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		Version No.	8.1
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Establishing System Operating Limits for the Operations Horizon		Distribution Restriction: None	

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Purpose

The NERC FAC-011-4 Standard requires that the Reliability Coordinator have a documented methodology for use in developing SOLs (SOL Methodology) within its Reliability Coordinator area. This document provides implementation details on how the California ISO applies the RC West SOL Methodology to the California ISO Controlled Grid to meet NERC FAC-014-3 R2 in establishing SOLs for the Operations Horizon. The Operations Horizon is defined as a rolling 12-month period starting at Real-Time (now) through the last hour of the twelfth month into the future, including the following Sub-horizons: Seasonal, Outage Planning, Next-day, Same-day, and Real-Time.

1. Responsibilities

CAISO System Operator	Hold authority, as delegated by the executive officers of the CAISO, to take or direct timely and appropriate Real-Time actions necessary to ensure reliable operation of the CAISO Controlled Grid, up to and including shedding Firm Load to prevent or alleviate System Operating Limit or Interconnection Reliability Operating Limit exceedance, comply with NERC and WECC Standards, and follow the reliability criteria and guidelines in this procedure.
CAISO Operations Engineering Services	Follow the reliability criteria and guidelines in this procedure when performing engineering studies and establishing System Operating Limits (SOLs) during the Operations Horizons and all Operations Sub-Horizons Real-Time.

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2. Scope/Applicability

2.1. Background

Applicable Reliability Standards

This implementation document is based on the North American Electric Reliability Corporation (NERC) Reliability Standards FAC-014 R2 and is in accordance with the Reliability Coordinator’s System Operating Limits (SOL) Methodology for the Operations Horizon.


2.2. Scope/ Applicability

This SOL implementation document is applicable to the CAISO Controlled Grid in establishing System Operating Limits for the Operations Horizon.

TTCs, SOLs, IROLs, and CPs

- WECC Paths do not have single uniquely monitored SOLs unless the WECC Path is associated with an established transient or voltage stability limit; however, WECC Paths that are associated with scheduling **limits** will continue to have a Total Transfer capability (TTC). TTCs would never exceed the WECC Path Rating for the respective paths.
- All operating limits, including Facility Ratings,¹ Transient Stability Limits, Voltage Stability Limits and Voltage Limits are designated SOLs to the California ISO in the Operations Horizon.
- A subset of the SOLs, which, if exceeded, could cause severe impacts on neighboring Balancing Authorities (BAs) and/or Transmission Operators (TOPs), will be coordinated with the RC to be considered as Interconnection Reliability Operating Limits (IROLs). These severe impacts include instability, uncontrolled separation, and cascading outages.
- A Control Point (CP) provides a MW guideline for operators to control the transmission grid in order to mitigate any potential SOL exceedances. The guideline is indicative of when potential SOL exceedances may appear in real-time assessments.
- CPs and TTCs are not SOLs. CP is normally established during Operations Planning or Day-Ahead time horizon; as such, it is established using certain system assumption (such as expected system topology and generation dispatch). As a result, exceeding control point does not always equate to SOL exceedance, because the RC SOL methodology defines SOL exceedance as a state of the system as defined by Real-Time Assessment.

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Note¹: As specified by the associated Participating Transmission Owners facility rating methodology.


3. Procedure Detail

3.1. Acceptable System Performance and Response

An SOL represents a value (such as MW, Mvar, Amperes, Frequency or Volts) that satisfies the most limiting operating criteria for a specified system configuration to ensure operation within acceptable operating criteria. These criteria include, but are not limited to, the following:

- Thermal limits are provided to the California ISO by the Participating Transmission Owners (PTOs)¹ and are documented in the CAISO Transmission Register² or in PTO Operating Procedures provided to the CAISO:
 - In pre-contingency analysis, the CAISO utilizes continuous/normal ratings of the monitored elements in establishing SOLs.
 - In post-contingency analysis, the CAISO utilizes short-term ratings³ of the monitored elements in establishing SOLs. If a short-term rating is not available, the CAISO will utilize the normal/continuous rating.
- Transient stability limits are established as pre-contingency SOLs on paths, cut planes or interfaces to facilitate monitoring in both operational planning studies and real-time operations. Paths, cut planes or interfaces should be clearly defined and the metering point should be identified.
- Voltage stability limits are established as pre-contingent SOLs on paths, cut planes or interfaces to facilitate monitoring in both operational planning studies and real-time operations.
- System voltage limits are provided to the CAISO by Participating Transmission Owners (PTOs) as listed in CAISO Operating Procedure [3100B System Voltage Limits and Credible Multiple Contingency List](#).
- An Interconnection Reliability Operating Limit (IROL) is a System Operating Limit (SOL) that, if exceeded, could lead to instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the Bulk Electric System (BES).
- In accordance with the Coordinated Functional Registration, the CAISO in coordination with the Participating Transmission Owners, calculates and establish SOLs based on the most restrictive of the above four criteria as determined by pre-contingency analysis, single-contingency analysis, and Credible Multiple Contingency analysis.

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Note¹: Normal/Continuous and short-term rating provided by PTO may reflect limitation on the protection system in the equipment, which could be more limiting than the actual thermal capability of the transmission line/transformer.

Note²: The CAISO Transmission Register (TR) is the official rating source for the CAISO. Any modifications to existing ratings used for real-time operations must be documented in the TR or a written PTO procedure.

Note³: Including an associated duration applicable to the short-term rating.

3.1.1. Acceptable System Performance for Pre-Contingency State


In the pre-contingency state under conditions that reflect current or expected system conditions and system topology, acceptable system performance for the pre-contingency state in the Operations Horizon is characterized by the following [NERC Standard FAC-011-4 R6.1]:

- Steady state flow through all Facilities shall be within their normal Facility Ratings. Emergency Ratings may be used when System adjustments to return the flow within its Normal Rating could be executed and completed within the specified time duration of those Emergency Ratings (Refer to Figure 1: SOL Performance Summary for Facility Ratings below.) [NERC Standard FAC-011-4 R6.1.1].
- Steady state voltages of all Facilities shall be within their normal System Voltage Limits, and emergency System Voltage Limits may be used when System adjustments to return the voltage within its normal System Voltage Limits could be executed and completed within the specified time duration of those emergency System Voltage Limits [NERC Standard FAC-011-4 R6.1.2].
- Predetermined stability limits are not exceeded [NERC Standard FAC-011-4 R6.1.3].
- Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur [NERC Standard FAC-011-4 R6.1.4].

3.1.2. Acceptable System Performance and Response for Single and Credible Multiple Contingencies

Following a single or Credible Multiple Contingency, acceptable system performance for the post-contingency state for single and Credible Multiple Contingencies (MCs) in the Operations Horizon is characterized by the following (NERC Standard FAC-011-4 R6.2):

- All Facilities¹ shall be within applicable emergency Facility Ratings. Steady state post-Contingency flowthrough a Facility must not be above the Facility's highest Emergency Rating. (Refer to Figure 1: SOL Performance Summary for Facility Ratings below.)

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[NERC Standard FAC-011-4 R6.2.1]

- All Facilities shall be within their emergency System Voltage Limits [NERC Standard FAC-011-4 R6.2.2].
- All Facilities shall be within their Stability Limits [NERC Standard FAC-011-4 R6.2.3].
- Instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System does not occur [NERC Standard FAC-011-4 R6.2.4].

A Single Contingency is defined as any of following [NERC Standard FAC-011-4 5.1.1]:

Loss of any of the following, either by single phase to ground or three-phase Fault (whichever is more severe), with Normal Clearing or without a Fault:


- Generator;
- Transmission circuit;
- Transformer;
- Shunt device; or
- Single pole block in a monopolar or bipolar high voltage direct current system

Please note that a Single Contingency may impact one or more facilities due to system configuration or protection settings. The following Contingencies at a minimum are applicable for TOP assessments within the Operations Horizon:

- Single P1 Contingencies internal to the TOP Area
- Credible MCs internal to the TOP Area
- Any Single P1 Contingencies and Credible MCs external to the TOP Area that are known to or may impact the TOP Area or system under study, as determined by the TOP. TOPs are responsible for determining whether Contingencies outside their TOP Area impacts them and for determining the external modeling necessary to support the evaluation of those Contingencies in their assessments.

Planned manual load shedding is acceptable only after all other available System adjustments have been made, provided the Contingency would not result in instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System [NERC Standard FAC-011-4 R6.4]. If the required System adjustments could impact delivery of energy to an energy deficient Balancing Authority in EEA 3, the RC would accept an Operating Plan that includes planned manual or automatic post-Contingent load shedding, provided the Contingency would not result in instability, Cascading or uncontrolled separation that adversely impact the reliability of the Bulk Electric System. This evaluation will be coordinated with any impacted TOPs and/or RCs [NERC Standard EOP-011-2 Attachment 1].

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The following, Figure 1: SOL Performance Summary for Facility Ratings provides an example of acceptable pre- and post-Contingency performance for a sample set of Facility Ratings.

Note: The Facility Ratings shown in the example are selected for illustration purposes only.

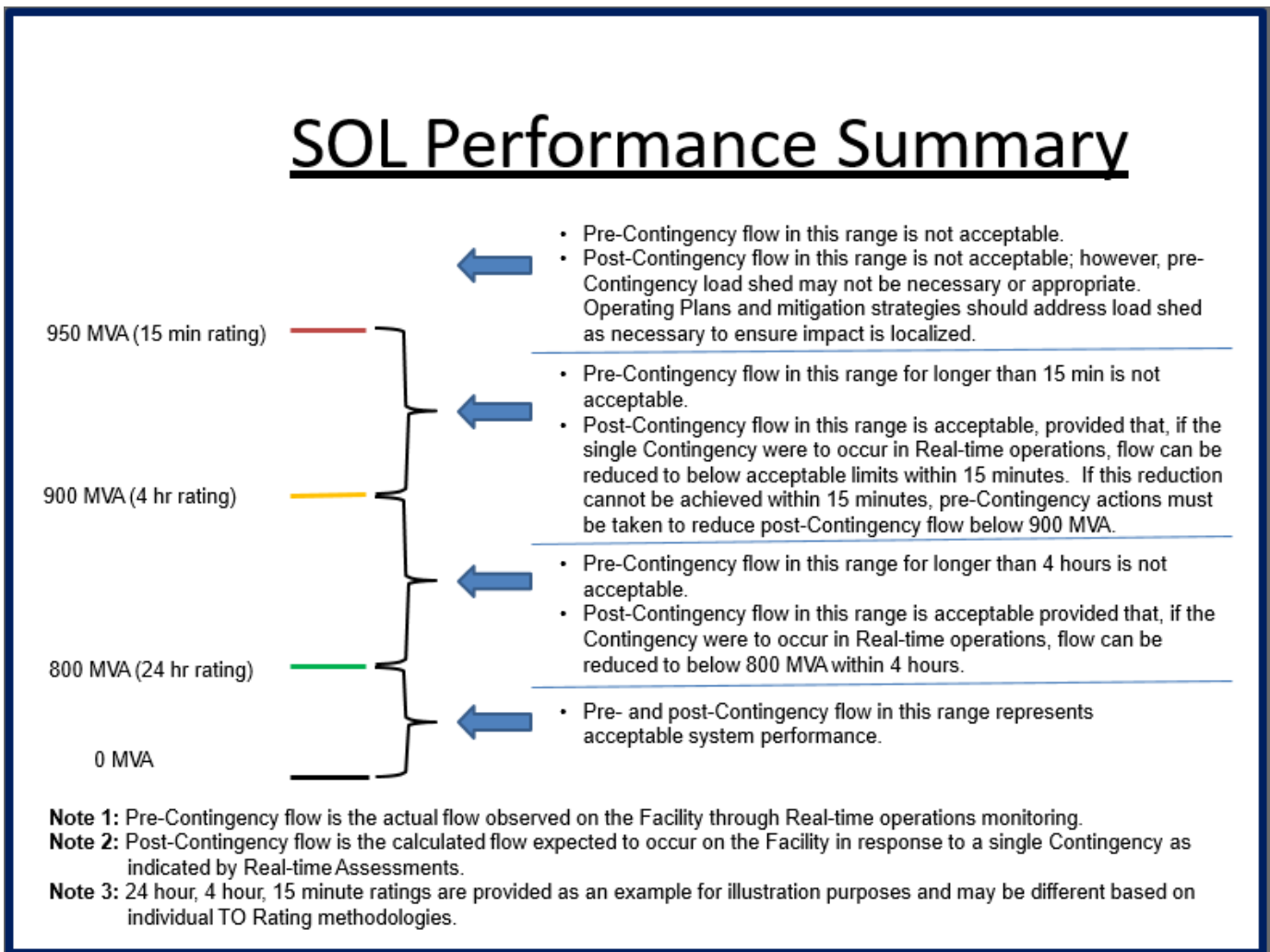



Figure 1: SOL Performance Summary for Facility Ratings

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As required by the RC West SOL Methodology for the Operations Horizon, the CAISO must determine which Multiple Contingencies in its TOP area are credible for the operations horizon by working with the:


- Planning Coordinators (PCs)
- Transmission Owners (TOs)
- Generator Owner (GO)
- Transmission Planner (TP)
- Referencing the applicable NERC/WECC Standard(s) (TPL-001-WECC-CRT-3.2, etc.). The comprehensive list of Credible Multiple Contingencies applicable to the California ISO are included in CAISO Operating Procedure [3100B System Voltage Limits and Credible Multiple Contingency List](#).

Credible MCs for the Operations Horizon will be broadly considered to fall into two categories – those that are “Always Credible” and those that are “Conditionally Credible.”

Conditionally Credible MCs become Credible when the Conditionally Credible MC poses a risk to reliability due to a known, foreseeable or observable threat. The TOP in whose TOP Area the MC Facilities reside is responsible for determining when a Conditionally Credible MC becomes Credible and when it ceases to be Credible. When a Conditionally Credible MC becomes Credible, the TOP in whose TOP Area the MC Facilities reside must notify the RC and other TOPs known or expected to be impacted by the Conditionally Credible MC. The TOP in whose TOP Area the MC Facilities reside must collaborate with the RC and impacted TOPs to create and implement an Operating Plan (or to implement a pre-determined Operating Plan) to address the known and observable risk associated with the Conditionally Credible MC. Impacted TOPs and the RC are expected to include the Conditionally Credible MCs in their respective studies while the Conditionally Credible MC is Credible. When Conditionally Credible MCs become Credible and the MC impacts multiple TOPs, the RC will collaborate with impacted TOPs to ensure that the MC is being addressed in a coordinated manner.

For a specific Credible MC, impacted TOPs may coordinate with the RC to allow less stringent performance criteria that does not result in System-wide instability, Cascading or uncontrolled separation.

The CAISO shall coordinate with impacted TOPs and establish adequate plans, processes, and procedures to contain and mitigate the impacts.

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3.2. Study Model

- The CAISO utilizes both the Full Network Model (which includes the WECC area's full loop model) and the approved WECC Regional Entity Operating Base Cases for establishing, calculating and monitoring SOLs/IROLs in the Operations Horizon. These cases are updated periodically to reflect expected system topology based on known and reported facility outages and upgrades.
- The CAISO's Full Network Model contains detailed representations of all the CAISO controlled facilities, including sub-100 kV facilities, (with proper equivalence, i.e., some loads fed by radial lines are lumped at the delivery bus) and the representations of the WECC area's full loop model.

3.3. Reliability Criteria and Guidelines for Determining SOLs and IROLs


The following criteria and guidelines will be applied in determining SOLs and IROLs to ensure the acceptable system performance is maintained following single and Credible Multiple Contingencies.

3.3.1. Determining Post-Contingency Steady State Limits

- Following a single or Credible Multiple Contingency, the flow on all Facilities² must be within their short-term facility ratings and thermal ratings, and post-contingency voltage limits. In addition, voltage instability, cascading outages, or uncontrolled separation must not occur. The thermal rating for post-contingency operation is defined as the short-term thermal rating (if a short-term rating is not available, the CAISO will utilize the normal/continuous rating).
- Post-contingency steady state voltage limits and guidelines in CAISO Operating Procedure [3100B System Voltage Limits and Credible Multiple Contingency List](#) are applied.
- In the post-contingency steady-state assessment, manual system reconfiguration, automatic control, or special protection scheme actions are allowed if it has been proven that these adjustments can be done in a timely manner and will be sufficient to prevent the system from equipment damage, voltage collapse, Cascading outages, or uncontrolled separation. This includes automatic voltage regulators, automatic fast-switched shunt capacitors, and special protection scheme actions.

² Except for CAISO BA Controlled Area per the CFR Appendix 1, generator step-up transformers, and exclusions denoted in [NERC BES reference document](#).

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3.3.2. Post-Transient Analysis Methodology

The post-transient period is the timeframe after any initial swings and transient effects of a disturbance are over, but prior to AGC or operator actions. Post-transient analysis is performed through a governor power flow study.

1. The starting point of the analysis is the system condition with the event modeled and taking into account the effects of allowable automatic actions as described in the Allowed Uses of Automatic Mitigation Schemes in the Operations Horizon section of the SOL Methodology, e.g., UVLS, UFLS and RAS actions.
2. Impacts of the composite load model as observed in transient analyses shall not be included in the post-transient analysis since the restoration of this load is not under the control of operating personnel. For example, a transient study indicates that a Contingency results in load being lost due to composite load model behavior in the transient timeframe. When performing a subsequent post-transient analysis of that Contingency, the load shall not be reduced by the amount of expected loss that occurred in the transient analysis in response to the composite load model.
3. The Contingencies being studied shall be run with the area Interchange controls and phase shifters controls disabled. Tap-Changer Under Load (TCUL), shunt capacitors and Static VAR Compensators (SVC) that are automatically controlled may be allowed to switch provided the automatic control settings are accurately modeled and the devices will switch within 20 seconds or less.¹ Generators and SVCs shall be set to regulate the terminal bus voltage unless reactive droop compensation is explicitly modeled or SVC control signals are received from a remote bus.

RAS actions shall be accounted for by taking the same specific actions as the RAS, i.e., the same generators will be tripped and the same loads disconnected. Loss of generation shall be accounted for in the power flow by scaling up the generation in the interconnected system, with PMax limits imposed, excluding negative generators and negative loads. Any increase or decrease in generation shall be done on the weighted MW margin (up/down range) or the closest equivalent based on the program used. Alternatively, units may respond in proportion to the nameplate ratings. Base-loaded units must be blocked from responding.

Note¹: The 20-second reaction time for switchable reactive devices is to ensure coordination with generator Maximum Excitation Limiter (MEL) settings. Typical MEL's will begin to reduce a generator's reactive output to safe operating levels within a 20-second window. Reference IEEE Recommended Practice for Excitation System Models for Power System Stability Studies, IEEE Std. 421.5-2005 (Revision of IEEE Std. 421.5-1992), 2006, pp. 0_1–85.

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3.3.3. Determining Voltage Stability Limits

1. Voltage stability limits are SOLs. Voltage stability limits are established using transient (for fast voltage collapse risks) and post-transient analysis techniques. One representation of a voltage stability limit is the maximum pre-Contingency megawatt power transfer for which a post-Contingency solution can be achieved for the limiting (critical) Contingency (i.e., the last good solution established the voltage stability limit). P-V and V-Q analysis techniques are used as necessary for the determination of voltage stability limits. While megawatt power transfer represents one approach for defining a voltage stability limit, other units of measure (such as VAR limits) may be used, provided this approach is coordinated between the TOP and the RC. Reference Figure 2: Sample P-V Curve as an example of a MW power transfer approach to defining a voltage stability limit.
2. The voltage stability limit does not include operating margins. Operating margins are specified in the corresponding Operating Plans.
3. If TOP or the RC post-transient analyses are technically accurate yet the results of the studies do not agree (i.e., if one TOP's analysis results differ from another TOP's analysis results, or if a TOP's analysis results differ from the RC's analysis results), then the most limiting analysis results are used as a default if the differences cannot be worked out.


Reference Figure 2: Sample P-V Curve below for an example of a PV curve for determining voltage Stability Limits.

Communication of Voltage Stability Limits

1. When TOP studies indicate the presence of voltage instability risks (whether contained or uncontained), the TOP shall communicate the study results to the RC and to impacted TOPs for further review. This communication should occur in a timely manner to allow for proper coordination and preparation prior to Real-Time operations.

Voltage stability limits shall be communicated per the posted RC instructions.

See Figure 2: Sample P-V Curve on the following page.

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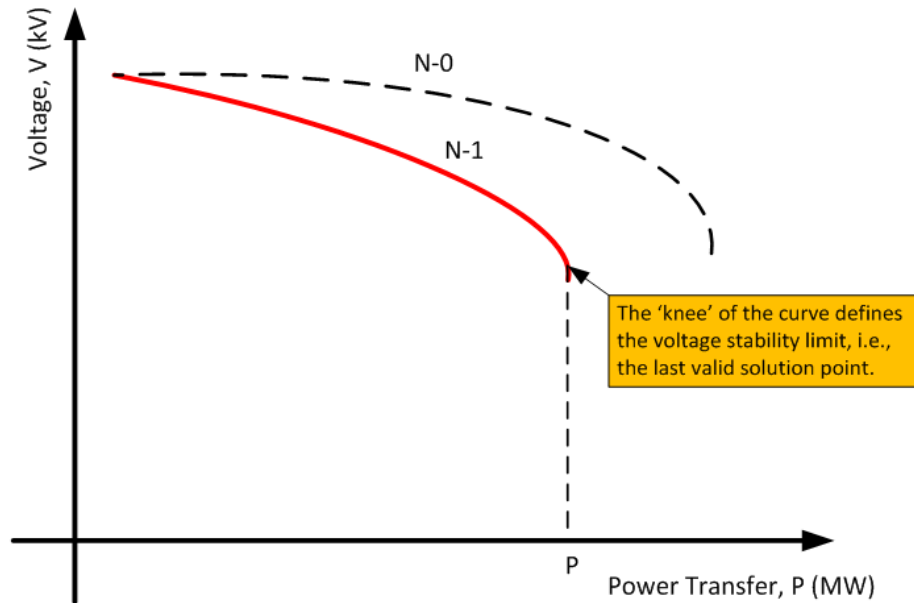



Figure 2: Sample P-V Curve

3.3.4. Determining Transient Stability Limits


1. It is up to the TOP and/or the RC to determine if and what types of operational transient studies are required for a given season, planned outage or operational scenario. For example, if a TOP or the RC determines, based on experience, engineering judgment and knowledge of the system, that a planned transmission or generation outage might pose a risk of transient instability for the next worst Single P1 Contingency or Credible MC, the TOP should perform the appropriate transient analyses to identify those risks.
2. If an allowable UVLS, UFLS or a RAS is relied upon to address a transient instability phenomenon, the transient analysis must include the actions of these schemes to ensure that the schemes adequately address the reliability issues. Associated study reports or Operating Plans must include a description of the actions and timing of these schemes.
3. Transient studies must model applicable Facility outages that are planned for the period of the study and must use appropriate load levels.

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4. Available peak and off-peak (light load) loading conditions should be screened for the period under study to determine the conditions under which instabilities occur. The TOP and/or the RC may run studies on only those specific set of conditions for subsequent studies. The intent is to do due diligence to identify instability risks for both expected heavy-load conditions and expected light-load conditions.
5. Single P1 or Credible Multiple Contingencies shall include the more severe or impactful of single line-to-ground Faults or three-phase Faults as determined by the TOP or the RC.
6. Three-phase and single line-to-ground Faults will be simulated at no more than 10 percent from each point of connection with bus, or the more severe of the high or low side of an autotransformer.
7. The Fault duration applied should be based on the total known Fault clearing times or as specified in the corresponding planning studies for the applicable voltage level. For Credible MC events, the appropriate clearing times must be modeled.
8. Transient analysis must extend for at least 10 seconds following the initiating event or longer if swings are not damped.
9. The dynamics parameter file used for transient studies shall be based upon the approved WECC dynamics file with the following additions: a generic mho distance relay model that is set for all Facilities 100 kV and above with zone 1 setting of 80 percent, a zone 2 setting of 120 percent with a 24 cycle delay and a zone 3 setting of 140 percent with a 36 cycle delay shall be included in the dynamics model file. These relays shall be set to “non-tripping” mode. Any actions by relay models during a simulation must be investigated and, if warranted, specific relay models and settings applied. Entities may modify the generic step distance relay settings specified above to reflect their protection philosophy.
10. A generic voltage and frequency ride-through relay model should be installed on all generators at the point of interconnection that models the voltage and frequency ride-through capabilities specified in PRC-024-3. This generic relay may be set to “non-tripping” but any actions by the relay must be checked against the unit actual tripping settings and the appropriate actions taken. For generators for which the GO has provided exceptions to the requirements of PRC-024-3 under requirement R3, the specific tripping points must be modeled and any appropriate actions taken.
11. The buses monitored for transient system performance should be determined based on engineering judgment.

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Transient Analysis Performance Requirements

Transient system performance requirements are indicated in Table 1, below.

Table 1: Transient System Performance Requirements

Transient System Performance	Required for Single and Credible Multiple Contingencies
<p>The system must demonstrate positive damping. The system is considered to demonstrate acceptable positive damping if the damping ratio of the power system oscillations is 3% or greater. The signals used generally include power angle, voltage and/or frequency.</p> <p>There may be instances where it is prudent to allow for a damping ratio less than 3%. In such cases, studies must demonstrate that the damping provides for an acceptable level of reliability.</p>	Yes
<p>The BES must remain transiently stable, and must not Cascade or experience uncontrolled separation as described in the SOL Methodology. System frequency in the interconnected system as a whole must not trigger UFLS. Any controlled islands formed must remain stable.</p>	Yes
<p>Transient voltage or frequency dips and settling points shall not violate in magnitude and duration:</p> <ol style="list-style-type: none"> 1. Generator ride-through capabilities as specified by PRC-024-3; no BES generating unit shall pull out of synchronism (or trip) in response to transient system performance 2. UFLS shall not be triggered as outlined in Planning Coordinator's UFLS program. 3. Nuclear plant interface requirements. 4. Known BES equipment trip or failure levels, e.g. surge arrestors, transformer saturation levels, generator over-excitation. 	Yes

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Establishment of Transient Stability Limits

1. Transient stability limits are established to meet the transient system performance requirements in Table 1: Transient System Performance Requirements.
2. Transient stability limits do not include operating margins. Operating margins are specified in the corresponding Operating Plans.
3. If TOP or RC transient analyses are technically accurate yet the results of the studies do not agree (i.e., if one TOP's analysis results differ from another TOP's analysis results, or if a TOP's analysis results differ from the RC's analysis results), then the most limiting analysis results are used as a default if the differences cannot be worked out.

Communication of Transient Stability Limits

When TOP studies indicate the presence of transient instability risks (whether contained or uncontained), the TOP shall communicate the study results to the RC and to impacted TOPs for further review. This communication should occur in a timely manner to allow for proper coordination and preparation prior to Real-Time operations.


3.3.5. Determining SOLs Affecting Other TOPs

When an SOL is identified that would affect other and adjacent TOPs, the CAISO will notify and coordinate with the impacted TOPs to determine SOL value and develop mitigation plans, processes and procedures. If there is disagreement between the CAISO and the impacted TOPs on the value of the SOL, the most conservative value shall be used until the issue is resolved.

3.3.6. Determining SOLs that Qualify as IROLs

IROLs are distinguished from SOLs in a few ways:

1. An IROL is a subset of SOLs that is associated with instability, uncontrolled separation or Cascading. SOLs include a broader set of limitations including Facility Ratings and System Voltage Limits, and certain non-IROL stability limitations.

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2. IROL exceedance is associated with a heightened risk to the reliability of the BES. The reliability consequences associated with exceeding an IROL are more severe and adversely impactful than the reliability consequences associated with exceeding an SOL that is not an IROL. This distinction is seen in the following:
 - a. Per the NERC Reliability Standards, an IROL carries with it a required mitigation time, the IROL T_v , which can be no longer than 30 minutes. When an IROL is exceeded, the NERC Reliability Standards require that the IROL be mitigated within the IROL T_v .
 - b. While the NERC Reliability Standards require that any SOL exceedance identified in Operational Planning Analyses must have an associated Operating Plan, the standards require that IROLs have an Operating Plan/Process/Procedure that contains steps up to and including load shedding to prevent exceeding the IROL.
3. IROLs should be established such that when an IROL is exceeded, the Interconnection has entered into an N-1 or Credible N-2 insecure state, i.e., the most limiting single P1 Contingency or Credible MC could result in instability, uncontrolled separation or Cascading outages that adversely impact the reliability of the BES.

By definition, IROLs are SOLs that could lead to any of the following three operational phenomena:

- Instability
- Uncontrolled separation
- Cascading outages


Instability

Transient or voltage instability that cannot be demonstrated through studies to be confined to a localized, contained area of the BES effectively has a critical impact on the operation of the Interconnection, and therefore warrants establishment of an IROL.

Uncontrolled Separation

Uncontrolled separation (which includes uncontrolled islanding) occurs when studies indicate that a Contingency is expected to result in rotor angle instability or to trigger relay action, which causes the system to break apart into major islands in an unintended (non-deliberate) manner. The determination of uncontrolled separation takes into consideration transient instability phenomena and relay actions that cause islands to form.

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It is recognized that transient instability may result in the loss of small pockets of generation and load, or radially connected subsystems that do not warrant establishment of an IROL and do not constitute a violation of the Credible MC performance requirements stated in section entitled Performance Requirements for Always Credible and Applicable Conditionally Credible MCs. In such scenarios, the loss of a unit (or group of units) may have little to no impact on the reliable operation of the interconnected system.

Uncontrolled separation can be understood by comparing it to the following description of controlled separation:

1. Controlled separation is achieved when there is an automatic scheme that exists and is specifically designed for the purposes of:
 - Intentionally separating the system.
 - Note that such schemes may be accompanied by generation drop schemes or UFLS that are designed to shed load or drop generation to achieve generation/load equilibrium upon occurrence of the controlled separation.
 - Intentionally mitigating known separation conditions.
 - I.e., a scheme that is designed specifically to drop load or generation to achieve generation/load equilibrium upon a known Contingency event that poses a separation risk.
2. Post-Contingency islanding due to transmission configuration does not constitute uncontrolled separation.
 - There are occasions where planned or forced transmission outages can render the transmission system as being configured in a manner where the next Contingency (single P1 Contingency or Credible MC) can result in the creation of an island. Operators are made aware of these scenarios through outage studies, OPAs and/or RTAs, and are expected to have Operating Plans that would address the condition in a reliable manner. Such conditions should consider the associated risks and mitigation mechanisms available; however, they are excluded from the scope of uncontrolled separation for the purposes of IROL establishment.
3. Examples of controlled separation:
 - Example 1: A RAS is designed specifically to break the system into islands in an intentional and controlled manner in response to a specific Contingency event(s). Supporting generation drop and/or UFLS are in place to achieve load/generation equilibrium.
 - Example 2: A UFLS is specifically designed to address a known condition where a Credible MC is expected to create an island condition.

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Cascading


Cascading can occur when studies indicate that a Contingency results in severe loading on a Facility, triggering a chain reaction of Facility disconnections by relay action, equipment failure or forced immediate manual disconnection of the Facility (for example, due to line sag or public safety concerns). Per the definition, when Cascading occurs, the electric service interruption cannot be restrained from sequentially spreading beyond an area pre-determined by studies.

Instability can cause Cascading. When Cascading is a response to instability, the Cascading will be addressed via a stability-related IROL.

Cascading test – If powerflow studies indicate that the successive tripping of Facilities stops before the case diverges, then by definition, the phenomenon is not considered to be Cascading, because the studies have effectively defined an “area predetermined by studies.” However, if the system collapses during the Cascading test, the area cannot be “predetermined by studies,” and therefore it is concluded that the extent of successive tripping of elements cannot be determined. When this is the case, an IROL is warranted.

Powerflow Cascading Test:

1. Run Contingency analysis and flag single P1 Contingencies and Credible MCs that result in post-Contingency loading in excess of the lower of:
 - a) The Facility(ies)'s trip setting.
 - b) 125 percent of the highest Emergency Rating.
2. For each flagged Contingency, open both the contingent element(s) that cause(s) the post-Contingency loading and all consequent Facilities that overload in excess of (a) or (b) above. Run powerflow.
3. Repeat Step (1) for any newly overloaded Facility(ies) in excess of (a) or (b) above. Continue with this process until no more Facilities are removed from service or until the powerflow solution diverges.
4. If the subsequent tripping of Facilities stops prior to case divergence, then it can be concluded that the area of impact is predetermined by studies, and thus Cascading does not occur. If the case diverges during the Cascading test, then it can be concluded that Cascading occurs.

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3.3.7. Criteria for Nuclear Power Interface Requirement

Diablo Canyon Power Plant (DCPP) is the only Nuclear Power Plant within the CAISO TOP area. The voltage requirements (both steady state and transient) for DCPP are considered as SOLs.

The specific voltage requirements for DCPP are specified under the corresponding Nuclear Plant Interface Requirements (NPIRs) and listed in CAISO Operating Procedure [3100B System Voltage Limits and Credible Multiple Contingency List](#).

3.3.8. Exception to these Criteria

Exception to the above criteria should only be allowed with permission of the owner of the impacted facilities. In addition, exception should only be allowed if there is no widespread impact and it does not conflict with RC West RC SOL Methodology for the Operations Horizon and applicable NERC Reliability Standards.

3.3.9. Re-assessing and Updating CPs/SOLs/IROLs

Although SOLs are established based on the anticipated transmission system configuration, generation dispatch, and load level, the system condition may still be different than the anticipated conditions as time progresses toward Real-Time, including in Real-Time. The CAISO may reassess the anticipated system conditions and perform new studies at any time up to Real-Time (to establish new CPs/SOLs/IROLs) or revise the existing SOLs if the anticipated system conditions are significantly different from those in the previous studies. The revised CPs/SOLs/IROLs can be higher or lower than those established in the previous studies (including seasonal studies, outage studies, or procedure studies), even for the same contingency and limiting element.

3.4. CP/SOL/IROL Documentation in CAISO Operating Procedure

CP/SOL/IROL that may be observed until real-time operations are identified during seasonal assessments and documented in CAISO Operating Procedures. Each operating procedure would contain tables in the specified format as illustrated in Table 1 or Table 2 below where the CP/SOL/IROL would be monitored using CP/SOL/IROL equations for thermal and in some instances for voltage issues in addition to monitoring in Real-Time Contingency Analysis (RTCA) or Voltage Stability Analysis Tool. Control Points will be verified in RTCA before mitigation.

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Table 1: Control Points/System Operating Limits/Interconnection Reliability Operating Limit (Option 1)

CP/SOL/IROL#	Transmission Facilities	CP/SOL/IROL (MW)		Stability, Thermal, or Voltage	a) Contingency b) Limiting Factors	a) Contingency Name/Flowgate Name b) Nomogram Name c) FlowgateName (for single line flow monitoring)
		Summer	Winter			

Table 2: Control Points/System Operating Limits/Interconnection Reliability Operating Limit (Option 2)

CP/SOL/IROL#	Transmission Facilities	CP/SOL/IROL (MW)	Stability, Thermal or Voltage	a) Contingency b) Limiting Factors	Contingency / Nomogram Name
				a) b)	


The column “Transmission Facilities” contains the list of facilities, flow limit, path, cut plane, or interface that will be monitored.

The column CP, SOL, or IROL contains the MW guideline where RTCA or Voltage Stability Analysis Tool is expected to report a potential overload and indicates if the limit is an SOL or an IROL and the applicable season.

The Column “Stability, Thermal or Voltage” contains limit type as follows:

- Stability limit can be due to transient stability or voltage stability.
- Thermal limit is due to thermal equipment of the facilities.
- Voltage limit is due to steady state voltage limit or voltage deviation criteria.

The column “Contingency and Limiting Factor” contains the information on the contingent element and the limiting elements that are to be protected by the SOL established.

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The column “Contingency/Nomogram/Flowgate Name” contains the information on how the potential congestion, CP, SOL, or IROL are being managed and respected in the CAISO Security Constrained Economic Dispatch tool.

In addition to Tables 1 and 2, each procedure contains facility ratings as illustrated in Table 3 or Table 4. These tables include the Facility/thermal capability of the lines and includes the time duration on which those ratings are derived for.


Table 3: Ratings Table (Option 1)

Transmission Facilities	Short Term Rating (MVA or Amps)	Short Term Rating Duration	Normal Ratings (MVA or Amps)	Short Term Ratings (MVA or Amps)	Short Term Rating Duration	Normal Rating (MVA or Amps)
	Summer			Winter		
230/115 Transformers						
60 kV Lines						
115 kV Lines						
230 kV Lines						

Table 4: Ratings Table (Option 2)

Transmission Facilities	Normal Ratings	Short Term Rating – 4 Hour (MVA or Amps)	Short Term Rating – 1 Hour (MVA or Amps)	Short Term Rating – 0.5 Hour (MVA or Amps)	Short Term Rating – 0.25 Hour (MVA or Amps)

Communication and sharing of the operating procedure containing SOL and IROLs will be sent to the Operationally Affected Parties including, but not limited to, the Participating Transmission Owner, Affected Neighboring BA/TOPs, and the Reliability Coordinator.

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3.5. CP, SOL, IROL, and Constraint Management in CAISO Market Application

CPs, SOLs, and IROLs that are established can be modeled as a transmission constraint within the CAISO Market System. This would allow the CAISO Market system to economically dispatch the resources while respecting established SOLs. Transmission constraints are modeled in the CAISO market to safeguard system reliability. Market applications automatically adjust system resources to relieve or mitigate any transmission congestion to avoid physical overload and/or other limit exceedances in the power systems as mandated by applicable industry reliability standards.

3.5.1. Transmission Constraints

Different types of transmission constraints may be appropriate depending on the operational circumstances. The commonly used transmission constraints are listed below:

- Normal flowgate ratings
- Emergency flowgate ratings from TR
- Nomogram limits and branch group limits
- Minimum online capacity (MOC, presently in day-ahead)
- Intertie scheduling limits (MSL or ITC)

Some of the major constraints and nomograms are defined at a high level in the BPM for Management of the Full Network Model and the BPM for Market Operations. Below are some additional details on the actions the CAISO can take in modeling a particular constraint through: 1) defining a contingency in the day-ahead/real-time markets, 2) adding a nomogram in the day-ahead/real-time markets and/or; 3) adding an MOC in the day-ahead market.


3.5.2. Application Considerations

The three modeling approaches discussed above are all methods to protect against or prepare the system for the next contingencies or N-1 contingencies.

3.5.2.1. Defining a Contingency

A Contingency can be incorporated into the CAISO market network model by opening certain breakers and/or disconnects that remove a transmission element. Once a Contingency is incorporated in the market applications, the market software can automatically run a power flow solution to verify that opening the breakers/disconnects will result in power flow on all

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monitored flowgates exceeding their respective emergency ratings. The market software would then economically dispatch resources to reduce/mitigate any overload.

A Contingency can be used when the potential reliability concern is limited to thermal overload issues only. Presently, the power flow algorithm in the market software only checks for over load conditions. It does not simulate voltage collapse or transient stability. Therefore, if there were reliability concerns other than thermal overloads such as voltage instability and transient instability, use of contingencies in the market would not be appropriate. A Contingency that removes supply or demand cannot be modeled because doing so disrupts the power balance. Other limitations of using a Contingency include lack of WECC full network model and RAS/SPS logic and pre-programmed actions.

Modeling of contingencies can occur in both day-ahead and real-time markets.

3.5.2.2. Nomogram Limits and Branch Group Limits

A nomogram is a linear expression of two or more variables. The most common use of a nomogram in the CAISO market is to model a combined loading limit on two or more circuits such that upon loss of one of the circuits, the remaining circuit would be above their respective emergency ratings. The limit is referred to as the right hand side (RHS) limit.

$$C1 * (\text{power flow on flowgate 1}) + C2 * (\text{power flow on flowgate 2}) + \dots < \text{RHS}$$

Coefficients C1 and C2 ... are pre-determined using offline power flow by operations engineers. For thermal overload constraint, C1 and C2 are also referred to as outage distribution factors or shift factors.


Nomograms are versatile and commonly used in the CAISO market to model various types of transmission constraint. They can be used for N-1 thermal overload reliability concerns as well as voltage collapse and transient instability concerns. When used for voltage collapse and transient stability limits, coefficients C1 and C2 ... are usually of value one (1).

Use of a nomogram is not limited to model a simple contingency. It can also be used when a contingency triggers RAS/SPS actions or results in loss of supply or demand. Nomograms are used in both Day-Ahead and Real-Time Markets.

3.5.2.3. Minimum Online Commitment (MOC)

Unlike contingencies or nomograms, an MOC is a constraint used in the Day-Ahead or Real-Time Markets to secure a minimum amount of capacity to be online at or above PMin in real-time. MOC is usually used to meet minimum reactive power margins required to protect against voltage collapse should the next contingency occurs in real-time. An MOC can also

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be used to provide minimum amount of inertia required to protect against transient instability in real-time.

3.5.3. Examples

Example 1: SDGE/CFE import branch group

Name: SDGE_CFEIMP_BG

Limit: RHS (less than or equal to) 1700 MW ~ 2100 MW

Purpose: This nomogram ensures that market applications automatically adjust system resources to mitigate from voltage instability in the CAISO controlled grid following loss of a contingency event.

Potential Market Impact: Congestion may occur on this constraint when the load is high and the generation is low in the local area enclosed by the branch group components. Local generation will be dispatched up to mitigate the congestion, resulting in positive congestion cost inside the branch group.

Example 2: SDGE import nomogram related to an outage: 1883001

Name: 1883001_SDGE_OC_NG

Limit: RHS (less than or equal to) 2408 MW

Purpose: This nomogram ensures that market applications automatically adjust system resources to be prepared to mitigate a voltage exceedance in the CAISO controlled grid should the most severe contingency in the area occur.

Potential Market Impact: Congestion may occur on this constraint when the load is high and the generation is low in the local area enclosed by the branch group components. Local generation will be dispatched up to mitigate the congestion, resulting in positive congestion cost inside the branch group.


Example 3: Miguel Banks nomograms related to an outage: 1883001

Names: 1883001 Miguel_BKS_NG, and 1883001 Miguel_BKS_NG_2

Limits: RHS (less than or equal to) 1400/1600 MW

Purpose: Working together, the above two nomograms ensure that market applications automatically limits the amount of pre-contingency flow on major transmission lines based on: 1) an adjustable limit depending on the amount of generation produced on active

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special protection scheme (SPS) and 2) up to a maximum flow level limit once generation on special protection scheme (SPS) reaches maximum level. The two nomogram limits are used to ensure post-contingency flow on the Miguel Banks remain below required levels in case of transmission contingency. Keeping the transmission grid intact is critical for reliability in southern California given the present system conditions with a significant amount of generation capacity unavailable in the region.

Potential Market Impact: When congestion occurs on these constraints, market applications will dispatch system resources to mitigate the congestion, resulting in positive and/or negative congestion costs on either side of the constraints.

3.5.4. Transmission Constraint Information Access

Detailed information on transmission constraints is available in the **Customer Market Results Interface (CMRI)**. CMRI is a secured information system that is accessible to market participants and parties who have a legitimate business need. **Please contact your company's User Access Administrator (UAA) for access. If you don't know who your company's UAA is, contact UAARRequests@caiso.com. If your company doesn't have a UAA, follow the UAA guide.**

3.6. Criteria and Guidelines for Mitigating SOL/IROL Exceedance


CAISO System Operators shall monitor the identified CPs, SOLs and IROLs in Real-Time and utilize the following criteria and guidelines to mitigate SOL/IROL exceedances. A Transmission Operator shall inform its Reliability Coordinator when an IROL or SOL has been exceeded and the actions being taken to return the system to within limits in accordance with [RC0610 System Operating Limits Methodology for the Operations Horizon](#) (TOP-001-6 R15).

3.6.1. Mitigating SOLs in Pre-contingency State

When an SOL is exceeded in pre-contingency state, it means that the system either is experiencing unacceptable pre-contingency performance or will experience unacceptable post-contingency performance if the corresponding contingency occurs. The system must be adjusted as soon as practicable to mitigate the SOL exceedance by taking pre-contingency actions, which include, at a minimum, the following:

- Commit and re-dispatch generation
- Adjust the use of the transmission system (e.g., schedule curtailments/adjustments)
- Make changes to system topology

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For any transient or voltage stability SOL, which has impacts on other TOPs but is not an SOL that qualifies as an IROL, the CAISO will coordinate with the impacted TOPs in developing plans, processes, and procedures to mitigate the SOL exceedance. Voltage limits can be found in the CAISO Operating Procedure [3100B System Voltage Limits and Credible Multiple Contingency List](#).

3.6.2. Mitigating SOLs in Post-contingency State

After a contingency occurs, the system may be in the following states:


1. Post-contingency Acceptable System Performance is not met. The System Operators shall take immediate actions to adjust the system to meet Post-contingency Acceptable System Performance.
2. All Post-contingency Acceptable System Performance is met; however, Pre-contingency Acceptable System Performance is not met. The System Operators shall take immediate actions to adjust the system to meet Pre-contingency Acceptable System Performance within the applicable time duration.
3. All Post-contingency Acceptable System Performance and Pre-contingency Acceptable System Performance criteria are met. However, studies indicate that the system will experience unacceptable post-contingency performance if another contingency is to occur. The system must be adjusted as soon as practicable to prepare for the next contingency.

3.6.3. Mitigating Thermal Limited SOLs

While there are stability or voltage limited SOLs within the CAISO system, the majority of the SOLs are established based on thermal limitations.¹ Given that no facility should be operated above its applicable thermal limits, an SOL may be monitored using a pre-contingency control point to ensure that following a contingency, all facilities remain within their applicable facility ratings. For these control points, CAISO System Operators must be aware of facilities being protected under their applicable facility ratings so that if the contingency occurs, they can take appropriate actions after verifying with RTCA.

Facility ratings are generally defined as normal or short-term with the distinction being that normal (continuous) ratings may be used continuously whereas use of short-term ratings is time limited. In addition, there may be multiple short-term ratings with different time limits applicable for their use. In all cases, ratings must have a time duration (whether continuous or other) specified for that rating.

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When a pre-contingency control point is established, it is important to understand that if the actual pre-contingency flow is at or near the control point, three scenarios exist for post-contingency flow (as illustrated in CAISO Operating Procedure [3100A Acceptable Thermal Performance Examples](#)):

- Post-contingency facility loading may be within normal ratings in which case no further action is necessary.
- Post-contingency facility loading may be above normal ratings, but within a defined short-term rating. In that case, the CAISO System Operator must verify with RTCA and then take whatever action is necessary to return facility loading to an applicable continuous rating within the time frame allowed by the short-term rating. For example, consider a line with the following ratings:


Description	Limit	Duration
Normal	800 MVA	Continuous
Short-term 4-hour	900 MVA	4 hour
Short-term 15-min	950 MVA	15 min

Assume the post-contingency loading of the line is 910 MVA. In this case, the line loading is within its 15-minute short-term rating and the System Operator has 15 minutes to return line loading to an appropriate lower level. In most cases, this will be to the 800 MVA normal rating; however, each Participating Transmission Owner defines short-term ratings based on its facility rating methodology and the conditions under which they may be applied. It is possible, for example, for the 15-minute rating to be based on returning the line loading to be within the 4-hour rating in 15 minutes and to be within the normal rating in an additional 4 hours.

For PG&E, SCE (Transmission line only) and SDGE (Transformer banks only) facilities, the facility rating methodology is to return the facility loading below the normal rating within the associated short-term rating duration. In the absence of specific instructions to the contrary as provided by PG&E and SCE, it is assumed that following a Contingency which loads some facility above its normal rating, but within a defined short-term rating, the facility loading must be returned below its normal rating within the time duration specified for the short-term rating in use.²

However, for facilities in SDG&E (Transmission line only), VEA and SCE (transformer banks only), the facility rating methodology is to return the facility loading below the next available lower short-term rating within the specified time duration, then to return the facility loading below the normal rating within additional time duration associated with the lower short-term rating. In the absence of specific instructions to the contrary as provided by SDG&E or VEA, it is assumed that following a contingency which loads some facility loading can be returned

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below the next available lower short-term rating within the associated time duration and then be returned below the normal rating within the additional time duration as specified for the lower short-term rating in use.³

- Post-contingency facility loading may be above all defined ratings. If pre-contingency loading was within the defined pre-contingency SOL, this should not be the case; however, if at any time any facility is loaded above its highest defined short-term rating, the System Operator shall take immediate actions to return the facility loading within its defined rating.

A clear distinction must be made between exceeding a pre-contingency control point that is verified in RTCA and exceeding all defined Facility Ratings. If a pre-contingency control point is being exceeded and has been verified in RTCA, actions must be taken to either reduce loading or mitigate the concern (such as checking with the facility owner to determine if higher short-term ratings can be applied based on current conditions). If some facility is loaded above all defined ratings for that facility, the System Operator must act immediately to reduce loading to within a defined rating.

If system conditions are such that the Contingency is imminent and there are no available resources to mitigate the flows, the System Operator should ensure that an adequate and timely plan exists to prevent Cascading outages. The System Operator needs to ensure, if utilized, that any post-contingency mitigation plans respect the time necessary to take mitigating actions, including control actions, to return the system to a secure state as soon as possible. If post-contingency mitigation cannot be implemented within the required time frame and the contingency could cause Cascading outages and wide spread impact, the System Operator should consider shedding load to return to the acceptable operating range.

Note¹: *Most Facilities are rated based on thermal limitations; however, some facilities may be rated based on relay settings. In these cases, the same philosophy that is applied to thermal ratings applies.*


Note²: *Meaning a rating with no time limit specified for its use, i.e., a rating that can be used continuously.*

Note³: *The rating in use is always the rating above the last rating exceeded.*

3.6.4. IROL Tv

The IROL Tv is the maximum time that an IROL can be violated before the risk to the interconnection or other Reliability Coordinator Area(s) becomes greater than acceptable. Within the CAISO BA, the default IROL Tv is 30 minutes. The shorter IROL Tv can be established according to the real-time operating conditions in coordination with other impacted TOPs based on relay/protection settings and other considerations.

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An IROL exceedance shall be mitigated in the pre-contingency state to prevent Cascading, voltage collapse, or instability in the post Contingency state. In Real-Time operations, after an IROL is confirmed to be exceeded by working with the RC and other impacted TOPs, the System Operators must take any appropriate actions, up to and including load shedding pre-contingency to bring the system below the IROL within the IROL Tv.

3.7. Study Guidelines for Conditionally-Credible Multiple Contingencies

Using the guidelines below, the PTO may choose to treat certain conditionally Credible Multiple Contingencies as Credible. The PTO will communicate its request for treatment of a conditionally Credible Contingency as Credible through WebOMS outage cards. When the PTO does this, the Contingency will be studied as Credible and the CAISO will coordinate with the impacted PTOs to determine if any mitigation actions are required.


The following guidelines are applied for the following conditionally Credible Multiple Contingencies:

1. Bus Section Contingencies

- Under system intact conditions at a bus (Meaning, either all buses or bus sections are in-service), a bus section Contingency will not be studied at the respective bus and no SOLs will be established unless requested to do so by the PTO. Bus section contingencies may be studied for situational awareness only.
- When a substation bus section or bus differential protection is abnormal as described below, the PTO may choose to treat a bus Contingency or a bus section Contingency as a Credible Multiple Contingency and will communicate its request for treatment of a conditionally Credible Contingency as Credible to CAISO to establish the corresponding SOLs:
 - a. Breaker Bypass & Clear resulting in switching elements to a common bus.
 - b. Bus 1 or Bus 2 clearance resulting in switching Bus 1 or Bus 2 elements to a common bus.
 - c. Non-redundant bus section differential protection cut-out such that remote tripping for a faulted bus also impacts the adjacent non-faulted bus
 - d. Connecting Bus 1 to Bus 2 by closing both bus selector switches resulting in Bus 1 and Bus 2 elements combined into a common bus differential protection zone.
 - e. Bus Differential Selector Switch in Switching Position, resulting in Bus 1 and Bus 2 elements combined into a common bus differential protection zone.

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2. Stuck Breaker Contingencies

- Stuck Breaker Contingencies will not be studied and no SOLs will be established. A Stuck Breaker Contingency may be studied for situational awareness only.

3. Common Tower Circuit Contingencies (230 kV and Below)

- Only the common tower circuit contingencies (230 kV and below) which are known to cause potential reliability issues to the studied area will be studied in the Operations Horizon to identify potential instability, uncontrolled separation, voltage collapse, or Cascading outage issues.
- The CAISO will coordinate with the impacted PTOs to determine if any actions are necessary to mitigate the impacts of instability, uncontrolled separation, voltage collapse, or Cascading outages.

4. Under certain conditions, such as the threat of fire or extreme weather, a non-credible Multiple Contingency may become Credible in the shorter sub-horizons. In such cases, the CAISO will coordinate with the impacted PTOs and communicate such information to the RC in a timely manner. The CAISO will coordinate with the affected PTOs to develop SOLs and mitigation plans, if needed.

3.8. Operations Horizon - Rolling 12-Month Period

The Operations Horizon is subdivided into sub-horizons that include Seasonal, Outage Planning, Next-day, Same-day, and Real-time. See the following figure:

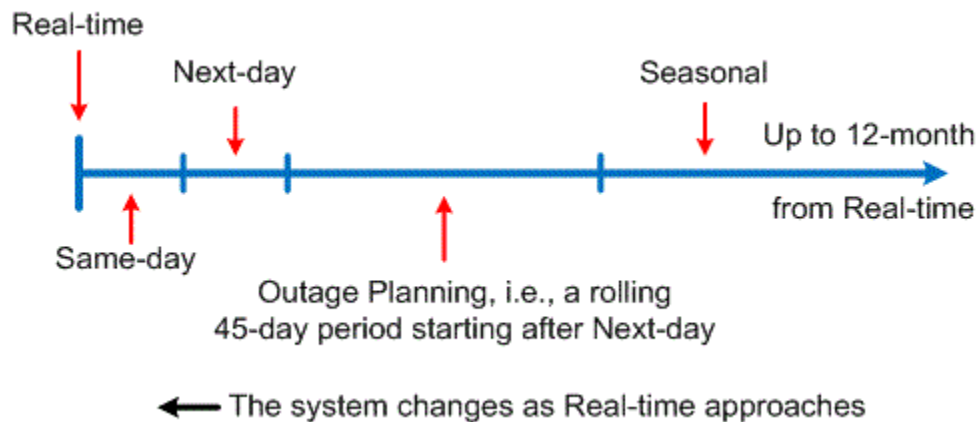



Figure 3: Operations Horizon - Rolling 12-Month Period

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4. Supporting Information

Operationally Affected Parties

Shared with the Public

References

Resources studied in the development of this procedure and that may have an effect upon some steps taken herein include but are not limited to:

CAISO Tariff	
CAISO Operating Procedure	
NERC Standards	FAC-011-4; FAC-014-3 TOP-001-6; TOP-002-4 VAR-001-5
WECC Criterion	TPL-001-WECC-CRT-4
Other References	RC West SOL Methodology: RC0610 System Operating Limits Methodology for the Operations Horizon


Definitions

Unless the context otherwise indicates, any word or expression defined in the Master Definitions Supplement to the CAISO Tariff shall have that meaning when capitalized in this Operating Procedure.

The following additional terms are capitalized in this Operating Procedure when used as defined below:


Credible	Meaning plausible (i.e., believable) with a sufficiently high degree of likelihood of occurrence.
Operations Horizon	A rolling 12-month period starting at Real-time (now) through the last hour of the twelfth month into the future. The Operations Horizon is subdivided into sub-horizons that include Seasonal, Outage Planning, Next-day, Same-day, and Real-time. See Figure 3, shown at the end of Section 3.8 .

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Multiple Contingency	The simultaneous failure of multiple system facilities that are physically or electrically linked in response to a single initiating event or common mode failure, e.g., common transmission tower failure, common right-of-way or breaker failure.
Transmission Path	Any defined grouping of BES facilities that are treated as a monitored power system element. Transmission Paths may include for example, paths internal to a TOP Area, paths spanning multiple TOP Areas, and paths defined by the list of "Major WECC Transfer Paths in the Bulk Electric System".
Regionally Critical Multiple Contingency	The contingency that is determined by the RC to have interconnection-wide impact (including but not limited to cascading, voltage collapse, and instability) and special circumstances which, considered together, supersede the determination of credibility by the TOPs. The special circumstances include historical performances and practices, system disturbances, system analysis, etc.
Single Contingency	The failure of any single element of facility that impacts one or more facilities as determined by prevailing zones of protection.
BA	Balancing Authority
BES	Bulk Electric System (aka North American Bulk Electric System)
GO	Generation Owner
IROL	Interconnection Reliability Operating Limit
NERC	North American Electric Reliability Corporation
NPIR	Nuclear Plant Interface Requirement
PC	Planning Coordinator
PTO	Participating TO or Participating Transmission Owner
RTCA	Real-Time Contingency Analysis
TOP	Transmission Operator
TP	Transmission Planner
TR	Transmission Registry
TTC	Total Transmission Capacity
SOL	System Operating Limit
CP	Control Point
TO	Transmission Owner


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Version History

Version	Change	Date
6.3	Modified for alignment with RC West's SOL Methodology. Section 3.1.3: Updated WECC references noted in 5 th bullet. Modified Section 3.7 Bus Section contingencies based on feedback and agreement with PG&E. Replaced Peak RC with the RC in most instances and RC West in few instances relating to RC SOL Methodology. Minor format and grammar updates. Removed version history prior to 5-years.	7/01/19
6.4	Section 3.6.3: Updated SDGE references (Transfer banks to return the loading below normal rating directly from the emergency rating).	9/20/19
6.5	Section 3.1, last bullet: Updated language in accordance with CFR designation of SOLs.	10/31/19
7.0	Periodic Review: Section 3.1: Updated Mvar reference. Section 3.3.6, Powerflow Cascading Test, #'s 1-3: Minor edits for clarity. Section 3.6.3: Removed random "2" from 1 st bullet.	3/26/20
7.1	Section 3.7: Updated, providing further clarity on when CAISO would determine SOLs for bus contingencies. Section 5: Minor edits for consistency. Updated instances of ISO to CAISO throughout. Updated NERC and WECC references. Minor format and grammar updates. Removed history prior to five years.	11/08/21
7.2	Updated NERC FAC-011 reference in Purpose section. Section 3.3.1: Updated footnote for facilities to include CAISO BA Controlled Area per the CFR Appendix 1, generator step-up transformers, and exclusions denoted in NERC BES reference document. Added NERC MOD-001 reference to References section.	10/01/22
7.3	Periodic Review: Definitions Section: Updated Transmission Path buy removing reference to NERC Standard TOP-007-WECC-1, as it no longer applies. Appendix Section: Updated procedure titles.	4/20/23
8.0	Major revision to address changes due to NERC FAC-011-4 and FAC-014-3 standard changes. Updated NERC Standards in References section. Minor edit made in Sections 3.5, 3.5.1 and 3.5.3. Minor formatting and grammar edits.	4/01/24

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Version	Change	Date
8.1	Section 2.2: Minor edit to include scheduling "limits" within first bullet. Section 3.3.2: Updated "Note" correcting acronym for Maximum Excitation Limiter to MEL. Section 3.4: Corrected labeling of Tables 2, 3 & 4. Section 3.5.3: Minor edits for clarification in Example 2, Purpose. Section 3.5.4: Updated reference to Customer Market Results Interface (CMRI) and detail for requesting access. Capitalized all instances of terms listed in Definitions Table for consistency and NERC Standard term, Cascading. References: Added NERC Standard VAR-001 and updated for WECC reference. Minor formatting and grammar edits. Removed history prior to five years.	8/15/24

5. Periodic Review Procedure

Review Criteria & Incorporation of Changes

There are no specific criteria for reviewing or changing this document, follow instructions in CAISO Operating Procedure 5510.

Frequency

Every three (3) Years

Appendix

3100A Acceptable Thermal Performance Examples
 3100B System Voltage Limits and Credible Multiple Contingency List

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