2025 Intra-Cluster Reliability Network Upgrade Prioritization

Study Plan and Methodology

June 27, 2025

California ISO

Table of Contents

1. Study Scope Summary 2
2. Schedule 3
3. Project and Interconnection Information 3
4. Study Criteria and Methodology 3

4.1 Eligible Generation Projects 3
4.2 Reliability Standards and Criteria 3
4.2.1 NERC Reliability Standards 3
4.2.2 WECC Regional Criteria 4
4.2.3 California ISO Planning Standards 4
4.3 Short Circuit Criteria 4
4.4 Transmission Assumptions 5
4.4.1 New Transmission Projects to be Modeled 5
4.4.2 Generation Projects to be Modeled 6
5. Study Scope 6

5.1 Short Circuit Analysis 6
5.2 Substation Evaluation 6
5.3 Use of Existing Studies 6
5.4 Power flow and stability studies 7
5.5 Reliability Margin 7
5.6 Ties 7
5.7 IRNUs requiring circuit breakers 7
6. Schedule 8

1. Study Scope Summary

In accordance with the Federal Energy Regulatory Commission (FERC) approved CAISO Tariff Generator Interconnection and Deliverability Allocation Procedures (GIDAP) Appendix DD, the California ISO (ISO), Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas & Electric Company (SDG&E), Valley Electric Association (VEA), Gridliance West (GLW), LSPower, DCR Transmission, LLC (DCRT), and Horizon West Transmission (HWT) will perform the RNU Prioritization Study (Study) to assess whether impacted Interconnection Customer projects may interconnect safely and reliably without the completion of certain Reliability Network Upgrades.

For any assigned Reliability Network Upgrades with construction schedules of four (4) or more years that delay an Interconnection Customer projects earliest available In-Service Date by two (2) years or more, the CAISO and Participating TO will assess whether impacted Interconnection Customer projects may interconnect safely and reliably without the completion of all such Reliability Network Upgrades. Reliability Network Upgrades considered will include Precursor Network Upgrades approved in the transmission planning process under section 24, and Assigned Network Upgrades. Interconnection Studies and GIAs will be updated to reflect where an Interconnection Customer project may interconnect earlier under Section 16.3, including whether there is insufficient projected margin such that a Limited Operation Study will be required.

The CAISO and Participating TOs will identify Interconnection Customer projects that have qualifying Reliability Network Upgrades and that there may be available capacity to interconnect earlier at least thirty (30) days before the deadline to submit affidavits for scoring.

This study plan and methodology document defines the scope, content, and assumptions for this Study. This Study will:

(i) Identify assigned Reliability Network Upgrades with construction schedules of four (4) or more years that delay an Interconnection Customer project's earliest available In-Service Date by two (2) years or more[1], the CAISO and Participating TO will assess whether impacted Interconnection Customer projects may interconnect safely and reliably without the completion of all such Reliability Network Upgrades. Reliability Network Upgrades considered will include Precursor Network Upgrades approved in the transmission planning process under section 24, and Assigned Network Upgrades;

(ii) establish numerical ranking scores for the eligible projects based on information submitted by the eligible projects based on Section 16.3 of Appendix DD (GIDAP) of the ISO Tariff;

[1] For upgrades that are listed in the posted Transmission Development Forum (TDF) documents the RNU construction durations will be based on the dates in the TDF documents relative to the date that the qualifying Reliability Network Upgrades are posted. For upgrades that are not in the TDF documents then the latest cluster study information will be utilized.

(iii) identify Interconnection Customer projects with the highest numerical scores[2] within the cluster that is triggering the need for each upgrade in (i) that can interconnect before completion of the upgrade.

2. Schedule

The study starts on 6/2/2025 and completes on 1/31/2026. A more detailed study schedule is shown Section 6 of this document.

3. Project and Interconnection Information

The generation projects included in the Study will be identified as a first step in the study process.

4. Study Criteria and Methodology

4.1 Eligible Generation Projects

Only projects in the cluster (e.g. cluster 14) that is triggering the upgrade identified in 1(i) would be eligible to participate in the Intra-Cluster Prioritization process for that upgrade. If a generation project has more than three required RNUs and IRNUs total that meet the criteria that need to considered simultaneously, then that project is not eligible to participate in the Intra-cluster Prioritization Process. In addition, if based on existing information there is no margin available after modeling earlier cluster projects and without modeling the required RNU, then none of the projects in the cluster that are triggering the need for the upgrade would be eligible[3].

4.2 Reliability Standards and Criteria

The Study will be conducted in compliance with the North American Electric Reliability Corporation (NERC) reliability standards, WECC regional criteria, and the ISO planning standards.

4.2.1 NERC Reliability Standards

The ISO will analyze the need for transmission upgrades and additions in accordance with NERC reliability standards. The following NERC reliability standards are applicable to the ISO, as a registered NERC planning authority, and the Participating TOs, as Transmission Planners, and are the primary standards for the interconnection of new facilities and system performance[4]:

- FAC-001: Facility Connection Requirements[5]
- FAC-002: Coordination of Plans for New Facilities[6]

[2] The ISO will provide numerical scores to the PTOs for this analysis. The entire generation queue project will be modeled based on its numerical score.

[3] If projects were identified as eligible based on existing information, but the study determines that based on updated information there is no margin available, then all of the generators in the cluster would need to wait for the required upgrade.

[4] https://www.nerc.com/pa/Stand/Pages/USRelStand.aspx

[5] https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-001-4.pdf FAC-001 is applicable to the PTOs, but not to the ISO.

[6] https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-002-4.pdf

- TPL-001: Transmission System Planning Performance Requirements[7]

4.2.2 WECC Regional Criteria

The WECC System Performance TPL-001-WECC-CRT-3.1[8] Regional Criterion is applicable to the ISO as a planning authority and set forth additional requirements that must be met under a varied but specific set of operating conditions.

4.2.3 California ISO Planning Standards

The California ISO Planning Standards specify the grid planning criteria to be used in the planning of ISO transmission facilities.[9]

4.3 Short Circuit Criteria

The short circuit analysis will be performed by simulating single-line-to-ground (1LG) and three-phase (3LG) bus faults, which represent the worst-case conditions. Maximum fault current will be used to determine the available SCD margin at the locations of previously triggered SCD upgrades. Criteria to determine if breakers are overstressed are specific to each study area and are outlined below:

PG&E

The short circuit analysis is performed by simulating single-line-to-ground (1LG) and three-phase (3LG) bus faults as the worst case in a study area, which represents the worst-case conditions to determine the maximum available fault current. The bus fault duty is used to determine an approximate level of overstress. When the bus fault duty is greater than the interrupting rating, a more detailed study is required to determine the worst-case fault current interrupted by the breaker.

A breaker is considered overstressed if the fault duty is greater than or equal to 100% of the breaker interrupting capability.

The cost responsibility for final short circuit related Reliability Network Upgrades (RNU) shall be assigned to all Interconnection Requests in the Group Study pro rata on the basis of short circuit duty contribution of each project that has a contribution of more than 100 A. If any project's cost allocation is less than $1,000, the project will not have any mitigation responsibility for the short circuit related RNU and the cost responsibility for the short circuit related RNU will be recalculated with those project short circuit duty contributions removed.

All projects were modeled based upon information provided by the Interconnection Customer using ASPEN Oneliner V14.8. For specific modeling methodology and possible limitations refer to Attachment 8.

PG&E System Protection has modeled all transformers with X/R ratios, medium voltage collector system equivalent lines and generator-tie lines, including negative sequence data where applicable, for all Cluster 14 projects. All models specified with 500 kV base voltage have been converted to 525 kV voltage base.

In ASPEN Oneliner, modeling very small impedances may cause convergence issues, therefore lines with small impedances might be removed.

SCE

[7] https://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-5.pdf
[8] https://www.wecc.org/wecc-document/6906
[9] https://www.caiso.com/Documents/ISO-Planning-Standards-Effective-Feb22023.pdf

SCE uses the following policy to determine breaker replacement responsibility for cluster projects that overstress or increase overstress on existing circuit breakers:

- The fault duties are calculated before and after current cluster projects to identify any equipment overstress conditions. Three-phase (3PH) and single line-to-ground (SLG) faults are simulated without the current cluster projects, as well as with the current cluster projects, including the identified Reliability and Local Delivery Network Upgrades from the power flow analysis.

- All bus locations where the current cluster projects increases the short-circuit duty by 0.1 kA or more and where duty is in excess of 60% of the minimum breaker nameplate rating are identified. These are examined further to determine if any equipment is overstressed as a result of the current cluster interconnections and corresponding network upgrades.

The responsibility to finance short-circuit duty-related Reliability Network Upgrades identified shall be assigned to all contributing IRs (projects) pro rata based on their short-circuit duty contribution. Furthermore, if a proposed network upgrade contributes to the adverse short circuit impact, such contribution shall be allocated to the projects triggering the need of the network upgrade based on the same factors used to allocate the proposed network upgrade cost. The project short-circuit duty contribution includes the direct contribution from the generation project and the network upgrade short-circuit duty contribution allocated to the generation project.

SDG&E

A short circuit study on the SDG&E transmission system is performed to evaluate the total fault current at each bus to ensure that circuit breakers are adequately sized according to American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) Standards, North American Electric Reliability Corporation's (NERC) standards.

The short circuit analysis is performed utilizing ASPEN One-Liner software to simulate single-line-to-ground (SLG) and three-line-to-ground (3LG) bus faults. The higher of the two fault currents is then used to calculate the magnitude of the short circuit duty that will determine if a circuit breaker needs to be upgraded. Affected circuit breakers in SDG&E's system will be replaced if the short circuit bus fault equals or exceeds 100% of the breakers interrupting capacity. SDG&E uses the IEEE Standard ANSI /IEEE C37.010-1999 as X/R ratio multiplier.

4.4 Transmission Assumptions

4.4.1 New Transmission Projects to be Modeled

All ISO-approved transmission projects will be modeled in the base case except for transmission projects identified in 1(i). In addition, all Reliability and Delivery Network Upgrades required for generation interconnection projects up to and including Queue Cluster 14 will be included in the base case except for RNUs identified in 1(i).

4.4.2 Generation Projects to be Modeled

If cluster (x) is triggering the upgrade identified in 1(i) then all generation projects in cluster (x-1) and earlier clusters should be included in the initial base case. If the earlier queued project has a later in-service date than the in-service date of the upgrade identified in 1(i), then the queue project does not need to be modeled.

5. Study Scope

5.1 Short Circuit Analysis

A short circuit study will be performed to determine the Pre Cluster (e.g. Pre QC14) short circuit current at the locations of previously triggered RNUs and will then evaluate which participating generation projects may connect before their assigned RNUs (PTOs to use existing results if needed per 5.3). This study will assess the impact of increased fault duty resulting from the added generation.
Interconnection queue SCD studies will be performed to determine the impact on circuit breakers with the interconnection of the highest scoring generation projects in the queue cluster that is currently identified as responsible for triggering the need for the upgrade from 1(i) along with all earlier queue cluster projects. The base case will include all existing and earlier queued generation interconnection projects and corresponding upgrades except the upgrade(s) from 1(i) in the starting base cases. In addition, the base case will include all CAISO approved transmission projects and all PTO approved non-CAISO upgrades and system modifications in the base case (except the upgrade(s) from 1(i)). The fault duties will be calculated to identify any equipment overstress conditions. Three-phase (3PH) and single-line-to-ground (SLG) faults will be simulated.
The highest scoring generation projects in the queue cluster that is currently identified as responsible for triggering the need for the upgrade from 1(i) will be added to the starting base case and the fault duties will be calculated to identify which generation projects can be interconnected before the completion of the upgrade from 1(i).

5.2 Substation Evaluation

For any upgrades identified in 1(i) that are needed based on a substation evaluation, a substation evaluation will be performed following a generally similar process as described for the short circuit duty analysis in order to identify which generation projects can be interconnected before the completion of the upgrade from 1(i).

5.3 Use of Existing Studies

The PTOs could use existing study results as much as possible to simplify any additional analysis needed for the purpose of this Study.

5.4 Power flow and stability studies

To the extent that there are upgrades from 1(i) that were originally identified as a result of power flow or stability studies, this study plan will be amended to describe the study scope for power flow or stability studies for this Study.

5.5 Reliability Margin

Short circuit duty and loading margin can be set aside to ensure that changes from Rule 21 projects, WDAT projects and other base case changes would not cause reliability issues. A limited operation study (LOS) will not be required as long as there is 3%[10] of margin (e.g., short circuit current less than 97% of the breaker capability or bus load flow less than 97 of its rating) after the participating generation project is added to the baseline scenario. However, if there is not adequate margin after the participating generation project is added to the baseline scenario, then a LOS would be required for the generator to synchronize ahead of its RNUs and in-service date. Generators that can be accommodated before exceeding 100% of the limiting facility rating, but still requiring an LOS will be identified and will have a priority over other generators in the same cluster with a lower ranking or did not participate in the Intra-Cluster prioritization process. GIAs will be updated to reflect where an Interconnection Customer project may interconnect earlier based on this study, including whether there is insufficient projected margin such that a Limited Operation Study will be required.

5.6 Ties

In allocating transmission capacity, the Participating TO will allocate transmission capacity based on the highest numerical score. The Participating TO will resolve any ties for capacity from short circuit related General Reliability Network Upgrades by short-circuit duty contribution, with the lowest contribution per MW prevailing. The Participating TO will resolve any ties for capacity from power flow related General Reliability Network Upgrades by flow contribution, with the lowest contribution prevailing. The Participating TO will resolve any ties for capacity from Interconnection Reliability Network Upgrades by Generating Facility capacity, with the largest capacity prevailing.

5.7 IRNUs requiring circuit breakers

In cases where the procurement timeline for circuit breakers represents the critical path to completing IRNUs required to connect a generating facility's tie-line to an existing substation, and the Participating TO has the ability to expedite procurement for a limited number of circuit breakers, such IRNUs will not, by default, disqualify the associated generation projects from participating in this process.

[10] A PTO can set aside less than 3% of margin, but is not be allowed to set aside more than 3%. Each PTO will by default set aside 3% margin, but during the course of the study may determine that less margin is acceptable and will document that in the study report.

In these instances, the Participating TO will instead consider other identified long-lead-time upgrades in its evaluation and determine which generation projects can be reasonably accommodated, pursuant to the methodology described herein. For all such projects selected for advancement, the Participating TO will evaluate, document, and reflect the applicable circuit breaker procurement timeline in an amendment to the project's LGIA.

6. Schedule

Description	**Target Completion Date**
Create draft final study plan	April 15, 2025
Create draft list of upgrades eligible for the process	May 1, 2025.
The CAISO will notify Interconnection Customers whether they have projects with qualifying Reliability Network Upgrades and there may be available capacity to interconnect earlier at least thirty (30) days before the deadline to submit affidavits for scoring.	July 1, 2025.
Participating Interconnection customers submit information needed for scoring	August 1, 2025
The CAISO provide ranking of participating projects to the PTOs	October 1, 2025
The Participating TOs perform SCD analysis using the ranking of participating projects provided by the CAISO	December 5, 2025
Inform customers of the results on the study	December 2025
Provide report documenting the study results	January 2026