California ISO | RC West	Reliability Coordinator Procedure	Procedure No.	RC0310
		Version No.	1.7
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Mitigating SOL and IROL Exceedances		**Distribution Restriction: None**	

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Purpose

Provide guidance on mitigating System Operating Limits (SOL) and Interconnection Reliability Operating Limits (IROL) exceedances within the Reliability Coordinator (RC) Area. This procedure also outlines tools used to perform the RC function, as well as mitigation options for resolving reliability issues affecting the Bulk Electric System (BES) in a timely manner.

1. Responsibilities

- Reliability Coordinator Operator

2. Scope/Applicability

- Reliability Coordination

3. Procedure Detail

3.1. Monitoring & Analysis Tools

This section provides a brief description of the Real-time monitoring and analysis tools RC West utilizes to perform RC functions for the RC Area. These tools are used for monitoring of all BES facilities, the status of Remedial Action Schemes (RAS), and non-BES facilities that impact the BES within the RC Area. RC West monitors facilities within its RC Area and neighboring RC Areas, and makes use of analysis tools to perform Real-time Assessments in order to identify facilities approaching SOL and IROL limits; and to identify SOL and IROL exceedances within the RC West Area.[1] If any of the listed real-time applications or tools fail, the RC operator ensures Real-Time Assessments are performed in a timely manner.[2]

- **Energy Management System (EMS)/Supervisory Control and Data Acquisition (SCADA) System**: Provides the RC operator with real-time monitoring and visibility of the status of BES transmission and generation facilities, RAS, non-BES facilities that impact the BES, and other critical real-time parameters for the reliable operation of the BES. The EMS system also provides alarming of critical events that affect the reliability of the BES.

- **Real-time State Estimator (RTSE)**: This application performs numerical analysis of the real-time network model and data to determine the system's current condition. The RTSE can typically identify bad analog telemetry, estimate non-telemetered flows and voltages and determine real-time operating limit exceedances. The RTSE runs every 5 minutes, and provides a base-case solution used by RTCA and RT-VSA applications.

[1] IRO-002-7 R5.
[2] See RC0520 Loss of Monitoring and Analysis Tools

- **Real-time Contingency Analysis (RTCA)**: This is a primary Real-time Assessment application that runs every 5 minutes and automatically performs analyses of all identified single and credible multiple Contingencies that affect the RC Area.[3] The RC operator utilizes the results to identify potential post-Contingency thermal or voltage exceedances on the system and to proactively develop mitigation plans to ensure reliability.

- **Real-time Voltage-Stability Analysis (RT-VSA)**: This application runs every 5 minutes and performs voltage-stability analyses of pre-determined stability limitations on the system to determine voltage-stability limits and margins for those interfaces.

- **Real-time Dynamic Stability Analysis (RT-DSA)**: This application runs every 15 minutes and performs transient stability analyses of pre-determined stability limitations on the system to identify transient-stability limits and margins for those interfaces.

- **Plant Information (PI) System**: This is a reliability tool used to process and provide visualization of complex real-time power system information in a user-friendly format for the RC operator to process and analyze. The tool provides real-time trending of power system parameters, which enhances situational awareness.

- **Dispatcher Load Flow (DLF) and Contingency Analysis (CA) Study Tools**: These applications are used by the RC operator to manually run load flow and Contingency analysis studies. The Real-time base case solution from RTSE can be loaded into these applications to be used as a starting point to run analysis of any scenario the operator wants to study.

3.2. Identifying SOL and IROL Exceedances

SOLs and IROLs used in Real-time are based on the RC West SOL Methodology (*CAISO Procedure RC0610: SOL Methodology for the Operations Horizon*), to ensure acceptable system performance pre- and post-Contingency. Operating Plans are documented in procedures, outage cards, next day studies and current day studies, and those limits are programmed into Real-time monitoring and analysis tools to aid the RC Operator in quickly determining if an SOL or IROL is being approached or exceeded.

When an SOL or IROL exceedance is identified, the RC Operator will work with and compare results with the responsible TOP(s). In instances where there is disagreement in results between entities, the RC Operator will take a conservative approach and operate to the most limiting results.[4]

[3] IRO-008-2 R4
[4] IRO-009-2 R4, TOP-001-5 R18 (applicable to TOP)

Reliability Coordinator Actions[5]
• **Monitor** Real-time flows, voltages and status of RAS's on BES and non-BES facilities that impact the BES using the EMS alarms, SCADA, PI and RTSE to determine any of the following *SOL exceedance* conditions: 1. Actual Thermal Limit Exceedance – Real-time flows are exceeding the normal (continuous) rating for a monitored facility. 2. Actual Voltage Limit Exceedance – Real-time bus voltages are outside the normal (continuous) voltage limits for a monitored facility. 3. Actual Stability Exceedance – Real-time flows on an interface/path are exceeding a pre-determined stability limit. • **Evaluate** *results* from RTCA, RT-VSA, DLF and CA Study tools to determine any of the following *SOL exceedance* conditions: 1. Post-Contingency Thermal Exceedance – Validated Contingency analysis results indicate post-Contingency flows will exceed the highest Emergency (Short-Term) Rating for a monitored facility. 2. Post-Contingency Voltage Exceedance – Validated Contingency analysis results indicate post-Contingency bus voltage will be outside the Emergency (Short-Term) limits. 3. Insecure Operating State – Single or credible multiple Contingency will result in instability, cascading or uncontrolled separation. • **Evaluate** *results* from EMS, PI, RTCA, RT-VSA, DLF and CA Study tools to determine any of the following *IROL exceedance* conditions: 1. IROL Exceedance - Single or credible multiple Contingency will result in exceeding a pre-determined IROL limit.

3.3. Actual Thermal Limit Exceedances

When EMS alarms, SCADA, PI and/or RTSE indicates the actual real-time flows are exceeding the Normal (continuous) Rating for a monitored facility, take the following actions:

Reliability Coordinator Actions
• **Confirm** the **condition** is real by checking flows and ratings with the TOP. ○ **Validate** the quality of the solution if the indication is from RTSE. ○ **Operate** to the *most limiting* results, in instances where there is disagreement in results between entities.

[5] IRO-002-7 R5

Reliability Coordinator Actions

- **Determine** the *mitigation time* based on the associated time duration of the rating of the monitored facility.

> Example: Line X-Y has a Normal Rating of 200 MW, a 4-hour Emergency Rating of 250 MW, and a 30-minute Emergency Rating of 300 MW.
>
> If flow on Line X-Y is 240 MW:
>
> - Mitigation Time = 4 hours. Flow must be reduced below 200 MW within 4 hours.
>
> If flow on Line X-Y is 280 MW:
>
> - Mitigation Time = 30 minutes. Flow must be reduced below 200 MW within 30 minutes, unless the TOP provides a less stringent Facility Ratings methodology.
>
> If flow on Line X-Y exceeds 300 MW:
>
> - Mitigation Time = None. Flow must be reduced below 200 MW immediately, unless the TOP provides a less stringent Facility Ratings methodology, which allows additional mitigation time once flows have been reduced below 300 MW.

- **Evaluate** the results in *RTCA* to determine the impact of Contingencies on the monitored facility. RTCA might indicate the need for a more stringent mitigation time.
- N**otify** the *impacted entity(ies)* of the exceedance,[6] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
- **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP to ensure exceedance will be mitigated within the required mitigation time. Options for mitigation include:
  - **Re-dispatching** generation,
  - **Reconfiguring** the transmission system,
  - **Transferring** load out of load pocket,
  - **Returning** scheduled outages,
  - **Curtailing** schedules,
  - **Using** phase shifters, series devices or HVDC to re-direct flows, and
  - **Shedding** load (*Refer to RC0410 System Emergencies, Section 3.5 Load Shedding Instructions)*.

[6] IRO-008-2 R5

Reliability Coordinator Actions
• **Issue** an **Operating Instruction** including the mitigation actions needed to return the system to within limits within a specified timeframe, if the mitigation actions taken, or being taken, are not appropriate, timely or sufficient (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*). **See** Appendix A for RC mitigation options. • **Notify** any *impacted entity(ies)*, as deemed necessary by the RC Operator, once the condition has been mitigated.[7] • **Log** all *communications* and *actions* taken to mitigate the exceedance.

3.4. Actual Voltage Limit Exceedances

When EMS alarms, SCADA, PI and/or RTSE indicates an actual bus voltage is outside the normal (continuous) voltage limits for a monitored facility, take the following actions:

Reliability Coordinator Actions

• **Confirm** the **condition** is real by checking voltage and ratings with the TOP.
  ○ **Validate** the quality of the solution if the indication is from RTSE.
  ○ **Operate** *to* the *most limiting* results, in instances where there is disagreement in results between entities.
• **Determine** the **mitigation time** based on the associated time duration of the rating of the monitored facility.
• **Evaluate** the results in *RTCA* to determine the impact of Contingencies on the monitored facility. RTCA might indicate the need for a more stringent mitigation time.
• **Notify** the *impacted entity(ies)* of the exceedance,[8] if the exceedance impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
• **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP to ensure exceedance will be mitigated within the required mitigation time. Options for mitigation include:
  ○ **Switching** static reactive devices such as shunt capacitors and reactors in/out of service,
  ○ **Re-dispatching** dynamic reactive resources such as synchronous condensers, static VAR compensators (SVCs), HVDC Voltage Source Converters (VSCs), STATCOMs, etc.,
  ○ **Using** transformer tap changers to redirect reactive flows,

[7] IRO-008-2 R6
[8] IRO-008-2 R5

Reliability Coordinator Actions
○ **Issuing** revised voltage schedules to synchronized generation, ○ **Re-dispatching** generation/pumps, ○ **Reconfiguring** the transmission system, ○ **Returning** scheduled outages, ○ **Curtailing** schedules, ○ **Using** phase shifters, series devices or HVDC to re-direct flows, and ○ **Shedding** load (*Refer to RC0410 System Emergencies, Section 3.5 Load Shedding Instructions*). • **Issue** an **Operating Instruction** including the mitigation actions needed to return the system to within limits within a specified timeframe, if the mitigation actions taken, or being taken, are not appropriate, timely or sufficient (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*). • **Notify** any *impacted entity(ies)*, as deemed necessary by the RC Operator, once the condition has been mitigated.[9] • **Log** all *communications* and *actions* taken to mitigate the exceedance.

3.5. Actual Stability Limit Exceedances

Stability limits have been established for certain interfaces/paths based on Operations Planning Studies. These limits already have built-in distribution factors that account for the effect of identified single or credible multiple Contingencies. If a stability limit is exceeded, the expectation is a contingency could cause instability on the system.

Pre-identified stability limits would typically have an associated Operating Plan, Procedure, Process, or memo.

When EMS alarms, SCADA, PI and/or RTSE indicate the flow on an interface/path is exceeding a pre-determined stability limit, take the following actions:

Reliability Coordinator Actions
• **Confirm** the *stability limit* and flows with the TOP. ○ **Ensure** the *revised limits* are *properly coordinated* with impacted entity(ies) if the TOP provides a revised stability limit. ○ **Operate** to the *most limiting* results, in instances where there is disagreement in results between entities.

[9] IRO-008-2 R6

Reliability Coordinator Actions

- **Determine** the *mitigation actions* and *mitigation time* from available pre-determined Operating Plans, Procedures, Processes, or memos for the limit.
- **Notify** the *impacted entity(ies)* of the exceedance,[10] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
- **Evaluate** the **effectiveness** of mitigation actions being taken by the TOP to ensure exceedance will be mitigated within the required mitigation time. Options for mitigation include:
  - **Re-dispatching** generation,
  - **Reconfiguring** the transmission system,
  - **Transferring** load out of area with stability concern,
  - **Returning** scheduled outages,
  - **Curtailing** schedules,
  - **Using** phase shifters, series devices or HVDC to redirect flows,
  - **Requesting** unscheduled flow (USF) mitigation for qualified paths, and
  - **Shedding** load (*Refer to RC0410 System Emergencies, Section 3.5 Load Shedding Instructions*).
- For a Voltage Stability exceedance, options for mitigation also include:
  - **Switching** static reactive devices such as shunt capacitors and reactors in/out of service,
  - **Re-dispatching** dynamic reactive resources such as synchronous condensers, static VAR compensators (SVCs), HVDC Voltage Source Converters (VSCs), STATCOMs, etc.,
  - **Using** transformer tap changers to redirect reactive flows, and
  - **Issuing** revised voltage schedules to synchronized generation.
- **Issue** an *Operating Instruction* with the mitigation actions to take to return the system to within limits within a specified timeframe, if the mitigation actions taken, or being taken, are not appropriate, timely or sufficient (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*). **See** Appendix A for RC mitigation options.
- **Notify** the *impacted entity(ies)* of the exceedance and the mitigation once completed,[11] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.

[10] IRO-008-2 R5
[11] IRO-008-2 R5, R6

Reliability Coordinator Actions
• **Notify** any *impacted entity(ies)*, as deemed necessary by the RC Operator, once the condition has been mitigated.[12] • **Log** all *communications* and *actions* taken to mitigate the exceedance.

3.6. RTCA Post-Contingency Thermal Exceedances

When RTCA results indicate calculated post-Contingency flow will exceed the highest Emergency (Short-Term) Rating for a monitored facility, an SOL is being exceeded, and actions must be taken to mitigate the exceedance *pre-Contingency*.

Reliability Coordinator Actions

- **Validate** the *results* and *limits* used in RTCA:
  - **Check** *RTSE* solution quality.
  - **Verify** if any *RAS*(s) is associated with the contingency and the status.
  - **Use** a DLF and CA *study* tool as needed to verify the results.
  - **Verify** the contingency definition.
  - **Request** a study by the RCOE.
- **Verify** results with the TOP and determine whether the *TOP's Real-time Assessment* indicates the same exceedance.
  - **Operate to** the *most limiting* RTCA results in instances where there is disagreement on the results.
- **Refer** to Section 3.9, if results indicate any post-Contingency *exceedance greater than 125%*.
- **Notify** the *impacted entity(ies)* of the exceedance,[13] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
- **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP. Options for mitigation include:
  - **Re-dispatching** generation,
  - **Reconfiguring** the transmission system,
  - **Transferring** load out of area,
  - **Returning** scheduled outages,

[12] IRO-008-2 R6
[13] IRO-008-2 R5

Reliability Coordinator Actions
○ **Curtailing** schedules, and ○ **Using** phase shifters, series devices or HVDC to re-direct flows. • **Require** the TOP to provide a *viable post-Contingency mitigation plan within 30 minutes,*[14] if the pre-contingent exceedance cannot be mitigated by implementing the primary Operating Plan, which would include actions up to and including post-contingent load shedding. (Refer to Section 3.12 Post-Contingency Mitigation Plans). • **Issue** an *Operating Instruction* including the mitigation actions needed to return the system to within limits within a specified timeframe if the mitigation actions taken, or being taken, are not appropriate, timely or sufficient (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*). **See** Appendix A for RC mitigation options. • **Notify** any *impacted entity(ies)*, as deemed necessary by the RC Operator, once the condition has been mitigated.[15] • **Log** all *communications* and *actions* taken to mitigate the exceedance.

3.7. RTCA Post-Contingency Voltage Exceedances

When RTCA results indicate calculated post-Contingency bus voltage will be outside the Emergency (Short-Term) limits for a monitored facility, an SOL is being exceeded, and actions must be taken to mitigate the exceedance *pre-Contingency*.

Reliability Coordinator Actions
• **Validate** the *results* and *limits* used in RTCA: ○ **Check** *RTSE* solution quality. ○ **Verify** if any *RAS*(s) is associated with the contingency and the status. ○ **Use** DLF and CA *study* tool as needed to verify the results. ○ **Verify** the Contingency definition. ○ **Request** a study by the RCOE. • **Verify** results with the TOP and determine whether the *TOPs Real-time Assessment* indicates the same exceedance. ○ **Operate** to the *most limiting* RTCA results in instances where there is disagreement on the results.

[14] The 30-minute requirement starts when the RC Operator requests for the plan from the TOP.
[15] IRO-008-2 R6

Reliability Coordinator Actions

- **Refer** to Section 3.9, if calculated post-Contingency results indicate *potential voltage collapse*.
- **Notify** the *impacted entity(ies)* of the exceedance,[16] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
- **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP. Options for mitigation include:
  - **Switching** static reactive devices such as shunt capacitors and reactors in/out of service,
  - **Re-dispatching** dynamic reactive resources such as synchronous condensers, static VAR compensators (SVCs), HVDC Voltage Source Converters (VSCs), etc.
  - **Using** transformer tap changers to redirect reactive flows,
  - **Issuing** revised voltage schedules to synchronized generation,
  - **Re-dispatching** generation/pumps,
  - **Reconfiguring** the transmission system,
  - **Transferring** load out of collapse zone,
  - **Returning** scheduled outages,
  - **Curtailing** schedules, and
  - **Using** phase shifters, series devices or HVDC to re-direct flows.
- **Require** the TOP to provide a *viable post-Contingency mitigation plan*, which would include actions up to and including post-contingent load shedding *within 30 minutes,*[17] if the pre-contingent exceedance cannot be mitigated by implementing the primary Operating Plan (Refer to Section 0: Post-Contingency Mitigation Plans).
- **Issue** an **Operating Instruction** including the mitigation actions needed to return the system within limits within a specified timeframe if the mitigation actions taken, or being taken, are not appropriate, timely or sufficient (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*).
- **Notify** any *impacted entity(ies),* as deemed necessary by the RC Operator, once the condition has been mitigated.[18]
- **Log** all *communications* and *actions* taken to mitigate the exceedance.

[16] IRO-008-2 R5
[17] The 30-minute requirement starts when the RC Operator requests for the plan from the TOP.
[18] IRO-008-2 R6

3.8. IROL Exceedances

For each IROL identified one or more days prior to the current day, RC West has an Operating Plan that identifies actions the RC shall take or direct others to take (up to and including load shedding) which can be implemented in time to prevent the identified IROL exceedance within IROL T_V.[19] The default IROL T_V is 30 minutes, unless conditions require a shorter T_V.

When EMS alarms, SCADA, PI and/or RTSE indicate the actual Real-time flow on an interface/path is exceeding a pre-determined IROL limit; or RTCA or RT-VSA indicates a single or credible multiple Contingency will result in exceeding a pre-determined IROL limit, take the following actions:

Reliability Coordinator Actions

- **Validate** the *results* and *limits* used in the application if the exceedance is based on RTCA or RT-VSA results:
  - **Check** *RTSE* solution quality
  - **Verify** if any *RAS*(s) is associated with the contingency and the status
  - **Use** DLF and CA *study* tool as needed to verify the results
- **Confirm** the *IROL limit* and flows with the TOP if the exceedance is based on real-time flows on an IROL interface/path,
  - **Ensure** the *revised limits* are *properly coordinated* with impacted BA/TOP and the RC if the TOP provides a revised IROL limit.
  - **Operate** to the *most limiting* IROL and T_V, in instances where there is disagreement in results between entities.
- **Review** the applicable *IROL Operating Plan*, and **determine** the required *mitigation actions*.[20]
- **Determine (**from the TOP) the amount of time needed to shed load, if required.
- **Notify** the *impacted entity(ies)* of the exceedance,[21] if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties.
- **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP to ensure exceedance will be *mitigated within 30 minutes* (IROL T_V).
- **Issue** an *Operating Instruction* immediately, if the actions being taken by the TOP will not resolve the exceedance within the 30-minute T_V.

[19] IRO-009-2 R1
[20] IRO-009-2 R2
[21] IRO-008-2 R5

Reliability Coordinator Actions
• **Issue** an Operating Instruction, without delay, to **shed load** (within the amount of time the TOP requires to accomplish it) to ensure the exceedance is resolved within the 30-minute T_V,[22] if further evaluation of the mitigation actions indicates the exceedance will not be mitigated within the 30-minute T_V (*Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions*). • **Notify** any *impacted entity(ies) in accordance with applicable IROL Operating Guide*.[23] • **Log** all *communications* and *actions* taken to mitigate the exceedance.

3.9. Insecure Operating State

When RTCA, RT-DSA or RT-VSA indicates a single or credible multiple Contingency will result in *instability, cascading outages* or *voltage collapse*, which was not identified one or more days prior to the current day,[24] the system is considered to be in an insecure operating state once the condition is verified. In this scenario, although an IROL was not previously identified, the exceedance of an unidentified IROL cannot be ruled out. Therefore, System Operators should focus on communicating **the urgency to the impacted BA/TOP(s) and RC(s) and returning** the system to a secure operating state **immediately.** A return to a secure operating state should be based on an updated study and mitigating actions up to and including shedding load. An after-the-fact analysis should explore whether an IROL and/or an area specific operating guide should be established for future similar real-time conditions.

Reliability Coordinator Actions

• **Validate** the **results** and **limits** used in the solution:
  ○ **Check** *RTSE* solution quality.
  ○ **Verify** if any *RAS*(s) is associated with the Contingency and the status.
  ○ **Verify** the contingency definition.
  ○ **Request** a study by the RCOE.

[22] IRO-009-2 R3
[23] IRO-008-2 R6
[24] IRO-009-2 R1

Reliability Coordinator Actions

- **Run** a **cascading test**, if RTCA indicates exceedance greater than *125%* of the *highest Emergency Rating* of a monitored facility *or* the facility's relay trip setting (if known), whichever is lower.

Cascading Test

1. **Load** the RTSE case into the CA study tool.
2. **Take out of service** the contingent element and the monitored element.
3. **Run** power flow study.
4. **Determine** if any facilities will be loaded above 125% of the highest Emergency rating or the facility's relay trip setting (if known), whichever is lower.
5. **Take out of service** any facility that meets the criteria in Step 4.
6. **Repeat** Steps 3 to 5 until no facility meets the criteria in Step 4, or until the solution diverges.

Note: *A diverged solution may indicate a potential voltage collapse.*

- **Verify** results with the TOP and determine whether the *TOPs Real-time Assessment* indicates the same condition.
  - **Operate** to the *most limiting* RTCA results in instances where there is disagreement on the results.
  - **Declare** an insecure operating state, via GMS without intentional delay as soon as instability, cascading outages, or voltage collapse indications are **verified** *(Refer to RC0310C Guidelines for Declaring Insecure Operating State)*. If necessary, initiate a conference call with the affected party(s).
- **Require** the TOP to start taking *mitigation actions*. The insecure operating state must be mitigated *within 30 minutes* from the time the insecure operating state was declared.
- **Evaluate** the *effectiveness* of mitigation actions being taken by the TOP. Options for mitigation include:
  - **Re-dispatching** generation,
  - **Reconfiguring** the transmission system,
  - **Transferring** load out of the zone,
  - **Returning** scheduled outages,
  - **Curtailing** schedules,

Reliability Coordinator Actions
○ **Using** phase shifters, series devices or HVDC to re-direct flows, ○ **Requesting** unscheduled flow (USF) mitigation for qualified paths, and ○ **Shedding** load (Refer to *RC West RC0410 System Emergencies, Section 3.5: Load Shedding*). • **Issue** an **Operating Instruction** to **shed load** (within the amount of time the TOP requires to accomplish it) to ensure the insecure operating state is resolved within the 30-minute timeframe, if further evaluation of the mitigation actions indicates the insecure operating state will not be mitigated within the 30-minute timeframe.[25] (*Refer to RC West Operating Procedure RC0410 System Emergencies, Section 3.4 Operating Instructions*). • **Notify** impacted BA(s), TOP(s) and RC(s) via GMS once the condition has been mitigated.[26] • **Log** all *communications* and *actions* taken to mitigate the insecure operating state.

3.10. Unsolved Contingencies in RTCA

A Contingency that fails to converge in RTCA may be an indication of a potential voltage collapse or other infeasible operating state that might occur if the Contingency actually happened.

On the other hand, an unsolved Contingency might also indicate a modelling error or other data problem, which could degrade the quality of the base case. Such errors could degrade the quality of the results for all Contingencies, even those that solve successfully.[27] If left unresolved, situational awareness of potential SOL or IROL violations is compromised until personnel can identify the cause of the unsolved Contingency.[28]

Reliability Coordinator Actions
• **Request** RCOE and EMS *Engineering support* to investigate and resolve the causal factors related to input data, the model or the RTCA application itself. • **Run** *study* of the Contingency in question using DLF and CA study tools • **Verify** results with the TOP and determine whether the *TOPs Real-time Assessment* indicates the same exceedance. ○ **Operate** to the *most limiting* results in instances where there is disagreement. • **Assume** a *conservative approach* because the post-Contingency operating state is most likely unstable or in a voltage collapse. Refer to Section 3.10: Unsolved Contingencies in RTCA.

[25] IRO-009-2 R3
[26] IRO-008-2 R6
[27] IRO-018-1(i) R2.3.
[28] NATF Operator Tools & Environment – Contingency Analysis Practices

Reliability Coordinator Actions
• Insecure Operating State. • **Log** each *unsolved Contingency*, verbal discussions, related studies and *actions* taken to resolve it.

3.11. Islanding Conditions

RC West RTCA will identify islands greater than 100 MW that will result from a single or credible multiple Contingency. Contingencies creating islands are not SOLs or IROLs; however, the RC will notify the impacted TOPs, BAs and RCs for situational awareness.

Reliability Coordinator Actions

• **Validate** the *islanding* condition in RTCA.
  ○ **Verify** the Contingency definition
  ○ **Verif**y the topology in the model.
  ○ **Use** DLF and CA *study* tool as needed to verify the results.
  ○ **Request** a study by the RCOE.
• **Notify** the impacted TOPs, BAs and RCs of the Contingency creating an island for situational awareness.

3.12. Post-Contingency Mitigation Plans

A TOP must provide a viable post-Contingency mitigation plan if it is unable to mitigate an SOL pre-Contingency in a timely manner, due to generation startup, ramp rate or other constraints; or if there are no automatic post-Contingency actions such as RAS/SPS that can resolve the issue. A post-Contingency mitigation plan is considered viable and acceptable by the RC when:

- The limitation in question is <u>not</u> an IROL, stability limit or Insecure Operating State.
- The plan can be implemented in a timely manner without adverse reliability consequences.
- The RC confirms the plan will resolve the reliability issue in a timely manner.
- All impacted BAs, TOPs and RCs agree with the plan.

Reliability Coordinator Actions
• **Ensure** the *TOP understands* the limiting contingency and monitored facility. • **Require** the *TOP* to provide the *specifics* of the plan and the *time to implement*. • **Ensure** the plan meets the four criteria described above.

Reliability Coordinator Actions
• **Request** a study by the RCOE if needed. • **Log** all *communications* and the specifics of the *plan*.

3.13. Change of RAS Status

Accurate RAS monitoring is necessary to perform Real-time Assessments in order to identify facilities approaching SOL and IROL limits; and to identify SOL and IROL exceedances within the RC West Area. The applicable TOP shall notify the RC if there is a change in RAS status according to RC0130 Reporting Requirements for Real-Time Events.

Reliability Coordinator Actions
• **Receive** notification from EMS, GMS, or phone that there has been a change in status for one or more RAS. • **Verify** with the *TOP* that the RAS status has changed, and the reason for the change. • **Request** the TOP to submit an OMS outage if the RAS is forced out of service for more than 30 minutes. • **Notify** the RCOE of the change in RAS status. • **Notify** the impacted TOPs, BAs and RCs of the RAS status change for situational awareness. • **Verify** that the RAS modeling is correctly reflected in RTCA. • **Request** a study by the RCOE if needed. • **Log** all *communications* and the specifics of the change in RAS status.

4. Supporting Information

Operationally Affected Parties

Shared with the Public; additionally shared with AESO, BCRC, and SPP RC.

References

NERC Requirements	IRO-002-7 R5; IRO-006-5 R1; IRO-006-WECC-3 R1; IRO-008-2 R4, R5, R6; IRO-009-2 R1, R2, R3, R4; IRO-014-3 R1; IRO-018-1(i) R2.3.
BA/TOP Operating Procedure	
RC West Operating Procedures	RC0310A Stability SOLs and Areas with Risk of Localized Voltage Collapse RC0310C Guidelines for Declaring Insecure Operating State RC0520 Loss of Monitoring and Analysis Tools RC0410 System Emergencies RC0610 SOL Methodology for the Operations Horizon RC9010 Unscheduled Flow Mitigation on Qualified Paths
Other References	NATF Operator Tools & Environment – Contingency Analysis Practices Western Interconnection Unscheduled Flow Mitigation Plan

Definitions

The following terms capitalized in this Operating Procedure are in accordance with the NERC Glossary, and/or otherwise when used are as defined below:

Term	Description
Energy Management System (EMS)	An application used to perform real-time monitoring, analysis, real-time coordination and generation control. Reliability entities provide telemetered data to CAISO EMS. Generators and CAISO Market Participants receive data and control signals from CAISO EMS.
Inter-Control Center Communication Protocol (ICCP)	Provides a standard format for exchanging data between system and / or entities.
PT RTCA	Backup RTCA tool

Term	Description
Remedial Action Schemes (RAS)	A scheme designed to detect predetermined System conditions and automatically take corrective actions that may include, but are not limited to, adjusting or tripping generation (MW and Mvar), tripping load, or reconfiguring a System(s). RAS accomplish objectives such as: • Meet requirements identified in the NERC Reliability Standards • Maintain Bulk Electric System (BES) stability • Maintain acceptable BES voltages • Maintain acceptable BES power flows • Limit the impact of Cascading or extreme events The following do not individually constitute a RAS: • Protection Systems installed for the purpose of detecting Faults on BES Elements and isolating the faulted Elements • Schemes for automatic underfrequency load shedding (UFLS) and automatic undervoltage load shedding (UVLS) comprised of only distributed relays • Out-of-step tripping and power swing blocking • Automatic reclosing schemes • Schemes applied on an Element for non-Fault conditions, such as, but not limited to, generator loss-of-field, transformer top-oil temperature, overvoltage, or overload to protect the Element against damage by removing it from service
System Operating Limit (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 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)

Term	Description
Interconnection Reliability Operating Limit (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.
IROL Tv	The maximum time that an Interconnection Reliability Operating Limit can be violated before the risk to the interconnection or other Reliability Coordinator Area(s) becomes greater than acceptable. Each Interconnection Reliability Operating Limit's Tv shall be less than or equal to 30 minutes.
SCADA	Supervisory Control and Data Acquisition
Reliability Coordinator (RC) Area	The collection of generation, transmission, and loads within the boundaries of the Reliability Coordinator. Its boundary coincides with one or more Balancing Authority Areas.
Normal (Continuous) Ratings	The rating as defined by the equipment owner that specifies the level of electrical loading, usually expressed in megawatts (MW) or other appropriate units that a system, facility, or element can support or withstand through the daily demand cycles without loss of equipment life.
Emergency (Short-Term) Rating	The rating as defined by the equipment owner that specifies the level of electrical loading or output, usually expressed in megawatts (MW) or Mvar or other appropriate units, that a system, facility, or element can support, produce, or withstand for a finite period. The rating assumes acceptable loss of equipment life or other physical or safety limitations for the equipment involved.
Operating Plan	A document that identifies a group of activities that may be used to achieve some goal. An Operating Plan may contain Operating Procedures and Operating Processes. A company-specific system restoration plan that includes an Operating Procedure for black-starting units, Operating Processes for communicating restoration progress with other entities, etc., is an example of an Operating Plan.

Term	Description
Operating Procedure	A document that identifies specific steps or tasks that should be taken by one or more specific operating positions to achieve specific operating goal(s). The steps in an Operating Procedure should be followed in the order in which they are presented, and should be performed by the position(s) identified. A document that lists the specific steps for a system operator to take in removing a specific transmission line from service is an example of an Operating Procedure.
Operating Process	A document that identifies general steps for achieving a generic operating goal. An Operating Process includes steps with options that may be selected depending upon Real-time conditions. A guideline for controlling high voltage is an example of an Operating Process.
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.)
Contingency	The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element.

Version History

Version	Change	Date
1.0	Approved by Steering Committee.	9/26/18
1.1	Added section 3.13 on USF relief for qualified paths, and appendix RC0310B on list of qualified paths and controllable devices. Minor clarifications to Section 3.3, 3.6, 3.7 and 3.12. Reviewed by RTWG.	1/16/19

Version	Change	Date
1.2	Due to retirement of *WECC Unscheduled Flow Reduction Guideline* document, changed references in section 3.14 to *Western Interconnection Unscheduled Flow Mitigation Plan*. Clarified example in section 3.3 on actual thermal limit exceedances. Added clarification language to section 3.9 to address insecure operating state. Added new section 3.13 for Change in RAS Status. Clarified requirement to approve/deny USF requests within 5 minutes in Section 3.14.	4/08/19
1.3	Fixed reference errors in Sections 3.6 and 3.7. Added new appendix RC0310C Guidelines for Declaring Insecure Operating State.	05/01/19
1.4	Minor updates for 11/1, replaced all CAISO RC references to RC West. Approved by RTWG on 06/21/19.	11/01/19
1.5	Section 3.9: Removed references of RCIS. Replaced Peak RC with SPP West RC or impacted RC. Updated NERC IRO-002 reference. Clarified RC Operator notification requirements after an exceedance is mitigated in Sections 3.3 to 3.8.	5/12/20
1.6	Section 3.2: Added footnote NERC Standard IRO-009-2 R4. Removed and merged Section 14 of RC0310 and RC0310B content into RC9010 procedure. Updated Operationally Affected Parties to include Neighboring RCs in addition to Public sharing. Updated NERC Standard references and added IRO-009-2 R4 to References Section. Removed RC0310 from Appendix list as it is being retired with the publish of RC9010. Minor format and grammar updates. Changes reviewed and approved by the Real-Time Working Group (RTWG).	6/11/21
1.7	Periodic Review: Added Appendix A and references to it in Sections 3.3, 3.5, 3.6. Section 3.5: Added bullet and sub-bullets for a Voltage Stability exceedance. Updated NERC Standard references and minor format and grammar updates throughout. Added procedure references to RC0310A and RC0310B in References section.	5/15/22

5. Periodic Review Procedure

Review Criteria & Incorporation of Changes

There are no specific review criteria identified for this document.

Frequency

Review at least once every three years.

Appendix A: RC Exceedance Mitigation Steps

The RC West Reliability Coordinator has the authority to implement congestion management steps in any order; however, the generally preferred order of actions is:

1) Security constrained market re-dispatch (if available).
2) Operating phase-shifting and series devices, including Unscheduled Flow Mitigation (if qualified).
3) Low-risk pre-contingency transmission reconfiguration.
4) Transferring load out of the area.
5) Returning scheduled outages.
6) Manual re-dispatch of generation and/or HVDC devices within the affected TOP area.
7) Cutting Path schedules and reducing TTCs (if constraint is related to one or more scheduling Paths).
8) Starting or shutting down generation within the affected TOP area.
9) Other pre-contingency transmission reconfiguration.
10) Manual generation re-dispatch instruction to generation and/or HVDC devices outside of the affected TOP area, by order of effectiveness.
11) Starting or shutting down generation outside of the affected TOP area, by order of effectiveness.
12) Shedding firm load.