California ISO

Deliverability Assessment Methodology Revisions

Straw Proposal

August 22, 2023

Infrastructure and Operations Planning

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Deliverability Assessment Methodology Straw Proposal

1 Executive Summary

The deliverability assessment methodology is a CAISO methodology developed for generation interconnection study purposes pursuant to the CAISO tariff, and is used to ensure that the transmission system can deliver resources providing Resource Adequacy (RA) capacity to serve load during stressed system conditions. The methodology was modified to address evolving circumstances, and a comprehensive stakeholder process was conducted in 2019 and 2020. In June 2022, storage dispatch assumptions were adjusted to reflect the evolving nature of the generation fleet.

Given the rapid growth in generation development and procurement, increased diversification of the resource fleet, and long lead time necessary for development of transmission upgrades, the CAISO proposes the following refinements to its deliverability assessment methodology to provide short-term relief and long-term adjustments, while maintaining system reliability:

- **Study of High System Need (HSN) and Secondary System Need (SSN):** In response to comments on the Issue Paper, the ISO explored the necessity of studying more than one stressed system condition, and proposes removing the SSN study from generation interconnection deliverability studies.
- **Dispatch levels:** Some stakeholders have stated that it is inappropriate to study intermittent resources with an output that is different than their Qualifying Capacity (QC) levels determined by the CPUC or other local regulatory authorities (LRAs). The ISO is not proposing any changes to dispatch levels and believes that its methodology for determining dispatch levels in the deliverability studies is reasonable.
- **Simultaneous dispatch**: In response to stakeholder comments, the ISO proposes to raise the 5% distribution factor threshold for 500 kV line overload constraints to 10%. The ISO expects this to be a more practical threshold for including the generators that have a significant impact on the 500 kV line overload constraint and excluding generators that have an insignificant impact on the high capacity and low impedance 500 kV constraint.
- **Study of n-2 contingencies:** The ISO considered stakeholder feedback on current requirements for the study and mitigation of n-2 contingencies on double-circuit towers. The ISO is required by the North American Electric Reliability Corporation (NERC) to study n-2 contingencies on double-circuit towers. Therefore, the ISO does not intend to change this practice. However, the ISO proposes a risk-based approach and resulting policy changes to provide a new type of deliverability, "conditional" deliverability, while a resource is waiting for the related n-2 deliverability upgrades to be completed.

- **ADNU/LDNU guidelines:** The ISO seeks stakeholder comments on the need to revise the guidelines for identifying Area Deliverability Constraints (ADCs) and offers three options for stakeholder consideration and comment:
    - Option 1: Raise the cost threshold in the Area Constraint guideline for ADC-C4 to $25 M in current dollars.
    - Option 2: Raise the cost threshold in the Area Constraint guideline for ADC-C4 to $35 M in current dollars.
    - Option 3: Eliminate the Area Constraint guideline ADC-C4.
- **Delayed deliverability upgrades:** The ISO understands the disruptions resulting from delayed Participating Transmission Owner (PTO) timelines for deliverability upgrades, and proposes provision of conditional deliverability to projects affected by delayed network upgrades through a risk-based approach.

2 Stakeholder Process

The ISO posted a December 12, 2022 Update Paper[1] to initiate a review of the methodology to ensure that the deliverability requirements strike the appropriate balance between reliability and cost containment, and that the reliability requirements are not unduly burdensome. An Issue Paper[2] was posted on May 31, 2023 and a stakeholder call held on June 8, 2023. Stakeholders provided comments on the Issue Paper, which are summarized below.

The ISO received comments from 22 parties, as well as "joint framework" comments submitted on behalf of three of the 22 responding parties (Joint Framework Proponents). Comments reflected support for various aspects of the current methodology, suggestions for specific changes to the methodology, and proposals for more sweeping changes.

The purpose of this straw proposal is to summarize and discuss the stakeholder input provided in response to the Issue Paper and propose potential solutions and revisions to the deliverability assessment methodology. This initiative is moving forward in coordination with the Interconnection Process Enhancements (IPE) process which is also underway and focuses on interconnection process issues that need to be considered more broadly. The deliverability allocation methodology is also related to the ISO's Resource Adequacy Initiative.

[1] Deliverability Challenges: An ISO Update. December 12, 2022. Update-Paper-Generation-Deliverability-Methodology-Review-Dec132022.pdf (caiso.com)
[2] Deliverability Assessment Methodology Issue Paper http://www.caiso.com/InitiativeDocuments/Issue-Paper-Generation-Deliverability-Methodology-Review-May312023.pdf

3 Background and Issues

The ISO understands the importance of Transmission Planning Deliverability (TPD) capacity for stakeholders. The Issue Paper detailed the current methodology for determining TPD and explored several issues that were raised in stakeholder comments in response to the ISO's Update Paper to generate discussion of potential alternatives regarding revisions of the deliverability assessment methodology.

Stakeholder feedback suggests a lack of common expectations for the RA program and for the deliverability methodology. The ISO provides its description of these programs and processes below.[3]

Resource Adequacy

RA is a regulatory construct developed to ensure there will be sufficient electric resources to serve demand in all but the most extreme conditions. Load-serving entities are required to procure a certain amount of RA capacity to meet planning requirements.

Resources seeking to provide RA capacity first have to meet basic interconnection requirements so they can be reliably interconnected. Resources that seek to provide RA capacity must have deliverability. Resources only meeting reliability requirements can operate as energy-only resources, without deliverability and not providing RA capacity.

Each resource has a qualifying capacity (QC) and net qualifying capacity (NQC). Qualifying capacity values are fuel-type specific and are set using methodologies determined by the appropriate local regulatory authority (LRA). This may be the California Public Utilities Commission (CPUC) or another entity for non-CPUC jurisdictional entities. The NQC value is resource-specific and is determined by the CAISO based on the QC and the deliverability status of the resource.

On-Peak Deliverability Assessment Methodology

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[3] The ISO notes that a tenet set out in the Joint Proposal Framework states "The CAISO has various means of addressing system reliability apart from the deliverability test…

- System reliability is currently addressed by LRA RA Programs, as well as the CAISO Transmission Planning Process (TPP), and the Generation Interconnection Process (GIP) reliability studies, and not from the CAISO deliverability test. If additional reliability concerns remain with the generation interconnection process, additional reliability test scenarios could be added to the generation interconnection study process."

The implications of this difference are discussed in more detail in the following section.

The on-peak deliverability assessment tests that the transmission system can reasonably ensure that RA capacity can be delivered to load during stressed system conditions.[4] "Stressed" was generally meant to be where load is high, supply is tight, and loss of load is a risk. Another perspective is that the transmission system needs to provide reasonable certainty that reliable supply can be maintained by relying solely on RA capacity. The need for adequate transmission to support the simultaneous access to RA capacity is a basic tenet of the RA program. The importance of the ability to access this capacity, or deliverability, was clear during extreme stressed conditions in each of the last three summers: August 13 and 14, 2020, July 9, 2021, and September 6, 2022.[5]

Deliverability ensures that under normal transmission system conditions, if resources with deliverability are available and called on, their ability to provide energy to the system at peak load will not be limited by the dispatch of other resources with deliverability in the vicinity. This test does not guarantee that a given resource will be dispatched to produce energy at any given system load condition. Rather, the test's purpose is to demonstrate that the available generation capacity in any electrical area can generate and be delivered simultaneously, at peak load, and that the excess energy above load in that electrical area can be exported to the remainder of the Balancing Authority Area.[6] In short, the test verifies that transmission-constrained capacity conditions will not exist at peak load, limiting the availability and usefulness of RA capacity resources for meeting RA requirements. In actual operating conditions, energy-only resources may displace RA resources in the market's economic dispatch that serves load.

The electrical regions from which generation must be deliverable range from individual buses to all of the available generation in the vicinity of the generator under study. The underlying assumption of the test is that all available capacity in the vicinity of the generator under study is required, therefore the remainder of the system is experiencing a significant reduction in available capacity. However, since localized transmission capacity deficiencies should be tested when evaluating deliverability from the load perspective, the dispatch pattern in the remainder of the system is appropriately distributed. Failure of the generator deliverability test when evaluating a new resource in the generator interconnection study affects the ability of the resource to receive a deliverability allocation and be procured to meet RA needs. If the addition of the resource will cause a deliverability deficiency, then the

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4 The ISO also engages in an off-peak deliverability assessment that focuses on renewable energy delivery and is used to identify transmission upgrades needed to relieve curtailment. More information is available in the ISO's Dec. 2022 Issue Paper.

5 From August 31 through September 9, 2022, California and much of the Western United States experienced record-setting heat resulting in all-time high demand for electricity across the region (September 2022 heat wave). The prolonged heat event precipitated an unprecedented number of calls for consumer conservation. This included 10 consecutive days of voluntary Flex Alerts and new state programs that provided non-market resources to address extreme events culminating on September 6, the only day when the ISO system reached its highest emergency alert level.

6 Subject to contingency testing.

resource should not be fully counted towards RA reserve requirements until transmission system upgrades are completed to correct the deficiency.

In summary, the goal of the on-peak deliverability study methodology is to determine if the aggregate of available generation output in a given area can be simultaneously transferred to the remainder of the ISO Balancing Authority Area during resource shortage conditions, considering transmission constraints. Any generators requesting Full or Partial Capacity Deliverability Status[7] in their interconnection request to the ISO-Controlled Grid will be analyzed for "deliverability" to identify the Delivery Network Upgrades (DNU) necessary to obtain this status. This analysis of required DNUs is completed in the queue cluster study process utilizing the deliverability assessment methodology.

At a high level, the test procedure includes the following three steps.

1. The ISO builds the initial power flow base case, dispatching all existing generation, and new generation to balance loads and resources.
2. The ISO uses a commercially available software tool to perform a generation sensitivity analysis to identify potentially limited generation pockets. At the most granular level, the sensitivity analysis identifies the exact generation facilities that have the highest flow impact on a particular transmission facility with all other facilities in-service and during forced outages of other facilities.
3. For each potentially limiting generation pocket identified in step 2, the ISO increases a subset of the generation with the highest flow impact on that facility to assess the potential for it to be overloaded under stressed system conditions.

All ISO-controlled facilities are analyzed to determine if they are limiting the deliverability of generation within the ISO deliverability methodology parameters.

In this context, system reliability requires both a reliable and secure transmission system, and sufficient resources ("resource sufficiency") to provide reliable service to customers. The deliverability methodology ensures that those resources can reasonably be delivered to load at stressed system conditions. The deliverability methodology is therefore an inherent component of the overall reliability framework.[8]

[7] Full Capacity Deliverability Status ("FCDS") means that the generator is requesting that its entire output be deliverable. Partial means something less than its entire output. Generating units comprising a single generating facility/interconnection customer/generator interconnection agreement may have separate meters and resource IDs such that the individual generating units may be FCDS even if the entire facility at the point of interconnection is not deliverable.

[8] The ISO acknowledges that while the deliverability methodology is an inherent component of the reliability framework, additional NERC reliability standards exist.

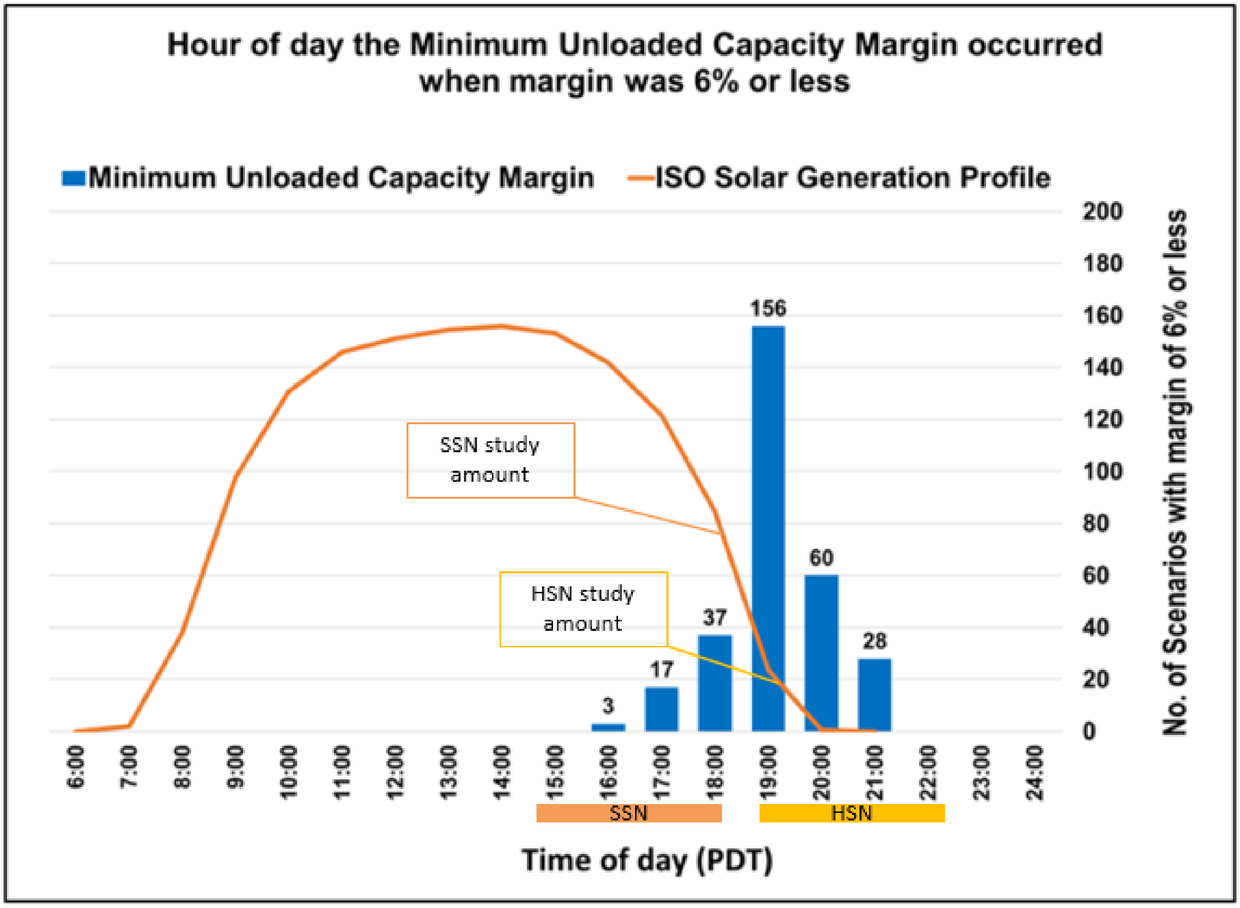
4 Discussion and Straw Proposal

4.1 Study of High System Need (HSN) and Secondary System Need (SSN)

The test methodology currently studies two scenarios: one is the highest system need (HSN) scenario and the other is known as the secondary system need (SSN) under higher gross load conditions when solar is dropping off. The HSN scenario is tested for all generating resources in the study. The load, generation dispatch, and imports correspond to when the system RA need is the highest during the year based on pre-selected profiles. The highest system need in the past has been the peak gross consumption condition, but that has transitioned to the peak sale condition with the behind-the-meter distributed generation (DG) growth. The study is therefore supplemented by the SSN scenario, which focuses on the transition period when the gross load is still high and the solar production is dropping off. During this condition, a resource shortage is less likely but could still occur.

The HSN and SSN study scenarios were proposed as a modification to the deliverability methodology in 2018 and implemented in 2020. During that previous stakeholder process, data from ISO's 2018 Summer Assessment and the CPUC's Loss of Load Expectation analysis demonstrated that resource shortage conditions occur during the SSN as well as the HSN study period.[9] The figure below provides data from the 2022 Summer Assessment, and, for purposes of this analysis, is not much different than the 2018 Summer Assessment data. In this figure, one can see that that resource shortage conditions continue to occur during the SSN as well as the HSN study period.

[9] http://www.caiso.com/InitiativeDocuments/IssuePaper-GenerationDeliverabilityAssessment.pdf



Stakeholder Input

NextEra Resources recommends that the ISO further evaluate the most appropriate dispatch assumptions for energy storage resources during the SSN window (including in later hours). While NextEra Resources agrees with the ISO that some level of capacity shortage risk during SSN hours when solar output is reduced is evident, and that this reliability risk should be mitigated in the hours leading to the High System Need (HSN) window, the current dispatch assumptions fail to recognize that storage resources will need to be prepared for full discharge during the HSN window. In essence, lowering the energy storage dispatch assumptions during SSN will more fully reflect the controllable nature of storage resources and ensure that storage operation is fully optimized. Furthermore, this modest reduction to lower levels (i.e., 30%) will better align with state objectives to enable the deliverability of significantly more resources, including long-duration resources, rather than depending upon the current dispatch assumption of 50% (for medium and long-term deliverability studies).

The Joint Framework Proponents comment that the SSN test focuses mainly on the local curtailment of supply resources, which does not translate to a lack of system reliability from an RA capacity standpoint since other system resources are available to meet the demand plus PRM.

Discussion

As shown in the 2018 and 2022 Summer Assessment analysis, resource shortage conditions do occur during the SSN study period, and that is the basis for the SSN study. However, the ISO's 2023 Summer Loads and Resources Assessment stated that the ISO's results for the summer of 2022 demonstrated the highest system risk occurring in hour ending 19:00, with the risk tailing off in the hours on either side. The results for the summer of 2023 demonstrate more consistent risk across the hours ending 19:00 through 21:00, as well as significantly lower risk in the hours leading up to hour ending 19:00. This can be attributed in part to the larger fleet of storage resources available to manage the rapid decline of solar output. It is also noteworthy that hydroelectric resource supply was exceptionally high in 2023 due to high precipitation in the previous season. The latest Summer Assessment seems to suggest that with an adequate resource supply the risk of a resource shortage in the SSN study period may be less of a concern.

CAISO Proposal

The ISO proposes to remove the SSN study from generation interconnection deliverability studies. In addition to the discussion above regarding the decreasing risk of resource shortages during the SSN study period, one additional observation is that with the update to study storage at 50%, the SSN study is rarely more binding than the HSN study. Lowering the storage study amount even further would likely result in the SSN study being less binding than the HSN study. However, the ISO would still perform the SSN study in the transmission planning process for at least a few years to ensure the ISO does not have an emerging issue with accessing resources across the daily cycle when needed. In addition, the ISO will explore other study conditions such as critical storage charging scenarios in the transmission planning process. With the evolving generation fleet and customer load profile, the ISO will explore study scenarios proactively to identify critical transmission stress conditions before they become a problem.

4.2 Dispatch levels

Initial Base Case Dispatch

Generation is dispatched in the initial base case at close to maximum dependable capacity. The selected percentage dispatch below maximum capacity considers the average forced outage rates of the generators, spinning reserve, and unexpected retirement of generation capacity across the system. For the cluster studies, the ISO dispatches all generation at 80% of maximum dependable capacity. Because we are modeling a resource shortage scenario, it is assumed that all available generation is being dispatched. Due to the shortage condition, the incremental dispatch cost of generation is not affecting the dispatch.

For the cluster studies, the amount of generation in the interconnection queue far exceeds the amount needed to achieve a load and resource balance. Therefore, the queued generation is organized into geographic areas, and eight to ten base cases are built, with each case designed to focus on a particular geographic area. Then the queued generation in these areas is dispatched similar to the existing generation (e.g. 80% of dependable capacity).

Identification of Generation Pockets Associated with Individual Transmission Facility Constraints

Each transmission line and transformer is analyzed individually, starting from the initial base case dispatch. A study group is established for each line and transformer that includes all generation with a 5% distribution factor or greater on the particular line or transformer.[10] For each analyzed facility, an electrical circle is drawn which includes all units that have a 5% or greater distribution factor (DFAX) on the facility being analyzed.[11] The 5% Circle can also be referred to as the study group for the particular facility being analyzed. Capacity generation dispatch inside the study group is increased to determine the loading on the line or transformer under stressed system conditions. Generation outside the study group is proportionally decreased to maintain the balance between loads and resources. This process is intended to test the ability of available resources inside the study group to be dispatched at full output when various resources across the ISO system are unavailable during a resource shortage condition.

Dispatch of Generators in the Study Group

The outputs of capacity units in the 5% Circle study group are increased starting with units with the largest impact on the transmission facility. The number of units to be increased within a group is limited to an amount of generation that can be reasonably expected to be simultaneously available, and the likelihood of all of the units within a group being available at the same time becomes smaller as the number of units in the group increases. The objective of the ISO deliverability methodology is to ensure that roughly 80% of the time, the transmission system will not constrain the output of generation in a study group during a resource shortage condition. The cumulative availability of 20 units with a 7.5% forced outage rate would be 21%. Therefore, no more than 20 units are increased to their maximum output within a study group. All remaining generation within the ISO balancing area is proportionally displaced to maintain a load and resource balance. The amount of generation increased also needs to be limited because decreasing the remaining generation can cause problems that are more closely related to a generation deficiency in a load pocket rather than a generation pocket deliverability problem. Therefore, no more than a 1500 MW increment of generation is increased within a study group.

For groups where the 20 units with the highest impact on the facility can be increased more than 1500 MW, the impact of the remaining amount of generation to be increased will be considered using a Facility Loading Adder. The Facility Loading Adder is calculated by taking the remaining MW amount available from the 20 units with the highest impact times the DFAX for each unit. An equivalent MW amount of generation with negative DFAXs times

[10] The 5% distribution factor threshold is also used by PJM and MISO in their deliverability analysis methodologies.

[11] Includes all generators that have a 5% or greater distribution factor (DFAX) or Flow Impact on the facility being analyzed is referred to as the 5% Circle. The Flow Impact is not considered for DFAX that are less than 2%.

the DFAX for each unit will also be included in the Facility Loading Adder, up to 20 units. Negative Facility Loading Adders are set to zero.

The test methodology currently studies two scenarios: one is the highest system need (HSN) scenario and the other is known as the secondary system need (SSN) under higher gross load conditions when solar is dropping off, as described in the section above.

The highest system need scenario represents when a capacity shortage is most likely to occur. In this scenario, the load is modeled at the peak sales amount with low solar output. The highest system need hours are hours ending 19 to 22 in the summer months with an unloaded capacity margin of less than 6% in the CAISO annual summer assessment or identified as loss-of-load hour in the CPUC Equivalent Load Carrying Capacity (ELCC) study for wind and solar resources.

For wind and solar resources, the HSN study values are set to the 20% exceedance level during the selected hours, to ensure a higher certainty of wind and solar being deliverable when capacity shortage risk is highest. The secondary system need hours are hours ending 15 to 18 in the summer months with an unloaded capacity margin less than 6% in the CAISO annual summer assessment or similar assessments in the long-term planning horizon. The SSN study values are set to the 50% exceedance level during the selected hours, due to a more moderate risk of capacity shortage.

All other resources are studied at their NQC values in both the HSN and SSN studies. However, after a review of storage production levels, it was found that in long-term studies, storage was producing at almost 50% of the available capacity when solar was at the SSN study level. Therefore, for long-term deliverability studies, storage is studied at 50% of installed capacity in the SSN study[12].

Stakeholder Input

The Joint Framework Proponents commented that each proposed new variable energy generator's dispatch should be set at, rather than above, its LRA-determined qualifying capacity (QC value, i.e., the value that the LRA's RA Program determines based on fuel type), noting that any production above that level can be curtailed in actual operations if transmission constraints exist. The Joint Framework Proponents argue that all existing Variable Energy Resources (VER) should be dispatched in the studies according to their already-assigned NQC levels. Most noteworthy, comments state:

> "The purpose of the deliverability test is to qualify resources for the CPUC's RA Program at a level up to their Qualifying Capacity (QC) levels established by the applicable local regulatory authority…"

[12] http://www.caiso.com/Documents/Presentation-GenerationDeliverabilityStudyDispatchAssumptions-Jun062022.pdf

Recurrent Energy stated that it agrees with the simultaneous dispatch approach during a shortage condition. However, Recurrent noted that not all queued generation within a geographic area is actually built. They suggested that the ISO consider a scaling factor to the generators dispatched (assume queue attrition or other metric) to provide more reliable results.

Discussion

The issue raised by the Joint Framework Proponents is primarily associated with wind generation study values due to the characteristics of the wind resources. The solar study amount levels in the HSN study are already at 10% of nameplate capacity, which are lower than the NQC values during the summer months. Though the HSN wind study amounts are higher than the NQC values, wind production levels are more variable on a temporal and geographic basis.

The ISO agrees that stressed but not extreme conditions should be assumed in the deliverability test studies. However, the proposal to only assume QC values for wind and solar generation has a fundamental gap as it relates to the RA program.

Example 1 in Appendix A of the Joint Framework Proponents' document showed an example where a 100 MW wind generator was behind a transmission constraint limiting its output to 56 MW every hour of the year, which is the HSN study amount used for wind generation. Technically, that generator would be deliverable based on the ISO's methodology, but most likely it would not be economically viable because the resource would be excessively curtailed. In addition, if a large number of wind resources were behind similar constraints, that would burden the market system and the operation of the grid and potentially cause reliability issues. Going further, the Joint Framework Proponents appear to be recommending that it would be acceptable to put that same 100 MW wind generator behind a 14 MW transmission constraint (the NQC value of the wind generator is 14 MW) which would clearly not be economically viable. It would also burden the market system and compromise the operation and reliability of the grid.

The ELCC-based NQC values for solar and wind resources are based on stochastic simulations looking at the future operation of all resources during the summer months when resource shortages are most likely. The values represent a theoretical equivalent generator. In the example above, the 100 MW wind generator is deemed to provide the same average contribution to overall reliability across a period of time as a 14 MW generator that is able to produce 14 MW in all hours. In reality, the individual wind generator will be producing 0 MW in many hours, but many hours it will produce much more than 14 MW. If it were transmission constrained to only 14 MW of output, it would no longer be equivalent to a 14 MW perfect generator.

The ISO has analyzed a simple example of two wind generation resource IDs using actual wind generation production data. Using September 1, 2022 data, which was during a prolonged heat event, the two generators combined were only able to meet their combined QC amount during hour 18. If the two resources were only deliverable up to their QC values then any production above their QC values would have been curtailed. Under those circumstances approximately 20% of the MW capacity would have been curtailed and only 83% of the QC would have been provided to the system during hour 18. September 6, 2022 was also part of the heat event and was a higher wind day. On that day, having to curtail the generation to its QC values would result in the loss of 50% of the wind production during the HSN period. During most SSN and HSN hours of September 1, 2022 the two unconstrained wind resources combined were not able to meet their combined NQC amount. This however was compensated by the overproduction on September 6, 2022, but if that overproduction would have been curtailed as described, then the reliability benefit of the wind would not have been equivalent to their NQC values over those two critical days.

The CPUC adopted a decision to replace the ELCC approach with a "Slice of Day" approach and an exceedance methodology. The ISO will continue to monitor development of NQC values, and evaluate the need for further updates to its deliverability methodology.

Regarding Recurrent Energy's suggestion that the ISO consider a scaling factor to the generators dispatched because not all queued generation within a geographic area will achieve COD, the ISO believes that issue is already addressed. One of the considerations in identifying constraints as Area Constraints is a comparison of the quantity of generators in the queue compared to the TPP resource portfolio that are behind the constraint. If there is more generation in the queue than in the TPP resource portfolio, that constraint is typically identified as an Area Constraint and the associated upgrade costs are not assigned to the interconnection customers.

CAISO Proposal

The ISO is not proposing any changes to dispatch levels and believes that its methodology for determining dispatch levels in the deliverability studies is reasonable. However, the dispatch levels do need to be monitored and updated periodically. The ISO notes that the CPUC is in the process of developing exceedance values as part of its slice-of-day implementation. The ISO will review the CPUC's analysis, as well as any changes to other local regulatory authorities' resource valuation methodologies, and reevaluate the deliverability assumptions as needed.

4.3 Simultaneous dispatch within a study area

The purpose of the ISO's deliverability test is to demonstrate that the available generation capacity in any electrical area can be run and delivered simultaneously, at peak load, and that the excess energy above load in that electrical area can be exported to the remainder of the Balancing Authority Area.

Stakeholder Inputs

BAMx commented that while it is true that during the August 2020 and August and December 2022 stressed system conditions, the ISO needed access to all available resources, this was due to a lack of generation capacity, not a lack of transmission capacity. The Joint Framework Proponents provided the following quote from PJM Manual 14B regarding the purpose of its deliverability test: , "…its purpose is to demonstrate that the installed capacity in any electrical area can be run simultaneously, and that the excess energy above load in that electrical area can be exported to the remainder of PJM…" The Joint Framework Proponents also recommended that the ISO consider the same flow impact levels being used by PJM for determining the generation circle behind constrained deliverability flowgates. PJM uses 5% DFAX for all constrained transmission lines up to 500 kV and 10% DFAX for all constrained transmission lines at 500 kV and above. The Joint Framework Proponents also commented that they understand that the ISO intends to deal with the issue of local versus system deliverability designation as part of a separate stakeholder process on RA capacity and they support that decision. The Joint Framework Proponents believe that many of the technical criteria for determining local deliverability designation should be addressed as part of this initiative due to its highly technical content that is dependent on transmission-related studies.

Discussion

The ISO has reviewed the comment about using 5% or 10% DFAX for 500 kV line overload constraints to identify generators whose deliverability is constrained, and reviewed previous study results. We found that with the 5% DFAX currently used as the threshold for 500 kV line overloads, the electrical and geographic area captured within the group can include multiple interconnection study areas. Given this observation on the ISO system and PJM's change to use a 10% DFAX for similar facilities, the ISO concurs with the stakeholder comment to use a 10% DFAX threshold for 500 kV line overload constraints.

The ISO has also considered the comment to consider some aspects of the local resource deliverability comment because of the highly technical content that is dependent on transmission-related studies. However, the ISO will have transmission planning engineers participating in the RA capacity initiative, who will be able to address issues with highly technical content.

CAISO Proposal

The ISO proposes to raise the 5% DFAX threshold for 500 kV line overload constraints to 10%. This is expected to be a more practical threshold for including the generators that have a significant impact on the 500 kV line overload constraint and exclude generators that have an insignificant impact on the high capacity and low impedance 500 kV constraint.

4.4 The study of n-2 contingencies

The ISO on-peak deliverability assessment methodology currently includes n-1 and n-2 contingencies. NERC Reliability Standard FAC 002, Facility Interconnection Studies, is an applicable reliability standard for generation interconnection studies. It requires steady-state, short-circuit, and dynamics studies as necessary to evaluate system performance under both normal and contingency conditions in accordance with Reliability Standard TPL-001. NERC Reliability Standard TPL-001 requires common mode n-2 contingency analysis. The generator interconnection and deliverability allocation procedures (GIDAP) tariff language requires a reliability study which consists of steady-state, short-circuit, and dynamics studies and deliverability studies which consist of a steady state study of a comprehensive variety of severely stressed conditions.[13] Mitigation plans are identified for reliability concerns found in the dynamics and short-circuit study. Mitigation plans are also identified for steady state concerns. The reliability studies tend to be an assessment of the maximum output of the generation in the interconnection study and are almost always studying more stressed system conditions than the deliverability studies. N-1 contingency overloads identified in the reliability studies, which are more severe than the deliverability study results, are addressed by congestion management. N-2 contingency overloads in the reliability studies are also almost always more severe than in the deliverability studies. However, congestion management is not a feasible mitigation for most n-2 contingencies because there are limits to the ability of the market to manage all n-2 contingencies simultaneously. As a result, they can only be considered during real-time operation selectively during periods of elevated risk of the n-2 outage occurring. Protecting for an n-2 contingency through this vehicle is therefore not acceptable if the consequences of the n-2 contingency are too severe.

Additionally, excessive reductions of output on a sustained basis to manage the risk of an n-2 contingency contradict the premise that the resources should be available to serve load. Therefore, remedial action schemes (RAS) or system upgrades are needed to mitigate n-2 contingencies. The deliverability study assumptions are designed to be plausible and reasonable; however, the dispatch of resources in the reliability studies are considered to represent a worst-case scenario. RAS will be utilized to mitigate n-2 constraints identified in both the reliability and the deliverability studies. If RAS is not sufficient, system upgrades are identified as needed in the planning horizon based on the deliverability study.

Stakeholder Input

In response to the Issue Paper, Cal Advocates recommends further discussion on whether n-2 contingencies should be evaluated in the CAISO's generation interconnection deliverability studies. Cal Advocates also makes the distinction that generator interconnection studies include separate reliability and deliverability studies. The reliability studies should consider the grid's performance under normal and contingency conditions in compliance with the NERC planning standards. The deliverability studies, in contrast, should determine if generators can operate at their maximum capacity without being constrained by the electrical system.

AES Clean Energy believes the deliverability study methodology is beyond NERC requirements.

The Joint Framework Proponents commented that reliability upgrades that currently come out of the generation interconnection procedures (GIP) are limited as they are based on a very limited set of reliability studies. To address any concerns about reliability not currently

[13] Appendix DD of the CAISO Tariff

addressed in the Generator Interconnection Process, an additional reliability test with an expanded scope could be added to the GIP. Such reliability studies should use generation dispatch similar to the one used in TPP reliability studies, including re-dispatch of resources.

Discussion

NERC TPL-001-5 states the following as its purpose: "Transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System (BES) that will operate reliably over a broad spectrum of System conditions and following a wide range of probable Contingencies (sic)." NERC TPL-001-5 includes n-2 contingences as within the wide range of probable contingencies, as shown in Table 1 of the standard. Within the NERC prescribed criterion of analyzing a broad spectrum of system conditions, it is prudent to analyze peak load conditions when all available resources within a limited area are needed to meet overall system load.

The CAISO's current reliability and deliverability studies are required to ensure the reliability and deliverability of the resources interconnected. Establishing a bright line between the two studies can be challenging to ensure that there are no gaps.

NERC Transmission Planning Standard TPL-001-5, Table 1 states that "Planned System adjustments such as transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings." Therefore, redispatch of resources needed to mitigate flows above short-term emergency facility ratings must be done before the contingency occurs (precontingency redispatch). As a result, in the reliability studies, resources cannot be relied upon in the planning horizon for any amounts that require precontingency redispatch. The ISO agrees that generation dispatch similar to the framework used in the TPP reliability studies is a reasonable approach. However, unlimited precontingency redispatch is not reasonable. The deliverability studies ensure that precontingency redispatch is not unlimited. Removing n-2 contingencies from the deliverability studies would require major revisions to the reliability studies to ensure that precontingency redispatch is not unlimited. TPL-001-5 also states that "Applicable Facility Ratings shall not be exceeded". Therefore, with these two statements from TPL-001-5, any contingency overloads identified in well-reasoned base case dispatch assumptions are intended to be mitigated in the long-term transmission planning horizon by transmission upgrades. The deliverability studies provide a systematic and transparent method for producing a well-reasoned base case dispatch for local generation pockets. The ISO process relies on both the deliverability studies and reliability studies to meet the NERC standards and to ensure deliverability.

Based on stakeholder feedback, the ISO is proposing revisions below to both the deliverability and reliability studies to ensure that we continue to maintain reliability and deliverability without creating gaps.

CAISO Proposal

As stated, the ISO is required by NERC to study n-2 contingencies on double-circuit towers, as are other ISOs such as MISO and PJM. Therefore, the ISO does not intend to change this practice. Further, the ISO is concerned that discontinuation of the n-2 contingency studies would lead to sub-optimal results that would need to be addressed and resolved – albeit less effectively and less timely - in the Transmission Planning Process (TPP). To continue to comply with NERC requirements and avoid additional delays associated with the time required to mitigate n-2 contingencies, the ISO is proposing a risk based approach and resulting policy changes to provide some form of interim deliverability for resources while waiting for the related n-2 deliverability upgrades to be completed. This award could only be considered in cases where reliability concerns do not exist.

As explained in detail above, NERC Standard TPL-001 requires the analysis and mitigation of n-2 contingencies. The ISO process relies on the deliverability studies and reliability studies to meet the NERC standards and to ensure deliverability. Both the operations and planning criteria do not allow cascading[14] outages following an n-2 contingency. Therefore, if a cascading outage risk is identified or if the n-2 contingency is considered always credible in the operations horizon, then the mitigation for that contingency would be required before additional generation projects behind that constraint could become deliverable. However, if the n-2 contingency results in an overloaded facility, but not cascading outages, then upgrades would be required but would not prohibit additional generation projects from becoming deliverable. The additional generation projects would be eligible for a conditional deliverability status during the development period of the transmission upgrades necessary to mitigate the n-2 contingency, assuming that no other constraints are binding. Unlike interim deliverability, conditional deliverability would not be lost just because earlier queued projects come on-line, assuming that no other constraints are binding.

4.5 ADNU/LDNU guidelines

Section 6.1.1.3 in the GIDAP Business Practice Manual_and Section 6.3.2.1.1 of the GIDAP tariff language_show that transmission constraints identified in the On-Peak deliverability study are classified as Area Deliverability Constraints (ADC) and Local Deliverability Constraints (LDC). In that framework, constraints with large amounts of generation behind them that trigger large, high-cost network upgrades are classified as Area Constraints, and corresponding Area Delivery Network Upgrades (ADNU) are identified. This framework is designed to avoid the identification of excessive delivery network upgrades that would be considered required and allocated among all the interconnection customers in the area in that application window despite only being needed for generation amounts far beyond the expected amount of generation development in the ISO's long-term transmission planning process based on state agency input. Section 6.1.1.4 of the GIDAP BPM provides the guidelines for determining which constraints are Area Constraints. This section was updated

[14] See explanation of cascading in Section L. http://www.caiso.com/Documents/RC0610.pdf

in the July 2020 BPM change management process.[15] The general direction of the updates was to lower the guideline parameters so that high cost Local Delivery Network Upgrades (LDNUs) would be classified as ADNUs. For example, the cost threshold in guideline ADC-C3 was lowered from $100 M to $50 M. Also, a new guideline ADC-C4 was added that if a constraint impacts 10 or more new and existing generators, and the mitigation costs more than $20 million, that would be an Area Constraint. This has, as expected, reduced the number of LDNUs and increased the number of Area Constraints identified.

Stakeholder Input

PG&E recommends CAISO re-evaluate the Area Deliverability Constraints criteria in effect (BPM GIDAP 6.1.1.4) since the amount of Area Delivery Network Upgrades identified were restricting generators from Deliverability allocation. To elaborate, PG&E noticed that the renewable base portfolio mapped to the electric circle is usually underestimated, making it easy for the total MW amount inside the electric circle to exceed the base portfolio value. This results in an auto-satisfaction of criteria in ADC-C3 and ADC-C4 and eventually makes a constraint easily qualified for an Area Deliverability Constraint. Once all ADCs are identified, the generators behind an ADNU are not required to build the network upgrade, so there is no pathway for the Interconnection Customers (ICs) who are willing to fund the upgrade and acquire the deliverability. The cost threshold re-evaluation is also recommended to accommodate the inflation rate increase after the deliverability methodology update in 2019. Overall, PG&E desires that a reasonable number of ADCs can be converted into Local Deliverability Constraints (LDC) and offer a pathway for ICs to fund the upgrade coming out of this ADC criteria re-evaluation.

Discussion

One of the considerations driving the BPM change in 2020 to the area and local constraint classification guidelines was to process the approval of all major transmission upgrades through the ISO's open TPP stakeholder process, and for upgrades costing more than $50 million to obtain ISO Board Approval. This was expected to facilitate construction permitting. Another consideration was to remove the financial burden of high-cost transmission projects from generation developers.

CAISO Proposal

The ISO seeks additional stakeholder comments on the need for revising the guidelines for identifying ADCs. Because this concern was not identified in the Issue Paper, we have not proposed any modifications at this time. However, the following options are under consideration for comments and discussion.

[15] http://www.caiso.com/Documents/Presentation-BusinessPracticeManualChangeManagementJul282020.pdf

- Option 1: Raise the cost threshold in the Area Constraint guideline for ADC-C4 to $25 M in current dollars.
- Option 2: Raise the cost threshold in the Area Constraint guideline for ADC-C4 to $35 M in current dollars.
- Option 3: Eliminate the Area Constraint guideline ADC-C4.

4.6 Delayed deliverability upgrades

Currently, a generator must wait for all reliability and deliverability network upgrades to be in-service before it can receive FCDS. As stated in the Straw Proposal paper, the ISO understands the disruptions resulting from delayed PTO timelines for deliverability upgrades, and will explore the provision of some form of interim deliverability to projects affected by delayed network upgrades through a risk-based approach.

Stakeholder Input

Wellhead Electric Company, Inc. commented that in the Transmission Development Forum it is clear that network upgrade timelines are being continuously delayed, sometimes for eight years or more (given how often dates are pushed out.) This puts the state's clean-energy goals, mid-term procurement, and reliability goals at risk. With Participating Transmission Owner construction timelines triggering such a profound increase in the amount of development uncertainty, CAISO must modify its deliverability methodology to grant deliverability when the barriers to preventing deliverability assignment are highly unlikely to occur or harm reliability.

Discussion

The ISO understands that delays to in-service dates for transmission upgrades needed for achieving deliverability status can sometimes result in resource development owners missing deadlines under their power purchase agreements (PPA). This can also result in the PPA counterparty not meeting RA requirements, forcing it to procure a different alternative resource at higher costs.

CAISO Proposal

The ISO tracks resource and transmission in-service dates and determines when a resource will achieve its allocated deliverability status. Therefore, the ISO is able to verify when transmission projects are delayed and when that causes a delay in an on-line resource achieving deliverability status. When this occurs, the ISO proposes to provide conditional deliverability based on the original schedules, accepting the risk of deliverability constraints for the interim period, rather than disrupting the resource procurement cycle. Unlike interim deliverability, for the transmission constraint that would be mitigated by the delayed transmission project, conditional deliverability would not be lost simply because earlier queued projects come on-line.

5 Next Steps

In this straw proposal, the CAISO has summarized stakeholder's comments and proposed revisions to the deliverability assessment to address stakeholders' concerns regarding the methodology. The CAISO will hold the second stakeholder meeting on August 29, 2023 to review this straw proposal and solicit input for the final proposal.

Date	**Milestone**
August 22, 2023	Straw proposal posting
August 29, 2023	Stakeholder call on straw proposal
September 12, 2023	Comments due on straw proposal
October 9, 2023	Draft final proposal posting
October 16, 2023	Stakeholder call on draft final proposal
October 30, 2023	Comments due on draft final proposal
Winter 2023*	Board of Governors approval