Project 2015-09 – System Operating Limits
Drafting Team Meeting Notes

Tuesday, February 23, 2016 | 8:30 AM – 5:00 PM
Wednesday, February 24, 2016 | 8:30 AM – 5:00 PM
Thursday, February 25, 2016 | 8:30 AM – 12:00 PM

WECC office
155 North 400 West
Salt Lake City, Utah 84103

ReadyTalk | Dial In: 1-866-740-1260 | Access Code: 5216143 | Security Code: 22316

Attendees:

Name	Company	Member/ Observer	In-person (IP)/ Web (W)		
			2/23	2/24	2/25
Vic Howell	Peak Reliability	Chair	IP	IP	IP
Hari Singh	Xcel Energy	Vice-chair	IP	IP	IP
David Bueche	CenterPoint Energy	Member	IP	IP	IP
David Hislop	PJM Interconnection	Member	IP	IP	IP
Samuel Jager	Independent Electricity System Operator	Member	IP	IP	IP
Dean LaForest	ISO New England	Member	IP	IP	IP
Thomas Leslie	Georgia Transmission Corp	Member	IP	IP	IP
Jason Smith	Southwest Power Pool	Member	IP	IP	IP
Stephen Solis	Electric Reliability Council of Texas	Member	IP	IP	IP
Aaron Staley	Orlando Utilities Commission	Member	IP	IP	IP
Dede Subakti	California ISO	Member	IP	IP	IP
Kumar Agarwal	FERC	Observer	W	W	W
Eugene Blick	FERC	Observer	IP	IP	IP
Mike Steckelberg	Great River Energy	Observer	W	W	W
Guy Zito	NPCC	Observer	IP	IP	-
Charles-Eric Langois	Hydro Quebec	Observer	IP	IP	IP
Lacey Ourso	NERC – Standards	NERC staff	IP	IP	IP
Mark Olson	NERC – Standards	NERC staff	IP	IP	IP
Shamai Elstein	NERC – Legal	NERC staff	IP	IP	IP

Agenda Items:

1. Welcome and administrative items (NERC Antitrust Guidelines, public meeting notice, etc.)
2. Discuss meeting objective(s)
3. Recap of January 2016 meeting, review draft definitions and notes

4. Continue drafting definitions
    a. Address all open/highlighted issues with draft definition
    b. Review Issues List to determine whether all items addressed in draft definition
    c. Review existing Reliability Standards…how do new definitions fit within existing standards?
5. Complete work for Bucket 2 (Establishing SOLs)
6. Project schedule and work plan
7. Next steps and action items

Meeting Notes

Discussion regarding revisions to definitions

1. Definition of System Operating Limit (SOL)

Existing language	Possible language (under consideration by SDT)
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 Ratings 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)	**As of January 2016 SDT meeting:** Reliability limits used for operations, to include Facility Ratings, System voltage limits, any (identified) stability limitations, and any (identified) equipment limitations. **February 2016 SDT meeting:** Reliability limits for use in operations, to include Facility Ratings, System voltage limits, and any (identified) stability limitations. ~~and any (identified) equipment limitations~~. Reliability limits used for operations, to include Facility Ratings, System voltage limits, and any (identified) stability limitations. ~~and any (identified) equipment limitations~~.

<u>Open items for further discussion/resolution</u>:

1. What does "identified" mean? Currently, the RC defines "stability"… is this flexibility good?
2. How do we deal with emergency voltage limits and not infringe on current "emergency" related definitions without confusing industry? Develop "System Voltage Limits" definition and clarify in definition.

2. Definition of SOL Exceedance

Existing language	Possible language (under consideration by SDT)
N/A	**As of January 2016 SDT meeting:** 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 • operating parameters are beyond identified equipment limitations
	February 2016 SDT meeting: 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 • ~~operating parameters are beyond identified equipment limitations~~

<u>**Open items for further discussion/resolution**</u>:

1. Do we need to define Normal system voltage limits? Emergency?
2. Do we need to define "system voltage limits"?
3. How are we defining or applying stability limit criteria?
4. Consider all time horizons where SOL exceedance used, and address Reliability Standards that currently use the "exceedance" term
5. "calculated post-Contingency flow on a Facility is above the Emergency Rating(s)" -- Does this only apply to single contingencies?

3. Definition of IROL

Existing language	Possible language (under consideration by SDT)
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.	**As of January 2016 SDT meeting:** A System Operating Limit that if exceeded could lead to instability that cannot be restrained from spreading beyond an area predetermined by studies, Cascading or uncontrolled separation. A System Operating Limit that if exceeded has been demonstrated to result in instability that cannot be restrained from spreading beyond an area predetermined by studies, Cascading or uncontrolled separation. A System Operating Limit that, if exceeded, has been demonstrated by studies to result in Cascading, uncontrolled separation, or instability that cannot be restrained from spreading beyond a predetermined area.

Issues with wording/language:

1. "if violated"
2. "could lead to"
3. "instability"
4. "adversely impacts the BES"

Open items for further discussion/resolution:

1. Stability issue. Can definition be interpreted to mean that "any" instability warrants an IROL, or is it only "instability" that "adversely impacts the reliability of the BES." If all instability does not warrant establishing IROL, should language be revised to clarify this? (i.e., localized stability limits should not be IROLs). IROL is a "widespread" SOL – need to determine a way to address this without using the term "widespread."
    a. FERC observer asked how instability is characterized as 'local', and what analysis is used to determine that the instability is bounded.
2. The word "could" lends itself to labelling an SOL an IROL before the SOL really matures into an IROL (which downstream has CIP and vegetation management implications). Remove "could" and replace with "demonstrated" to prevent this interpretation.
    a. Want to express that the IROL should be pre-determined by studies and not something labelled without adequate analysis. Consider using language: "demonstrated by studies" in the definition, or put this into a requirement in the standards (currently FAC-011).
3. What about use of "IROL exceedance" in various Reliability Standards? IRO-008-2, IRO-009-2.
4. FERC observer noted the following guidance for the SDT to consider: FERC Order No. 817 P 21-27, including footnote 22 (Federal Power Act and "Reliable Operations") and FERC Order No. 802 P 23-35.
    a. SDT agreed to prepare specific examples of day-to-day operations that would lead to the need to pre-Contingency load shedding.

Discussion regarding Facility Ratings

Facility Ratings: 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.

- These SOLs are critical for TOPs and RCs for reliable operations planning and real-time operations. They need to be in the TOPs and RCs models and monitoring tools.
- These SOLs are critical for real-time monitoring and Real-time Assessments, and for operations planning studies including seasonal planning assessments, outage coordination studies, and Operational Planning Analyses
- It is important that the SOLs used in operations are correct, are kept up to date, are clearly understood, and have a clearly defined source of record.
- **Open item**: Where is the appropriate place to address use of Facility Ratings in operations? Requirement of standard (Requirement for developing SOL methodology) vs. definition (does current language need to be revised… currently means that all Facility Ratings are SOLs)
- What is needed? Normal and emergency facility ratings for BES Facilities and time values associated with each
- How it works today? TOs and GOs are the source of record for Facility Ratings. They are responsible for establishing and communicating Facility Ratings.
    - TO and GO are required to "have" Facility Ratings consistent with its Facility Ratings Methodology (R6).
    - TO and GO are required to provide Facility Ratings to requestors (R7 and R8).
    - Assumption: Facility Ratings that are used in operations to be predetermined and consistent between a TOP and its RC.
        - **Open item**: What happens if TOP and RC are not using the same limit? (*e.g.*, 2 hour vs. 4 hour)
        - **Open item**: Consider addressing instances of Facilities with multiple owners. (Does the current FAC standard address this with enough clarity?)

Facility Ratings: Options considered by SDT
1. **Requirement for Reliability Coordinator (RC) methodology to determine which Facility Ratings to be used in operations**
2. **Requirement for Transmission Operator (TOP) to have process for determining and communicating Facility Ratings that are used in operations**
3. **Existing FAC-008 requirements adequately address establishing Facility Ratings**

Discussion regarding System voltage limits

- System voltage limits must respect the equipment voltage ratings. Equipment voltage ratings provided by the asset owner (Transmission Owners and Generator Owners). By definition a Facility Rating is the most limiting.
- Two types: high or low…
  - High voltage limits – to protect against equipment failure.
    - high-voltage ride through for generator
    - power quality
  - Low voltage limits – to protect against voltage collapse. This is more "system"/reliability related.
    - must stay above UVLS set points for TOP area
    - low-voltage ride through for generator
- What happens today?
  - Equipment voltage ratings are established by the asset owner (TO/GO).
  - TOP establishes the System voltage limits for use in operations that respects the Equipment voltage rating.
  - Neighboring TOs should coordinate regarding voltage limits to ensure that set appropriately
  - Assumption: System voltage limits that are used in operations to be predetermined and consistent between a TOP and its RC.
- What information is needed for SOL? High voltage limits (for normal and emergency) and low voltage limits (for normal and emergency)
- Open item: If Facility Rating accounts for equipment voltage limitations, how is this incorporated into TOP SOL methodology?

System voltage limits: Options considered by SDT

1. **Develop a (new) definition for "System Voltage Limits"**

2. **Use existing FAC-008, which requires the owner to provide Facility Ratings (and Equipment voltage Rating) to the TOP, who would use to establish the SOL that respects equipment voltage rating.**

3. **Operating parameters of voltage limits (both high and low) are predefined by TOP and validated to the owner (TO/GO). After TOP validates with owner, TOP to communicate to entities that need information.**
   a. **TOP would determine high and low limits for both normal and emergency**
   b. **Equipment voltage ratings would be required to respect**

4. **TOP establishes the System voltage limits. Equipment owners to provide requested information to TOP to develop System voltage limits. TOP communicates System voltage limits.**

<u>Discussion regarding stability limits</u>

- What happens today? RC methodology prescribes method for TOP to use in establishing limits.
- Is the current approach for establishing stability limits working (*i.e.*, should the RC continue to prescribe methodology for TOP use in establishing limits?) If yes, should the RC have complete flexibility for developing methodology to establish stability limits? [FAC-011-3, Requirement R2]
    a. What is the best way to maintain RC flexibility but yet create uniformity/minimum standard/baseline.
    b. FAC-011 currently contains some stability limit criteria…
    c. What baseline/minimum needs to be identified for RC:
        i. Consider developing a table similar to TPL?
            1. TPL table lists the critical contingencies, but it does not outline *performance* requirements
            2. FAC-010 – provides PC with flexibility to develop stability limits (based on whatever contingencies it deems appropriate)
        ii. For "credible contingencies" creates challenge…do we need to have uniformity with these?
        iii. Difference between performance vs. contingency.
- **RC required to have documentation to address voltage stability limit? Yes.**
- **Does this mean new FAC-011 must include a requirement for RC to create a written methodology to address the voltage stability limit? Yes.**

<u>Individual SDT approaches/perspectives re stability limits</u>:

1. **Do you apply margins to limits? If yes, how.**
2. **What criteria are considered for transient stability in addition to unit stability?**
    a. **Do you allow for single or multiple unit instability? (is a single unit instability deemed to be a stability problem?)**
3. **Do you recognize unit relaying when making stability determinations?**
4. **Do you use practices to prevent violating "stability limits" – (*i.e.*, is system planned to operate to a certain level of acceptable risk)?**
5. **Are your stability limits based on single vs. multiple contingencies?**
6. **When determined? Calculate limits in real-time or ahead of time (how far)?**

<u>SDT # 1</u>: Same approach as SDT #9

<u>SDT # 2</u>

1. Margin:

    Inter-Area:

    - operating margin (back off MW) value for each Reactive Transfer when it is solving against a non-convergence, or the Last-Converged point.
    - Last-Converged Point is the IROL and includes no back off.
    - If the reactive transfer is solving for a VD violation, margin is not applied.

- The back off is a set MW value and goes against the Last Converged point, not a percentage.
- Typically a range that would approximate to 5-10% of a peak flow across the interface.

Intra-Area: No back off.

2. Do not allow for single unit instability.
3. Relays modeled: Model the dynamic model, but similar to SDT #5 and SDT #11, it's atypical to have the full relaying for a generator.
4. Yes, would not switch into a TSA or to violate the operating limit for a reactive transfer as calculated by TLC (Transfer Limit Calculator)
   - TLC studies are performed using the same engine within any study timeframe; and, required as part of EHV switching.
   - TSA studies are performed upon request, a month ahead of any stability issues with respect to a nuclear station, and within OPA beginning 3-business days ahead of the outage.
5. Single and identified multiple.

   Inter-Area:
   - Multiple are atypical, unless conditions are indicating a situation where a multiple is anticipated (*i.e.*, stuck breaker; icing) and treat the multiple as a single.

   Intra-Area:
   - More typical to be monitoring multiple.
   - Model all single phase with normal clearing and single with delayed clearing.
6. Limits calculated Dynamically (as well as default limits defined within studies; See #4 above), in real-time:

   Inter-Area:
   - Transfer Limit Calculator solves every 5-10 min with a new solution based upon current topology.

   Intra-Area:
   - TSA has not been approved for every area (generating substation or generation pocket) of identified stability concern. For areas that have not been vetted, but with known stability concern, se TSA for monitoring only.
   - TSA has been approved for 30+ areas of stability concern in area. Only 2 known stability areas which are not currently addressed.
   - Provides MW limit and/or a MVAR adjustment to support a higher limit.
   - 24x7 on call support available for both application support as well as TSA Study Support.

     SDT discussion:
     - *TSA is not necessarily calculating a limit: it is determining whether you have an acceptable level of performance. Relevant because in SPP – for thermal and voltage, don't use proxy, only actual. Most are converting TSL into a MW value.*
     - *It may not be a MW calculation exactly; not always providing a MW value to operator…do not convert to interface limit – instead, calculate how much individual generator output to be changed to resolve stability limit. Found a way to surgically resolve stability limitation issue.*
     - *Instead of calculating a stability limit "number" – the limit is derived from a study (OPA),*
     - *Distinction here is that TSA limit is on the generator or generator station.*
     - *For contingency list, is this updated to reflect outage coordination? Not in Real-time; only in studies.*
     - *TSA runs angular stability analysis (same as planning) except that it incorporates real-time topology conditions*

SDT # 3 – From RC perspective

1. **1.** Path SOL = yes. IROL = no (handled through IROL operating procedure).
   - RC looks to TOP to identify and communicate stability limitations. For WECC transfer paths (major interfaces), entities establish transfer capability on the path and this is an SOL. These are "thermally limited" – so stress path, until first reliability limitation reached, keep going a teeny bit and test for stability. This is the "Path SOL" (which may be determined years to days in advance). Path SOL functions as a "proxy" for instability. RC has asked TOP to provide transient stability and voltage limits.
2. SOL methodology identifies criteria. TOP to perform analysis and communicate to RC.
3. Unsure. Allow for RAS to operate as intended. RC is not prescriptive in this area
4. When RC knows of risk, then take steps to avoid.
5. Both.
6. Depends. Generally calculated ahead of time (x days); depends on the TOP. RC has real time voltage stability analysis tool (PV curve calculated – 2 scenarios for IROLs). Same analysis run for day-ahead.

SDT # 4 - Very similar to SDT #5

1. 10% margin applied to all stability limits - Voltage and transient
2. Same as SDT #5 except no transient voltage and the addition of relay margin both on distance from protection tripping characteristic and time of relay operation
3. Same as SDT #5
4. Yes - use SPS arming, other control actions. Which include RE dispatch. We won't plan ourselves into an outage situation whereby we cannot re-prepare the system following any applicable n-2 or n-1 contingency to respect the next n-1 contingency
5. Multiples and singles including in areas with IROLS present. Otherwise only singles. Multiples including stuck breaker with delayed clear, tower sharing circuits for SLG on each element. Singles include inadvertent breaker operation and bus faults.
6. No RTA for stability yet. Similar to SDT #5...run stability simulations for outage planning where problems are known or suspected (usually 3+ days out). We have a set of static instructions we maintain at all times for all elements in service and N-1 situations. We have ability to scramble and run studies manually in short notice exporting our EMS solution to a PSSE / DSA base case.

SDT # 5

1. Apply margins - typically in the 5 to 10% range. There is additional margin in our study practices (study light load levels, units at full output, etc.) that is not reflected in this 5% to 10% value.
2. A single unit going unstable sets a stability limit for us. We also respect a damping criteria and a post fault voltage dip criteria. We also prevent wind units from tripping on low or high voltage similar to unit stability, to preclude unknown operating states.
3. We recognize and model unit relaying where we have the info, but we only have info on a few out of step relays. By and large, we do not account for unit relays, but feel comfortable with this given our unit instability criteria.
4. Yes, we do, through outage scheduling.
5. The limits are based on both single and multiple contingencies. The common multiple element contingency we respect is a single line to ground fault with a stuck breaker. There are other multi-element contingencies we would only respect if they had an IROL consequence.
6. We calculate our limits ahead of time, anywhere from 2 years to near real time. We also can and do studies in real time to support changes in system topology. We have real time stability limit determination capability

(TSAT) but are not ready to implement it in the control room. We do the limit calculation for N-0 and N-1 system states ahead of time, and capture the multi-facility conditions in outage coordination.

SDT # 6 - From planning perspective

1. Approx. 5-10% margins
2. ?
3. ?
4. Yes – corrective action to limit unit
5. Both. In planning, they provide limits that are commonly used in operations …and allow for three-phase.
6. System-wide study every 7 years and then annually conduct review of study to ensure up-to-date. Also, conducted on a case-by-case basis.

SDT # 7

SDT # 8 – Very similar to SDT #9

1. Margins are applied on case-by-case basis – greater margin given based on time horizon or level of confidence. For example limits established based on seasonal studies but used in RT may have a higher margin – limits established in near RT with improved inputs may have tighter margins.
2. Screening studies on specific interfaces – when apply contingencies (i.e., undamped oscillations); damping criteria (> 3%); some Facility interconnection studies identify localized stability issues;
    a. Yes – single unit
3. Yes – considerations/exceptions based on resource type
4. Yes – But detailed planning/considerations factored. In some cases, "plan" out of stability limit risk - In most cases where generator instability is discovered, it results in creation/implementation of revisions to protection settings on the transmission system, at the generator, or creation of a RAS.
5. All singles considered; double circuits/common Right of Way greater than 1 mile …bus-type contingency that is more severe (dynamic stability limits); Stuck breaker/primary protection failure studied.
6. Anything, PV – then run during the operating day periodically (2-4 times/day). Some outage coordination included- depending on area. Not running limits until day-ahead (at that time, have good solid idea of generation dispatch). Use VSAT (voltage stability) limits – run some scenarios day-ahead.

SDT # 9

1. Margins are applied on case-by-case basis – greater margin may be given based on time horizon that the limit is calculated (Ops Planning vs Real time) Limits published and shared are actual limits, however the margin is typically employed by operations to take earlier actions and control limits better so that the flow does not drift back and forth over the limit.
2. Screening studies on specific interfaces – when apply contingencies (ie undamped oscillations, angular instability); damping criteria (> 3%); some Facility interconnection studies identify localized stability issues that must be monitored until upgrades can be installed.
    a. Yes – single unit
3. Yes – considerations/exceptions based on resource type, typically if included in the dynamic model, we consider, if absent a proxy or typical is used.
4. Yes – But detailed planning/considerations factored. In some cases, "plan" /position the system out of stability limit risk by ensuring sufficient Facilities are in service.
5. All singles considered; double circuits greater than ½ mile with contiguous span… may be more severe contingencies applied for dynamic stability limits (e.g. bus/stuck breaker-type contingency)
6. Anything, PV – then run in Day Ahead/RT. Some outage coordination included- depending on area to screen for stability risks which may warrant additional studies. Not running stability limits until day-ahead (at that

time, have good solid generation dispatch). Dynamic/Transient stability limits utilize table or similar pre-determined limit values for day ahead and real time.

SDT # 10 - Generally do not have stability issues; so this is not monitored in real-time.

1. 200 MW to Single IROL
2. None (because don't have any)
    a. Single Unit
3. Limited
4. Yes. The configuration of the FRCC system is such that we don't currently have any single units that trip for a single contingency and very limited that trip under multiple and severe events.
5. Single
6. Existing IROL is done in real time (Voltage Stability) as well in monthly studies. Other limits are tested for in long range studies though none have currently been found.

SDT # 11

1. For Voltage Stability Limit - The published IROL does not have any margin. The actual operating point and operating plan has margin to it. The margin is about 5%.
   For Transient Stability Limit: margin is used in term of MW (not %).
2. The WECC has traditionally establish "Finger diagram" – This include transient voltage dip, transient frequency dip, and variations for these (how low, duration). The criteria is different for bus with load vs. bus with no load. This was part of TPL planning criteria. Created challenge because system planned with criteria that assumes all lines in service; if lines out, can no longer meet same criteria. How is planning criteria then used? RC allows TOP to define which transient voltage criteria applicable in operations horizon. Use judgment based on RT circumstances
    a. It is unacceptable to have unit instability.
3. Only when unit relay is modeled in system. If it's in the WECC dynamic data model
4. Yes, but only if the limit is known ahead of time. Planners analyze – and give to operations and identify areas to look for. Seasonal studies, outage coordination. In operations horizon, rely on historical data, planning, TPL – to identify stability limitations, and using this conduct operations stability analysis
5. Yes – both. The list of credible Multiple is in FAC-011 WECC Criteria posted in the standard. It has everything in the TPL table plus: RAS failures, bus section with breaker failure. … Peak RC now has SOL methodology that define process for Credible Multiple Contingency
6. Planning TPL process identifies the area of stability limitation. This is passed to the Operating horizon (per FAC-014). The remaining analysis in operating horizon:
    a. Seasonal Assessment, and Outage Coordination are conducted offline through utilization of GE PSLF program. Only for those identified the area of stability limitations. The criteria is the same as the WECC planning criteria
    b. Day-ahead process and RT process are conducted in EMS node breaker model utilizing Advanced Network Applications (but do not apply transient voltage and transient frequency dip)

Observer #1 - Generally, similar to SDT #5. Because system is historically prone to stability issues – both SOL and IROL. Angular issues, voltage issues,

1. Margins – 5-10% generally. Some major interfaces – have less of margin (based on MW).
2. No single unit instability. Additional criteria: depending upon the particular localized
3. ?
4. Yes
5. Both.

Stability limits: Options considered by SDT

1. **Current FAC-11-3 approach: the standard establishes baseline requirements that the RC methodology must include. TOP establishes stability limits in accordance with RC methodology [FAC-014].**
    a. **"Baseline requirements" meaning: single contingencies and acceptable system performance**
    b. **Single contingencies are defined (through baseline requirements); multiple contingencies are determined through a process defined by the RC.**
    c. **PC provides input to the RC on multiple contingencies that create instability risk [FAC-014, Requirement R6]**

2. **Develop a new standard that provides the methodology for establishing SOLs (including stability limits). The standard includes requirements for the RCs (and/or TOPs) to establish criteria for determining various limits (such as stability criteria).**

Open items for technical conference:

1. Does retiring FAC-010 leave a gap in planning and operations?
2. How does PC/TP consider the RC SOL methodology today? If not considered, why?
3. How does RC consider the PC/TP methodology today?
4. What is the right balance…if PC and TP were required to follow RC methodology?

Discussion regarding equipment limitations

- What other types of limitations exist? [Question for technical conference]
  - Phase angle limitations
  - SSO (sub- sync oscillation)
  - SCR (short circuit ratio)
  - Fault interrupting capability of breakers
  - Transient voltage limitations on equipment
  - Geomagnetic induced currents on equipment
- Why was the term "equipment limitations" expressly included in new RTA and OPA definitions (TOP/IRO project)? SDT discussion regarding possibly removing "equipment limitations" from definition and developing guidance.
  - Open item: One option is to remove "equipment limitations" (as catch all) from definition; develop guidance for industry.
  - "Real-time Assessment – 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.)"
  - "Operational Planning Analysis – 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.)"

Discussion regarding IROLs

- What constitutes an IROL?
  - S. Solis: Texas has 8 stability limits that are monitored; 1 of those is IROL.
    - 6% loss of load threshold (cascading or voltage collapse) -- Manual vs. automatic (UFLS).
    - Trigger set point for UFLS (59.3hz) [Establish limits on loss of generation]
    - Observable inter-area oscillations with damping ratio less than 3%
  - S. Jager: Steady-state or transient if the issue cannot be proven to be contained in a "small portion" of system. "Small portion" means it will not impact adjacent transfer limits.
    - Maximum for Loss of load and loss of source
    - Even if contained in a "small portion" – determine if it impacts neighbors
  - RCs define IROLs to meet the unique characteristics of their particular system.
  - SDT believes there is a disconnect between the definition of IROL and FAC-011 (RC methodology to establish). The current definition of IROL (in isolation of FAC-011-3), could be construed to mean that *any* instability or *any* cascading outage, would require the establishment of an IROL to prevent that instability or cascading outage. Whereas, FAC-011-3 R1 and R3 allow the RC to identify which specific SOLs qualify as IROLs.
  - Discussion regarding risk:
    - Risk – what level of risk is at stake?
    - Define the risk specific to you.
    - Identify how control the risk.
    - Identify commonalities (if possible)
  - Local vs. non-local issue. How do you identify what is "local" to you? MW?
  - Concern regarding: Pre-Contingency load shed for any type of instability.
    - Generator forced offline because ramifications of labeling as an IROL (time component)
    - Load impact/distribution
  - "IROL Facilities" and "having an IROL" and "IROL condition" – common phrases in industry.