
 California ISO	Reliability Coordinator Procedure	Procedure No.	RC0310
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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 the CAISO RC 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. The CAISO RC 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 CAISO RC 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 is an application that 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-002-5 R5.

² See CAISO-RC-5XXX-Loss of Monitoring and Analysis Tools

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- **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 CAISO RC 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 results⁴.

³ IRO-008-2 R4

⁴ TOP-001-3 R18 (applicable to TOP)

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Reliability Coordinator Actions ⁵
<ul style="list-style-type: none"> • 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 <i>SOL exceedance</i> conditions: <ol style="list-style-type: none"> 1. <u>Actual Thermal Limit Exceedance</u> – Real-time flows are exceeding the normal (continuous) rating for a monitored facility. 2. <u>Actual Voltage Limit Exceedance</u> – Real-time bus voltages are outside the normal (continuous) voltage limits for a monitored facility. 3. <u>Actual Stability Exceedance</u> – 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 <i>SOL exceedance</i> conditions: <ol style="list-style-type: none"> 1. <u>Post-Contingency Thermal Exceedance</u> – Validated Contingency analysis results indicate post-Contingency flows will exceed the highest Emergency (Short-Term) Rating for a monitored facility. 2. <u>Post-Contingency Voltage Exceedance</u> – Validated Contingency analysis results indicate post-Contingency bus voltage will be outside the Emergency (Short-Term) limits. 3. <u>Insecure Operating State</u> – 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 <i>IROL exceedance</i> conditions: <ol style="list-style-type: none"> 1. <u>IROL Exceedance</u> - 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
<ul style="list-style-type: none"> • Confirm the condition is real by checking flows and ratings with the TOP. <ul style="list-style-type: none"> ○ Validate the quality of the solution if the indication is from RTSE. ○ Operate to the <i>most limiting</i> results, in instances where there is disagreement in results between entities.

⁵ IRO-002-5 R5



Mitigating SOL and IROL Exceedances

Distribution Restriction:
None

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. An SOL is exceeded if flow remains greater than 240 MW for greater than 4 hours.

If flow on Line X-Y is 280 MW:


- Mitigation Time = 30 minutes. An SOL is exceeded if flow remains greater than 280 MW for greater than 30 minutes.

If flow on Line X-Y exceeds 300 MW:

- Mitigation Time = None. An SOL is exceeded whenever flow exceeds 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.
- **Notify** the *impacted entity(ies)* of the exceedance⁶, 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*).
- **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

⁶ IRO-008-2- R5

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Reliability Coordinator Actions
<p>taken, are not appropriate, timely or sufficient (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>).</p> <ul style="list-style-type: none"> • Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.⁷ • Log all <i>communications</i> and <i>actions</i> 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
<ul style="list-style-type: none"> • Confirm the condition is real by checking voltage and ratings with the TOP. <ul style="list-style-type: none"> ○ Validate the quality of the solution if the indication is from RTSE. ○ Operate to the <i>most limiting</i> 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 <i>RTCA</i> to determine the impact of Contingencies on the monitored facility. <i>RTCA</i> might indicate the need for a more stringent mitigation time. • Notify the <i>impacted entity(ies)</i> of the exceedance⁸, if the exceedance impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties. • Evaluate the <i>effectiveness</i> of mitigation actions being taken by the TOP to ensure exceedance will be mitigated within the required mitigation time. Options for mitigation include: <ul style="list-style-type: none"> ○ 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, ○ Issuing revised voltage schedules to synchronized generation, ○ Re-dispatching generation/pumps,

⁷ IRO-008-2- R6

⁸ IRO-008-2- R5

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Reliability Coordinator Actions
<ul style="list-style-type: none"> ○ Reconfiguring the transmission system, ○ Returning scheduled outages, ○ Curtailling schedules, ○ Using phase shifters, series devices or HVDC to re-direct flows, and ○ Shedding load (<i>Refer to RC0410 System Emergencies, Section 3.5 Load Shedding Instructions</i>). ● 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 (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>). ● Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.⁹ ● Log all <i>communications</i> and <i>actions</i> 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
<ul style="list-style-type: none"> ● Confirm the <i>stability limit</i> and flows with the TOP. <ul style="list-style-type: none"> ○ Ensure the <i>revised limits</i> are <i>properly coordinated</i> with impacted entity(ies) if the TOP provides a revised stability limit. ○ Operate to the <i>most limiting</i> results, in instances where there is disagreement in results between entities. ● Determine the <i>mitigation actions</i> and <i>mitigation time</i> from available pre-determined Operating Plans, Procedures, Processes, or memos for the limit.

⁹ IRO-008-2- R6

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Reliability Coordinator Actions
<ul style="list-style-type: none"> • Notify the <i>impacted entity(ies)</i> 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: <ul style="list-style-type: none"> ○ Re-dispatching generation, ○ Reconfiguring the transmission system, ○ Transferring load out of area with stability concern, ○ Returning scheduled outages, ○ Curtailling schedules, ○ Using phase shifters, series devices or HVDC to redirect flows, ○ Requesting unscheduled flow (USF) mitigation for qualified paths, and ○ Shedding load (<i>Refer to RC0410 System Emergencies, Section 3.5 Load Shedding Instructions</i>). • Issue an <i>Operating Instruction</i> 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 (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>). • Notify the <i>impacted entity(ies)</i> 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. • Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.¹² • Log all <i>communications</i> and <i>actions</i> 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*.

¹⁰ IRO-008-2- R5


¹¹ IRO-008-2- R5, R6

¹² IRO-008-2- R6

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Reliability Coordinator Actions
<ul style="list-style-type: none"> • Validate the <i>results</i> and <i>limits</i> used in RTCA: <ul style="list-style-type: none"> ○ Check RTSE solution quality. ○ Verify if any RAS(s) is associated with the contingency and the status. ○ Use a DLF and CA <i>study</i> 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 <i>Real-time Assessment</i> indicates the same exceedance. <ul style="list-style-type: none"> ○ Operate to the <i>most limiting</i> RTCA results in instances where there is disagreement on the results. • Refer to Section 3.11: I, if results indicate any post-Contingency <i>exceedance greater than 125%</i>. • Notify the <i>impacted entity(ies)</i> 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 <i>effectiveness</i> of mitigation actions being taken by the TOP. Options for mitigation include: <ul style="list-style-type: none"> ○ Re-dispatching generation, ○ Reconfiguring the transmission system, ○ Transferring load out of area, ○ Returning scheduled outages, ○ Curtailling 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, 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 02: <ul style="list-style-type: none"> • Post-Contingency Mitigation Plans). • Issue an <i>Operating Instruction</i> 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 (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>).

¹³ IRO-008-2- R5

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Reliability Coordinator Actions
<ul style="list-style-type: none"> • Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.¹⁴ • Log all <i>communications</i> and <i>actions</i> 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
<ul style="list-style-type: none"> • Validate the <i>results</i> and <i>limits</i> used in RTCA: <ul style="list-style-type: none"> ○ Check <i>RTSE</i> solution quality. ○ Verify if any <i>RAS(s)</i> is associated with the contingency and the status. ○ Use DLF and <i>CA study</i> 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 <i>TOPs Real-time Assessment</i> indicates the same exceedance. <ul style="list-style-type: none"> ○ Operate to the <i>most limiting</i> RTCA results in instances where there is disagreement on the results. • Refer to Section 3.11: I, if calculated post-Contingency results indicate <i>potential voltage collapse</i>. • Notify the <i>impacted entity(ies)</i> of the exceedance¹⁵, if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties. • Evaluate the <i>effectiveness</i> of mitigation actions being taken by the TOP. Options for mitigation include: <ul style="list-style-type: none"> ○ 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,

¹⁴ IRO-008-2- R6

¹⁵ IRO-008-2- R5

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Reliability Coordinator Actions
<ul style="list-style-type: none"> ○ 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 <i>viable post-Contingency mitigation plan</i>, which would include actions up to and including post-contingent load shedding <i>within 30 minutes</i>, if the pre-contingent exceedance cannot be mitigated by implementing the primary Operating Plan (Refer to Section 0: <ul style="list-style-type: none"> ● 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 (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>). ● Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.¹⁶ ● Log all <i>communications</i> and <i>actions</i> taken to mitigate the exceedance.


3.8. IROL Exceedances

For each IROL identified one or more days prior to the current day, the CAISO RC 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 .¹⁷ 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:

¹⁶ IRO-008-2- R6

¹⁷ IRO-009-2 R1

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Reliability Coordinator Actions
<ul style="list-style-type: none"> • Validate the <i>results</i> and <i>limits</i> used in the application if the exceedance is based on RTCA or RT-VSA results: <ul style="list-style-type: none"> ○ Check RTSE solution quality ○ Verify if any RAS(s) is associated with the contingency and the status ○ Use DLF and CA <i>study</i> tool as needed to verify the results • Confirm the <i>IROL limit</i> and flows with the TOP if the exceedance is based on real-time flows on an IROL interface/path, <ul style="list-style-type: none"> ○ Ensure the <i>revised limits</i> are <i>properly coordinated</i> with impacted BA/TOP and the RC if the TOP provides a revised IROL limit. ○ Operate to the <i>most limiting</i> IROL and T_V, in instances where there is disagreement in results between entities. • Review the applicable <i>IROL Operating Plan</i>, and determine the required <i>mitigation actions</i>.¹⁸ • Determine (from the TOP) the amount of time needed to shed load, if required. • Notify the <i>impacted entity(ies)</i> of the exceedance¹⁹, if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties. • Evaluate the <i>effectiveness</i> of mitigation actions being taken by the TOP to ensure exceedance will be <i>mitigated within 30 minutes</i> (IROL T_V). • Issue an <i>Operating Instruction</i> without delay, if the actions being taken by the TOP will not resolve the exceedance within the 30-minute T_V. • Issue an <i>Operating Instruction</i>, 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_V²⁰, if further evaluation of the mitigation actions indicates the exceedance will not be mitigated within the 30-minute T_V (<i>Refer to RC0410 System Emergencies, Section 3.4 Operating Instructions</i>). • Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.²¹ • Log all <i>communications</i> and <i>actions</i> taken to mitigate the exceedance.

¹⁸ IRO-009-2 R2

¹⁹ IRO-008-2- R5

²⁰ IRO-009-2 R3

²¹ IRO-008-2- R6


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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,²² the system is considered to be in an insecure operating state. Since this condition was not identified one or more days prior to the current day, an existing Operating Plan with planned mitigation actions may not be available to address the exceedance.

Reliability Coordinator Actions
<ul style="list-style-type: none"> • Validate the results and limits used in the solution: <ul style="list-style-type: none"> ○ 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. • Run a cascading test, if RTCA indicates exceedance greater than 125% of the <i>highest Emergency Rating</i> of a monitored facility <i>or</i> the facility's relay trip setting (if known), whichever is lower. <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p><u>Cascading Test</u></p> <ol style="list-style-type: none"> 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. <p>A diverged solution may indicate a potential voltage collapse</p> </div> • Verify results with the TOP and determine whether the <i>TOPs Real-time Assessment</i> indicates the same exceedance. <ul style="list-style-type: none"> ○ Operate to the <i>most limiting</i> RTCA results in instances where there is disagreement on the results.

²² IRO-009-2 R1

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Reliability Coordinator Actions
<ul style="list-style-type: none"> • Notify the <i>impacted entity(ies)</i> of the exceedance²³, if it impacts or potentially impacts neighboring TOPs, BAs, or RCs. If necessary, initiate a conference call with the affected parties. • Require the TOP to start taking <i>mitigation actions</i>. The exceedance must be mitigated <i>within 30 minutes</i> from the time the insecure operating state was confirmed. • Evaluate the <i>effectiveness</i> of mitigation actions being taken by the TOP. Options for mitigation include: <ul style="list-style-type: none"> ○ Re-dispatching generation, ○ Reconfiguring the transmission system, ○ Transferring load out of the zone, ○ Returning scheduled outages, ○ Curtailing schedules, ○ Using phase shifters, series devices or HVDC to re-direct flows, ○ Requesting unscheduled flow (USF) mitigation for qualified paths, and ○ Shedding load (Refer to <i>CAISO RC0410 System Emergencies, Section 3.5: Load Shedding</i>). • 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 timeframe, if further evaluation of the mitigation actions indicates the exceedance will not be mitigated within the 30-minute timeframe²⁴ (Refer to <i>RC0410 System Emergencies, Section 3.4 Operating Instructions</i>). • Notify any <i>impacted entity(ies)</i> once the condition has been mitigated.²⁵ • Log all <i>communications</i> and <i>actions</i> taken to mitigate the exceedance.

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

²³ IRO-008-2- R5

²⁴ IRO-009-2 R3

²⁵ IRO-008-2- R6

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the quality of the results for all Contingencies, even those that solve successfully²⁶. If left unresolved, situational awareness of potential SOL or IROL violations is compromised until personnel can identify the cause of the unsolved Contingency²⁷.

Reliability Coordinator Actions
<ul style="list-style-type: none"> • Request RCOE and EMS <i>Engineering support</i> to investigate and resolve the causal factors related to input data, the model or the RTCA application itself. • Run <i>study</i> of the Contingency in question using DLF and CA study tools • Verify results with the TOP and determine whether the <i>TOPs Real-time Assessment</i> indicates the same exceedance. <ul style="list-style-type: none"> ○ Operate to the <i>most limiting</i> results in instances where there is disagreement. • Assume a <i>conservative approach</i> because the post-Contingency operating state is most likely unstable or in a voltage collapse. Refer to Section 3.10: Unsolved Contingencies in RTCA • Insecure Operating State. • Log each <i>unsolved Contingency</i>, verbal discussions, related studies and <i>actions</i> taken to resolve it.


3.11. Islanding Conditions

CAISO RC 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
<ul style="list-style-type: none"> • Validate the <i>islanding</i> condition in RTCA. <ul style="list-style-type: none"> ○ Verify the Contingency definition ○ Verify the topology in the model. ○ Use DLF and CA <i>study</i> 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.

²⁶ IRO-018-1 R2.3.

²⁷ NATF Operator Tools & Environment – Contingency Analysis Practices

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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 not 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
<ul style="list-style-type: none"> • Ensure the <i>TOP understands</i> the limiting contingency and monitored facility. • Require the <i>TOP</i> to provide the <i>specifics</i> of the plan and the <i>time to implement</i>. • Ensure the highest facility <i>thermal ratings</i> will not be exceeded. • Ensure the highest/lowest <i>voltage limits</i> will not be exceeded. • Evaluate the plan and <i>verify</i> the <i>plan</i> will resolve the reliability issue in a timely manner. Request a study by the RCOE if needed. • Ensure all impacted BAs, TOPs and RCs agree with the plan. • Log all <i>communications</i> and the specifics of the <i>plan</i>.


4. Supporting Information

Operationally Affected Parties

Shared with Public.

References

NERC Requirements	IRO-002-5 R5; IRO-006-5 R1; IRO-006-WECC-2 R1; IRO-008-2 R4, R5, R6; IRO-009-2 R1, R2, R3; IRO-018-1 R2.3.
BA/TOP Operating Procedure	
Other References	CAISO-RC0520-Loss of Monitoring and Analysis Tools


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	CAISO-RC0410 System Emergencies CAISO Procedure RC0610: SOL Methodology for the Operations Horizon NATF Operator Tools & Environment – Contingency Analysis Practices
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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
Remedial Action Schemes (RAS)	<p>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 MVA_r), tripping load, or reconfiguring a System(s). RAS accomplish objectives such as:</p> <ul style="list-style-type: none"> • 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 <p>The following do not individually constitute a RAS:</p> <ul style="list-style-type: none"> • Protection Systems installed for the purpose of detecting Faults on BES Elements and isolating the faulted Elements

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Term	Description
	<ul style="list-style-type: none"> • 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)	<p>The value (such as MW, MVA, 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:</p> <ul style="list-style-type: none"> • 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)
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.

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Term	Description
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.
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

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	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.

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Version History

Version	Change	Date
1.0	Approved by Steering Committee.	9/26/18

5. Periodic Review Procedure

Appendix

RC0310A – Non-IROL Stability Limits (Restricted)