

## Mapping of Revised TOP and IRO Reliability Standards to Address 2011 Southwest Outage Report Recommendations

The following table provides a mapping of the recommendations applicable to the Reliability Coordinator, Transmission Operator, and/or Balancing Authority contained in the 2011 Southwest Outage Report. Several of the recommendations are specific to the particular facts and circumstances of the 2011 Southwest Outage and are therefore not addressed here.

#	Recommendation	Mapping to Proposed TOP/IRO Reliability Standards
1	All TOPs should conduct next-day studies and share the results with neighboring TOPs and the RC (before the next day) to ensure that all contingencies that could impact the BPS are studied.	<p>Next-day studies are required by proposed TOP-002-4, Requirement R1. Sharing the results of those studies is required in proposed TOP-002-4, Requirement R3. Providing results to the Reliability Coordinator is required in proposed TOP-002-4, Requirement R6.</p> <p><b>Proposed TOP-002-4, Requirement R1:</b> Each Transmission Operator shall have an Operational Planning Analysis that will allow it to assess whether its planned operations for the next day within its Transmission Operator Area will exceed any of its System Operating Limits (SOLs).</p> <p><b>Proposed TOP-002-4, Requirement R3:</b> Each Transmission Operator shall notify impacted NERC registered entities identified in the Operating Plan(s) cited in Requirement R2 as to their role in those plan(s).</p> <p><b>Proposed TOP-002-4, Requirement R6:</b> Each Transmission Operator shall provide its Operating Plan(s) for next-day operations identified in Requirement R2 to its Reliability Coordinator.</p>
2	TOPs and BAs should ensure that their next-day studies are updated to reflect next-day operating conditions external to their systems, such as generation and	This is addressed in proposed TOP-002-4, through the revised definition of Operational Planning Analysis, and by the data specification standard

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	<p>transmission outages and scheduled interchanges, which can significantly impact the operation of their systems.</p>	<p>which dictates that external system data must be part of the data specification.</p> <p><b>Proposed TOP-002-4, Requirement R1:</b>            Each Transmission Operator shall have an Operational Planning Analysis that will allow it to assess whether its planned operations for the next day within its Transmission Operator Area will exceed any of its System Operating Limits (SOLs).</p> <p><b>Proposed: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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 contracted services.)</p> <p><b>Proposed TOP-003-3, Requirement R1, part 1.1:</b>            Each Transmission Operator shall maintain a documented specification for the data necessary for it to perform its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments. The data specification shall include, but not be limited to:</p> <p><b>1.1</b> A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p>

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	<p>TOPs and BAs should take the necessary steps, such as executing nondisclosure agreements, to allow the free exchange of next-day operations data between operating entities.</p> <p>Also, RCs should review the procedures in the region for coordinating next-day studies, ensure adequate data exchange among BAs and TOPs, and facilitate the next-day studies of BAs and TOPs.</p>	<p>This item is addressed through proposed TOP-003-3.</p> <p><b>Proposed TOP-003-3, Requirement R1:</b> Each Transmission Operator shall maintain a documented specification for the data necessary for it to perform its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments. The data specification shall include, but not be limited to:</p> <p><b>Proposed TOP-003-3, Requirement R2:</b> Each Balancing Authority shall maintain a documented specification for the data necessary for it to perform its analysis functions and Real-time monitoring. The data specification shall include, but not be limited to:</p> <p><b>Proposed TOP-003-3, Requirement R5:</b> Each Transmission Operator, Balancing Authority, Generator Owner, Generator Operator, Interchange Authority, Load-Serving Entity, Transmission Owner, and Distribution Provider receiving a data specification in Requirement R3 or R4 shall satisfy the obligations of the documented specifications using:</p> <p>Proposed IRO-008-2, Requirement R2 requires the Reliability Coordinator to review next day operating plans of its Transmission Operators and Balancing Authorities.</p> <p><b>Proposed IRO-008-2, Requirement R2:</b> Each Reliability Coordinator shall review the Operating Plans for next-day operations provided by its Transmission Operators and Balancing Authorities.</p>
3	<p>TOPs and RCs should ensure that their next-day studies include all internal and external facilities (including those below 100 kV) that can impact BPS reliability.</p>	<p>This is addressed in the data specification standards.</p> <p><b>Proposed TOP-003-3, Requirement R1, part 1.1:</b> A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and</p>

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		<p>Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p> <p><b>Proposed IRO-010-2, Requirement R1, part 1.1:</b>                      A list of data and information needed by the Reliability Coordinator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data, as deemed necessary by the Reliability Coordinator</p>
4	<p>WECC RC should improve its process for predicting interchanges in the day-ahead timeframe.</p>	<p>Interchange is now part of the list of things that a Reliability Coordinator must consider in the revised definition of Operational Planning Analysis.</p> <p><b>Proposed Definition: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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 contracted services.)</p>
5	<p>WECC RE should ensure better integration and coordination of the various subregions' seasonal studies for the entire WECC system. To ensure a thorough seasonal planning process, at a minimum, WECC RE should require a full contingency analysis of the entire WECC system, using one integrated seasonal study, and should identify and eliminate gaps between subregional studies.</p>	<p>This recommendation is not applicable to the Reliability Coordinator, Transmission Operator, and/or Balancing Authority and is therefore not addressed here.</p>

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	<p>Individual TOPs should also conduct a full contingency analysis to identify contingencies outside their own systems that can impact the reliability of the BPS within their system and should share their seasonal studies with TOPs shown to affect or be affected by their contingencies.</p>	<p>The proposed TOP-003-3 states that Transmission Operators must gather external network data and proposed TOP-002-4 mandates sharing the results of studies.</p> <p><b>Proposed TOP-003-3, Requirements R1, part 1.1:</b> A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p> <p><b>Proposed TOP-002-4, Requirement R3:</b> Each Transmission Operator shall notify impacted NERC registered entities identified in the Operating Plan(s) cited in Requirement R2 as to their role in those plan(s).</p> <p>Seasonal studies are accommodated in proposed IRO-017-1, Requirement R1, part 1.5.</p> <p><b>Proposed IRO-017-1, Requirement R1, part 1.5:</b> Document and maintain the specifications for outage analysis during the operations planning horizon.</p>
6	<p>TOPs should expand the focus of their seasonal planning to include external facilities and internal and external sub-100 kV facilities that impact BPS reliability.</p>	<p>The proposed TOP-003-3 explicitly states that Transmission Operators must obtain external network and sub-100 kV data.</p> <p><b>Proposed TOP-003-3, Requirements R1, part 1.1</b> A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p>

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		<p>Seasonal studies are accommodated in proposed IRO-017-1, Requirement R1, part 1.5.</p> <p><b>Proposed IRO-017-1, Requirement R1, part 1.5:</b> Document and maintain the specifications for outage analysis during the operations planning horizon.</p>
7	<p>TOPs should expand the cases on which they run their individual planning studies to include multiple base cases, as well as generation maintenance outages and dispatch scenarios during high load shoulder periods.</p>	<p>The revised definition of Operational Planning Analysis states that “projected system conditions” must be considered which would include generator outages and high load periods.</p> <p><b>Proposed Definition: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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 contracted services.)</p>
8	<p>TOPs should include in the information they share during the seasonal planning process the overload relay trip settings on transformers and transmission lines that impact the BPS, and separately identify those that have overload trip settings below 150% of their normal rating, or below 115% of the highest emergency rating, whichever of these two values is greater.</p>	<p>The proposed TOP-003-3 states that Protection System data must be obtained. And the revised definition of Operational Planning Analysis states explicitly that Protection Systems must be included in studies. Sharing of results is addressed in proposed TOP-002-4.</p> <p><b>Proposed TOP-003-3, Requirements R1, part 1.2:</b> Provisions for notification of current Protection System and Special Protection System status or degradation that impacts System reliability.</p> <p><b>Proposed Definition: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and</p>

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		<p>potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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 contracted services.)</p> <p><b>Proposed TOP-002-4, Requirement R3:</b> Each Transmission Operator shall notify impacted NERC registered entities identified in the Operating Plan(s) cited in Requirement R2 as to their role in those plan(s).</p> <p>Seasonal studies are accommodated in proposed IRO-017-1, Requirement R1, part 1.5.</p> <p><b>Proposed IRO-017-1, Requirement R1, part 1.5:</b> Document and maintain the specifications for outage analysis during the operations planning horizon.</p>
9	<p>WECC RE should take actions to mitigate these and any other identified gaps in the procedures for conducting near- and long-term planning studies. The September 8th event and other major events should be used to identify shortcomings when developing valid cases over the planning horizon and to identify flaws in the existing planning structure. WECC RE should then propose changes to improve the performance of planning studies on a subregional- and Interconnection-wide basis and ensure a coordinated review of TPs' and PCs' studies.</p>	<p>This recommendation is not applicable to the Reliability Coordinator, Transmission Operator, and/or Balancing Authority and is therefore not addressed here.</p>

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	<p>TOPs, TPs, and PCs should develop study cases that cover critical system conditions over the planning horizon; consider the benefits and potential adverse effects of all protection systems, including RASs, Safety Nets (such as the SONGS separation scheme), and overload protection schemes; study the interaction of RASs and Safety Nets; and consider the impact of elements operated at less than 100 kV on BPS reliability.</p>	<p>The proposed TOP-003-3 addresses these items.</p> <p><b>Proposed TOP-003-3, Requirements R1, parts 1.1 and 1.2:</b></p> <p>1.1 A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p> <p>1.2 Provisions for notification of current Protection System and Special Protection System status or degradation that impacts System reliability.</p> <p>Planning Coordinators and Transmission Planners are outside the scope of this project.</p>
10	<p>WECC dynamic models should be benchmarked by TPs against actual data from the September 8th event to improve their conformity to actual system performance. In particular, improvements to model performance from validation would be helpful in analysis of under and/or over frequency events in the Western Interconnection and the stability of islanding scenarios in the SDG&amp;E and CFE areas.</p>	<p>This recommendation is not applicable to the Reliability Coordinator, Transmission Operator, and/or Balancing Authority and is therefore not addressed here.</p>
11	<p>TOPs should engage in more real-time data sharing to increase their visibility and situational awareness of external contingencies that could impact the reliability of their systems. They should obtain sufficient data to monitor significant external facilities in real time, especially those that are known to have a direct bearing on the reliability of their system, and properly assess the impact of internal contingencies on the SOLs of other TOPs.</p>	<p>Proposed TOP-003-3, Requirement R1, part 1.1 states that Transmission Operators must include external network data in their respective data specifications.</p> <p><b>Proposed TOP-003-3, Requirement R1, part 1.1:</b></p> <p>A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p>

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	<p>In addition, TOPs should review their real-time monitoring tools, such as State Estimator and RTCA, to ensure that such tools represent critical facilities needed for the reliable operation of the BPS.</p>	<p><b>Proposed TOP-001-3, Requirement R13:</b> Each Transmission Operator shall perform a Real-time Assessment at least once every 30 minutes.</p> <p>The revised definition of Real-time Assessment includes potential post-contingency operating conditions.</p> <p><b>Proposed Definition: Real-time Assessment</b> - An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions. The assessment shall reflect 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 contracted services.)</p> <p><b>Proposed TOP-001-3, Requirement R13:</b> Each Transmission Operator shall perform a Real-time Assessment at least once every 30 minutes.</p>
12	<p>TOPs should take measures to ensure that their real-time tools are adequate, operational, and run frequently enough to provide their operators the situational awareness necessary to identify and plan for contingencies and reliably operate their systems.</p>	<p>The Project 2014-03 SDT has developed a requirement for the performance of a Real-time Assessment for Transmission Operators.</p> <p><b>Proposed TOP-001-3, Requirement R13:</b> Each Transmission Operator shall perform a Real-time Assessment at least once every 30 minutes.</p>
13	<p>TOPs should review existing operating processes and procedures to ensure that post-contingency mitigation plans reflect the time necessary to take mitigating</p>	<p>Proposed TOP-002-4, Requirement R2 states that Transmission Operators must have an Operating Plan to address SOL exceedances. Proposed TOP-001-3, Requirement R14 then states that the Transmission Operator must</p>

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	<p>actions, including control actions, to return the system to a secure N-1 state as soon as possible but no longer than 30 minutes following a single contingency.</p> <p>As part of this review, TOPs should consider the effect of relays that automatically isolate facilities without providing operators sufficient time to take mitigating measures.</p>	<p>initiate its Operating Plan for mitigating and SOL exceedance. In addition, the SDT has developed a white paper on SOL Exceedance that clarifies the SDT position on SOL performance and SOL exceedance.</p> <p><b>Proposed TOP-002-4, Requirement R2:</b> Each Transmission Operator shall have an Operating Plan(s) for next-day operations to address potential System Operating Limit (SOL) exceedances identified as a result of its Operational Planning Analysis as required in Requirement R1.</p> <p><b>Proposed TOP-001-3, Requirement R14:</b> Each Transmission Operator shall initiate its Operating Plan to mitigate an SOL exceedance identified as part of its Real-time monitoring or Real-time Assessment.</p> <p>The proposed TOP-003-3 explicitly requires the acquisition of Protection System data and the revised definitions of Operational Planning Analysis and Real-time Assessment call out Protection Systems as an item to be studied.</p> <p><b>Proposed TOP-003-3, Requirement R1, part 1.2:</b> Provisions for notification of current Protection System and Special Protection System status or degradation that impacts System reliability.</p> <p><b>Proposed: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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</p>

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		<p>limitations. (Operational Planning Analysis may be provided through internal systems or through contracted services.)</p> <p><b>Proposed: Real-time Assessment</b> - An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions. The assessment shall reflect 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 contracted services.)</p>
14	WECC RC should evaluate the effectiveness of its staffing level, training and tools. Based on the results of this evaluation, it should determine what actions are necessary to perform its functions appropriately as the RC and address any identified deficiencies.	This recommendation is specific to the WECC Reliability Coordinator and is therefore not addressed here.
15	TOPs should ensure procedures and training are in place to notify WECC RC and neighboring TOPs and BAs promptly after losing RTCA capabilities.	<p>Proposed TOP-001-3, Requirement R9 states that Transmission Operators must notify impacted NERC registered entities of outages to monitoring and assessment capabilities. Training is outside the scope of this project.</p> <p><b>Proposed TOP-001-3, Requirement R9:</b> Each Balancing Authority and Transmission Operator shall notify its Reliability Coordinator and negatively impacted interconnected NERC registered entities of outages of telemetering and telecommunication equipment, control equipment, monitoring and assessment capabilities, and associated communication channels between the affected entities.</p>
16	WECC should ensure consistencies in model parameters between its planning model and its RTCA model and should review all model parameters on a	Model parameters are outside the scope of this project.

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	consistent basis to make sure discrepancies do not occur.	
17	WECC, as the RE, should lead other entities, including TOPs and BAs, to ensure that all facilities that can adversely impact BPS reliability are either designated as part of the BES or otherwise incorporated into planning and operations studies and actively monitored and alarmed in RTCA systems.	<p>Designation of BES facilities is outside the scope of this project. However, the revised standards do incorporate the need for sub-100 kV data and monitoring as deemed necessary by the reliability entities.</p> <p><b>Proposed TOP-003-3, Requirement R1, part 1.1:</b> A list of data and information needed by the Transmission Operator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data as deemed necessary by the Transmission Operator.</p> <p><b>Proposed IRO-010-2, Requirement R1, part 1.1:</b> A list of data and information needed by the Reliability Coordinator to support its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments including sub-100 kV data and external network data, as deemed necessary by the Reliability Coordinator.</p> <p><b>Proposed TOP-001-3, Requirement R10:</b> Each Transmission Operator shall monitor Facilities within its Transmission Operator Area and neighboring Transmission Operator Areas to maintain reliability within its Transmission Operator Area including sub-100 kV facilities needed to maintain reliability and the status of Special Protection Systems within its Transmission Operator Area.</p> <p><b>Proposed IRO-002-4, Requirement R4:</b> Each Reliability Coordinator shall monitor Facilities within its Reliability Coordinator Area and neighboring Reliability Coordinator Areas to determine any potential System Operating Limit and Interconnection Reliability Operating Limit exceedances within its Reliability Coordinator Area, including sub-100 kV facilities needed to make this determination</p>

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		and the status of Special Protection Systems in its Reliability Coordinator Area.
19, 20, 22, 23, 25, 26	About coordination of SPS/RAS at the RC and TOP level.	<p>Coordination of Special Protection Systems and Remedial Action Schemes is addressed in approved PRC-001-1.1a. Any changes to Protection System coordination issues is outside the scope of this project. Monitoring is addressed in proposed TOP-001-3, Requirement R10 and proposed IRO-002-4, Requirement R4.</p> <p><b>Proposed TOP-001-3, Requirement R10:</b> Each Transmission Operator shall monitor Facilities within its Transmission Operator Area and neighboring Transmission Operator Areas to maintain reliability within its Transmission Operator Area including sub-100 kV facilities needed to maintain reliability and the status of Special Protection Systems within its Transmission Operator Area.</p> <p><b>Proposed IRO-002-4, Requirement R4:</b> Each Reliability Coordinator shall monitor Facilities within its Reliability Coordinator Area and neighboring Reliability Coordinator Areas to determine any potential System Operating Limit and Interconnection Reliability Operating Limit exceedances within its Reliability Coordinator Area, including sub-100 kV facilities needed to make this determination and the status of Special Protection Systems in its Reliability Coordinator Area.</p>
27	TOPs should have: (1) the tools necessary to determine phase angle differences following the loss of lines; and (2) mitigation and operating plans for reclosing lines with large phase angle differences.	<p>(1) Phase angle calculation tools are outside the scope of this project.</p> <p>(2) Consideration of phase angle limitations has been added to the proposed definitions of Real-time Assessment (RTA) and Operational Planning Analysis (OPA).</p> <p><b>Proposed Definition: Operational Planning Analysis</b> - An evaluation of projected system conditions to assess anticipated (pre-Contingency) and</p>

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	<p>TOPs should also train operators to effectively respond to phase angle differences. These plans should be developed based on the seasonal and next-day contingency analyses that address the angular differences across opened system elements.</p>	<p>potential (post-Contingency) conditions for next-day operations. The evaluation shall reflect 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 contracted services.)</p> <p><b>Proposed Definition: Real-time Assessment</b> - An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions. The assessment shall reflect 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 contracted services.)</p> <p>Seasonal studies are accommodated in proposed IRO-017-1, Requirement R1, part 1.5: Document and maintain the specifications for outage analysis during the operations planning horizon.</p> <p>Training is outside the scope of this project.</p>