Off-Peak Deliverability Assessment Methodology

1.0 Introduction

The ISO modified its on-peak deliverability assessment to reflect the changing contribution of solar to meeting resource adequacy needs. Additional solar resources provide a much lower incremental reliability benefit to the system than the initial solar resources, because their output profile ceases to align with the peak hour of demand on the transmission system which has shifted to later in the day due to the proliferation of behind-the-meter solar. As a result, there is a reduced need for transmission upgrades to support deliverability of additional solar resources for resource adequacy purposes. Generation developers have been relying on transmission upgrades required under the previous on-peak deliverability assessment methodology to ensure that generation would not be exposed to excessive curtailment due to transmission limitations. Although transmission upgrades to deliver renewable energy reliably and economically are evaluated and approved through the ISO transmission planning process, concerns remain with the ability of the transmission planning process to identify the upgrades on a timely basis to facilitate generation development, especially local transmission upgrades that depend on the exact point of interconnection of the future generation. Therefore, the off-peak deliverability methodology was developed to address renewable energy delivery during hours outside of the summer peak load period to ensure some minimal level of protection from otherwise potentially unlimited curtailment.

2.0 Principles of Off-Peak Deliverability Assessment

The off-peak deliverability assessment is not for resource adequacy purposes. It is a supplemental study that focuses on renewable energy delivery during hours outside of the summer peak load period. The objective of the off-peak deliverability assessment is to identify transmission upgrades needed to relieve excessive renewable curtailment caused by transmission constraints. It informs generators of their curtailment risk and how to reduce such risk at the early development stage. The off-peak deliverability assessment is built around the following principles:

1. Identify transmission bottlenecks that would cause excessive renewable curtailment, but the study assumptions should focus on system conditions when a system-wide oversupply of resources is not likely.
2. Identify transmission upgrades for local constraints that tend to be less expensive. The need for such upgrades are highly dependent on the development of specific generation projects interconnecting in a small localized area. These local constraints are hit by a relatively high simultaneous output of local generation before the system-wide oversupply situation occurs.

3. It is prudent to rely on the TPP framework to approve transmission upgrades for area constraints that tend to be expensive. For area constraints, the general placement of new renewable generation in the portfolio is sufficient to identify the need.
4. The curtailment risk is regardless of the generator's deliverability status, so this study should consider both full capacity and energy only generators.

3.0 Off-Peak Deliverability Assessment Modeling Assumptions

The general system study conditions should capture a reasonable scenario for the load, generation, and imports that stress the transmission system, but not coinciding with an oversupply situation. By examining the renewable curtailment data from 2018, a load level of about 55% to 60% of the summer peak load and an import level of about 6000 MW was selected for the off-peak deliverability assessment.

The production of wind and solar resources under the selected load and import conditions varies widely. The production duration curves for solar and wind were examined. The production level under which 90% of the annual energy was selected to set the outputs to be tested in the off-peak deliverability assessment. As seen in Figure 1 and Figure 2, the 90% energy levels are 68% of installed capacity for solar and 44% for wind.

Figure 1: Normalized CAISO Total Solar Output Duration Curve

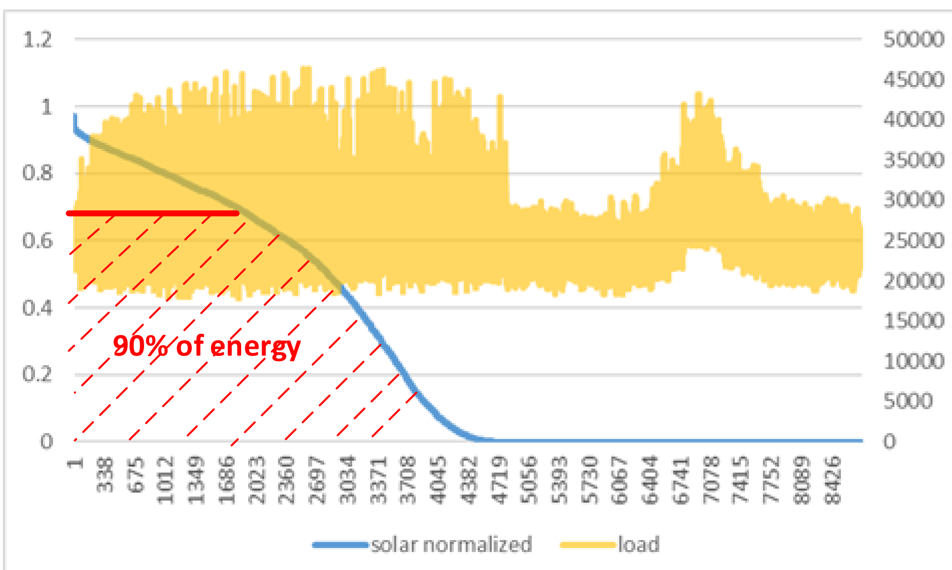
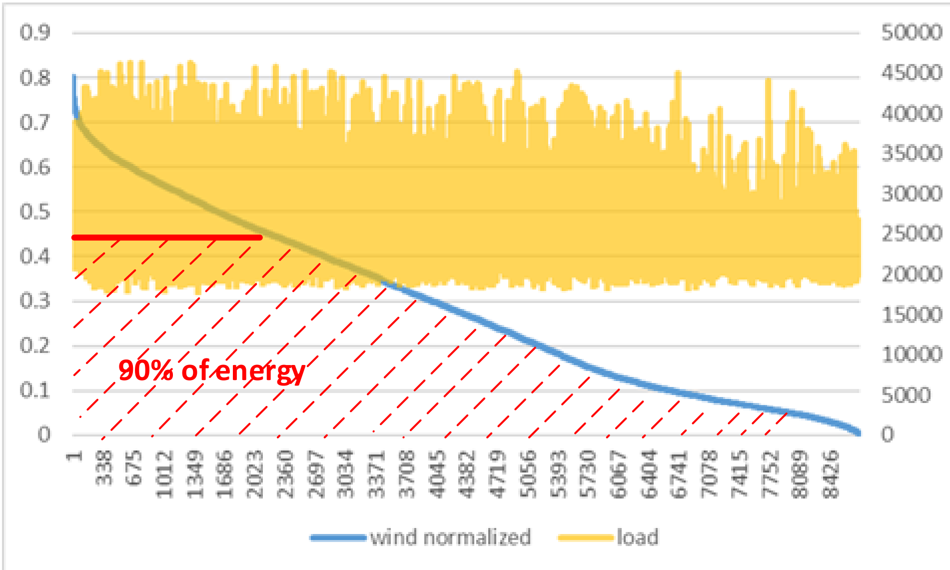


Figure 2: Normalized CAISO Total Wind Output Duration Curve



The dispatch of the remaining generation fleet is set by examining historical production associated with the selected renewable production levels. The hydro dispatch is about 30% of the installed capacity and the thermal dispatch is about 15%. All energy storage facilities are assumed offline.

The dispatch assumptions discussed above apply to both full capacity and energy-only resources. However, with the large amount of generation in the interconnection study queue, it is impossible to balance load and resources under such conditions with all queued generation dispatched. The dispatch assumptions are applied to all existing generators first, then some future generators if needed to balance load and resources. This establishes a system-wide dispatch base case that is the starting case for developing each of the study area base cases to be used in the off-peak deliverability assessments. Table 1 summarizes the generation dispatch assumptions in the starting base case.

Table 1: CAISO System-Wide Generator Dispatch Assumptions

	Dispatch Level
wind	44%
solar	68%
battery storage	0
hydro	30%
thermal	15%

The off-peak deliverability assessment models all the approved transmission upgrades, as well as RNUs and LDNUs required under the on-peak deliverability assessment.

4.0 <u>Off-Peak Deliverability Assessment Procedure</u>

The off-peak deliverability assessment is performed for each study area separately. The study areas in general are the same as the reliability assessment areas in the generation interconnection studies. However, to avoid excessive generation being dispatched in one study area, one reliability assessment area may be broken into several smaller gen-pockets that separate wind/solar areas and align with TPP study areas. Below is the preliminary list of the study areas –

- PG&E north
- PG&E Fresno
- PG&E Kern
- SCE Northern
- SCE North of Lugo
- SCE/VEA/GWL East of Pisgah
- SCE/DCRT Eastern
- SDGE Inland
- SDGE East

Study area base cases are created from the system-wide dispatch base case. All generators in the study area, existing or new, are dispatched to a consistent output level. In order to capture local curtailment, the renewable dispatch is increased to the 90% energy level for the study area, which is higher than the system-wide 90% energy level. The study area 90% energy level was determined from representing individual plants in different areas.

If the renewables inside the study area are predominantly wind resources (more than 70% of total study area capacity), increase wind resource dispatch as shown in Table 2. All the solar resources in the wind pocket are dispatched at the system-wide level of 68%. If the renewables inside the study area are not predominantly wind resources, then the dispatch assumptions in Table 3 are used.

Table 2: Local Area Solar and Wind Dispatch Assumptions in Wind Area

	Wind Dispatch Level	Solar Dispatch Level
SDG&E	69%	68%
SCE	64%	
PG&E	63%	

Table 3: Local Area Solar and Wind Dispatch Assumptions in Solar Area

	Solar Dispatch Level	Wind Dispatch Level
SDG&E	79%	44%
SCE	77%	
PG&E	79%	

As the generation dispatch increases inside the study area, the following resource adjustment can be performed to balance the loads and resources:

- Reduce new generation outside the study area (staying within the Path 26, 4000 MW north to south, and 3000 MW south to north limits).
- Reduce thermal generation inside the study area.
- Reduce imports.
- Reduce thermal generation outside the study area.

Once each study area case has been developed, a contingency analysis is performed for normal conditions and selected contingencies:

- Normal conditions (P0).
- Single contingency of transmission circuit (P1.2), transformer (P1.3), single pole of DC lines (P1.5) and two poles of PDCI if impacting the study area.
- Multiple contingency of two adjacent circuits on common structures (P7.1) and loss of a bipolar DC line (P7.2).
- Two adjacent transmission circuit according to WECC's Project Coordination, Path Rating and Progress Report Processes.

For overloads identified under such dispatch, resources that can be re-dispatched to relieve the overloads are adjusted to determine if the overload can be mitigated:

- Existing energy storage resources are dispatched to their full four hour charging capacity to relieve the overload.
- Thermal generators contributing to the overloads are turned off.
- Imports contributing to the overloads are reduced to the level required to support out-of-state renewables in the RPS portfolios.

The remaining overloads after the re-dispatch will be mitigated by the identification of transmission upgrades. First, the overloads are identified as local constraints or area constraints. The CAISO will apply a local vs. area constraint classification methodology similar to the on-peak deliverability assessment. Then, the transmission upgrades to mitigate local constraints are labeled as off-peak local network upgrades and the transmission upgrades to mitigate area constraints are labeled as off-peak area network upgrades. Generators with 5% or higher distribution factor on the constraint are considered contributing generators. The distribution factor is the percentage of a particular generation unit's incremental increase in output that flows on a particular transmission line or transformer under the applicable contingency condition when the displaced generation is spread proportionally, across all dispatched resources available to scale down output proportionally. Generation units are scaled down in proportion to the dispatch level of the unit.