Issues

- In response to forced outages or similar unforeseen events, real-time operating conditions can occur such that an RTA identifies an operating state (not a pre-defined IROL exceedance) where the next worst Contingency could result in instability, uncontrolled separation, or cascading outages.
- When these types of operating conditions occur in Real-time operations, it is clear that System Operators are expected to take urgent action to get out of the potentially N-1 insecure operating state as soon as possible
- It is unclear whether these conditions constitute an IROL exceedance where IROL-related Reliability Standards would apply.

IROL Definition Issue

Background

- Glossary definition of IROL: “A System Operating Limit that, if violated, could lead to instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Bulk Electric System.”
- FAC-011-2 Requirement R1.3 – …This SOL Methodology shall…include a description of how to identify the subset of SOLs that qualify as IROLs.
- FAC-011-3 Requirement R3.7 – The RC’s SOL Methodology shall include…Criteria for determining when violating a SOL qualifies as an Interconnection Reliability Operating Limit (IROL) and criteria for developing any associated IROL Tv.

Non-IROL Stability SOL Examples

- Import voltage stability limit of 100 MW where a localized load pocket is lost as a result of voltage collapse.
- Export angular stability limit with a consequence of the loss of 100 MW of aggregated generation.
- Small island would be created with next Contingency after forced outages on a small localized load pocket.
- What is the consequence of defining these SOLs as IROLs?
  - Mandatory pre-contingency load shedding or removal of generation
  - Potential for operational misalignment of risk (100 MW same priority as 5000 MW)
  - Triggers application of other NERC Reliability Standards

SDT Direction

- Some members of the SDT believe that only instability and uncontrolled separation that meets the criteria identified in the SOL methodology warrants an IROL designation
- Several approaches could be used
  - Revise the definition of IROL
  - Define “instability” and “uncontrolled separation” similar to Cascading
  - Include a clause in the IROL definition to provide clarity that not all instability or uncontrolled separation is included (e.g., local, localized, predetermined area)
  - Link the IROL definition to the standard requirements by including a statement or phrase, in order to prevent misinterpretation of the definition (in isolation of the criteria identified in the SOL methodology)
  - No definition change with guidance provided elsewhere (guideline, RSAW)

Questions

- Do you believe that the current definition of IROL could be construed to mean that *any* instability requires the establishment of an IROL without regard to the severity and extent of impact?
- Does all instability warrant establishing an IROL? If no, what type of instability does not warrant establishment of an IROL? What about uncontrolled separation and Cascading?
- Should pre-Contingency mitigation action be required for any type of instability up to and including load shed? (*e.g.,* Shedding 50 MW pre-contingency to avoid losing 100 MW if the contingency was to occur)

IROL Criteria
Regional Difference

IROL Criteria Regional Differences

- Requirements allow the necessary flexibility for the RC to assess its unique risks and system topology for its RC Area.
- Flexibility does create differences between one RC Area to another RC Area.
- FERC Order No. 817:
  - "However, when this issue is considered in Project 2015-19, the specific regional difference of WECC's 1,000 MW threshold in IROLs should be evaluated in light of the Commission's directive in Order No. 802 (approving Reliability Standard CIP-014) to eliminate or clarify the "widespread" qualifier on "instability" as well as our statement in the Remand NOPR that "operators do not always foresee the consequences of exceeding such SOLs and thus cannot be sure of preventing harm to reliability."

IROL Criteria Regional Differences

- SDT discussions on regional differences highlighted several similarities and differences in criteria
  - Similarities:
    - Loss of Load criteria
    - Loss of generation criteria
    - Non-localized/uncontained Cascading
    - Affects neighboring RC Area
  - Differences:
    - Static (# MW) vs. dynamic (% of Load/generation)
    - Quantities of MW Load/generation criteria
    - Single RC/BA Interconnection vs. multi RC Interconnection
    - Varying stability criteria

IROL Criteria Regional Differences

- Uniform criteria approach (same thresholds/values and considered elements for every RC)
  - Pros:
    - Improved consistency and transparency
    - More conservative approach for those RCs who move from a less conservative criteria
  - Cons:
    - Unnecessary pre-contingency Load shedding for those RCs adopting more conservative criteria
    - Less conservative approach for those RCs who move to a less conservative criteria
    - Lack of flexibility to address risks unique to RC area

IROL Criteria Regional Differences

- Hybrid Approach: RC specific criteria with minimum elements for consideration (flexibility with thresholds but consistent elements)
  - Pros:
    - Improved consistency and transparency
    - Flexibility to address risks unique to RC Area
    - Pre-contingency Load shedding better aligned with RC Area risks
    - More conservative approach for those RCs who move from a less conservative criteria
  - Cons:
    - Thresholds will still vary between RC (*e.g.*, loss of Load threshold)

Potential Solution

- Conduct a survey of RCs to identify every RC IROL criteria
- RC survey may allow the SDT to identify a minimum set of criteria and elements that should be considered when an RC identifies its criteria.
- Example
  - Loss of Load threshold
  - Loss of generation threshold
  - Non-local stability criteria
  - Neighboring RC criteria in a multiple RC Interconnection

Questions

- Do you favor the uniform approach or hybrid approach described for defining and identifying IROLs?
- Do you agree that a survey should be conducted of the RCs to establish a minimum set of criteria and elements that should be considered when an RC identifies its specific IROL criteria?
- Are there any additional elements that should be considered?

Real Time IROL-like Conditions

Real Time IROL-like Conditions

- Unanticipated Real-time conditions can occur such that a Real-time Assessment identifies an SOL (not predetermined to be an IROL) exceedance or an operating state where the next Contingency could result in instability, uncontrolled separation or Cascading outages.
- Additional assessment may be necessary to evaluate abnormal post-Contingency results if corrective actions cannot be quickly implemented
  - high post-Contingency thermal overloads
  - Unsolved or partially solved Contingencies
  - Observed system oscillations
  - Multiple steady state voltage low limit exceedances in an area

Real Time IROL-like Conditions

- These conditions typically occur as a result of forced outages and are generally temporary in nature as the system is repositioned to remain post-Contingency secure.

- An IROL designation for a brief condition has many impacts:
  - pre-Contingency Load shedding
  - Lack of clarity regarding when Tv time begins

- FERC Order No. 817: “operators do not always foresee the consequences of exceeding such SOLs and thus cannot be sure of preventing harm to reliability.”

Questions

- Do you believe that this is an issue that needs to be addressed? If yes, how might the Reliability Standards be modified to address outside the designation of IROL exceedance?

- If you believe that such operating conditions constitute an IROL exceedance?
  - When do you believe T_V begins?

Questions

- Do you have a process to assess current operating conditions to determine whether the system has entered into a potential post-Contingency insecure state (*i.e.*, next worst Contingency could result in instability, uncontrolled separation, or Cascading)?

- Are these types of operating conditions considered to be an emergency condition?

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Topic 4: Establishing SOLs in the Planning Horizon

Hari Singh, Xcel Energy

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Proposed Retirement of FAC-010-3

Planning Horizon SOL Methodology Background

- FAC-010-3 requires the Planning Coordinator (PC) to have an SOL Methodology for establishing SOLs used in the planning horizon (one to ten years)
- FAC-014-2 requires the PC and the Transmission Planner (TP) to establish SOLs consistent with its PC's SOL Methodology
- FAC-010-3 is almost the same as FAC-011-3. The difference is that FAC-010-3 is applicable to the PC and the planning horizon, while FAC-011-3 is applicable to the RC and the operations horizon (now to 1 year)
- TPL-001-4 provides for almost identical requirements for analysis of the BES and sharing of results in a Planning Assessment

Planning Horizon SOL Methodology

- Project 2015-03 – Periodic Review Team (PRT) conclusions:
  - SOLs and the SOL methodology for planning horizon are *not necessary inputs* to the BES (reliability) planning process because:
    - BES (reliability) planning is comprehensively covered by TPL-001-4
    - FAC-010-3 requirements are redundant with TPL-001-4 (demonstrated with mapping tables for Requirements R2 and R3)
  - Paragraph 81 Criteria B7 applies to FAC-010-3 Requirements: the requirement is unnecessary and eligible for retirement
- FAC-010 regional difference applicable to Western Interconnection has been approved for retirement by WECC/NERC; petition pending at FERC
- Some or all of the SDT agrees with the PRT recommendation to retire FAC-010-3

Revisions to SOL Definition

Proposed revision to SOL definition:

Reliability limits used for operations, to include Facility Ratings, System voltage limits, and any identified stability limitations

- Proposed definition makes it explicitly clear that the concept of SOLs is used (*i.e.*, needed) for BES operations – that is, for real-time and/or operations planning horizons, not for long-term planning horizon

- This supports the SDT acceptance of the PRT recommendation to retire FAC-010-3

Questions

- In light of the requirements in various existing Reliability Standards (*i.e.*, TPL, TOP and IRO), is there a reliability-related need for the requirements in FAC-010-3 and (related requirements in FAC-014-2), which relate to establishing SOLs in the planning horizon?
- What reliability information should be identified in the planning horizon and communicated to the appropriate entities in the operations horizon?
- What results/outputs from the Planning Assessment Studies (*i.e.*, reliability risks/limits) would be desirable (or essential?) inputs to:
  - Reliability Coordinator SOL/IROL Methodology?
  - Performing OPA and/or RTA?
  - Establishing the SOLs and IROLs?

Questions

- Does the absence of PC/TP-defined SOLs and IROLs create a reliability gap for the operations horizon?
- Do you believe there is a reliability need for instability risks to be identified in the planning horizon and communicated to operating entities?
- If so, whose methodology should the planning entities use for identifying these instability risks? Should the planning entities use their own methodology/criteria pursuant to TPL-001-4 Requirement R6, or should the RC methodology be used? If the planning entities use a methodology other than the RC methodology, does this create a potential reliability gap?

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Question & Answer Session

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Review of Key Themes from Technical Conference

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Closing Remarks

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