Interactions of CIRs/deliverability and ELCC Studies

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- “**Nameplate power**” is a rough term referring to the maximum MW output capability of a generator. The GADS term “Net Maximum Capacity” is a more precise formulation of something similar.
- “**Effective Load Carrying Capability**” or “**ELCC**” is the method PJM uses to calculate the maximum amount of capacity that renewables & storage can offer into the capacity market.
- “**Installed Capacity**” or “**ICAP**” is a longstanding term that, under ELCC, has limited application to wind and solar resources (and other Variable Resources). ICAP is roughly the tested power capability during summer peak load conditions (related to nameplate, but much closer to GADS “Net Dependable Capacity” in hot summer months, because ICAP is derated for challenging hot summer ambient conditions).
- “**Effective Nameplate Capacity**” or “**ENC**” is a new term used in ELCC calculations. It is generally equal to the Maximum Facility Output recorded in a resource’s Interconnection Service Agreement. It is similar to nameplate, except the ENC for storage resources is derated if they have a shorter duration than their class. It plays a similar role to ICAP, but for renewables and storage.

Terminology Review

- **"UCAP"** is the amount of Capacity a resource can sell or otherwise provide in the Capacity Market (i.e., UCAP is a measure of resource adequacy).
  - Accredited UCAP or "**AUCAP"** is the UCAP value that results from the ELCC accreditation process.
- For discussion purposes**, "deliverability"** refers to the ability of the transmission system to accommodate the full provision of a service. Often used in the context of resource adequacy (i.e., Capacity).
- For discussion purposes**, "tested deliverability"** refers to the MW level to which the transmission system has been stress tested for a given generation capacity resource.
- **"Capacity Interconnection Rights"** or "**CIRs"** are a generator's right to inject into the transmission system. CIR MWs are enabled by (not equal to) the **tested deliverability** that is maintained on the transmission network for that resource.
- Because of variable availability for all resource types, transmission system **tested deliverability** usually ought to be equal to or higher than the **UCAP** level.
  - E.g., a 100 MW gas generator that is entirely broken every other week has a 50 MW UCAP but still needs 100 MW of deliverability.
- PJM will only count on resource adequacy (i.e., Capacity) that is deliverable.
  - **There is therefore an interaction between the amount of capacity a resource can sell, and the amount of tested transmission system deliverability that has been validated by PJM to enable that capacity.**

Current Approach to Accounting for Deliverability in Capacity Value Accreditation

- ***There is therefore an interaction between the amount of capacity a resource can sell, and the amount of tested transmission system deliverability that has been validated by PJM to enable that capacity.***
- Under both the pre-ELCC method and the current ELCC, a resource cannot be accredited for capacity higher than CIRs.
- Today, CIR MWs are equal to tested deliverability MWs.
- Under ELCC, any historically observed curtailments are included in the ELCC model and the resource's accreditation, which further accounts for empirical deliverability in the capacity/UCAP accreditation process.
- These methods together are today's approach to ensuring that capacity from ELCC Resources is deliverable.

PJM believes that, under high renewables deployment, a new approach to accounting for deliverability in UCAP accreditation is necessary. In particular, it will be important that the transmission system is tested for all meaningful hourly injection levels accounted for in the ELCC accreditation process.

- *I.e., the hourly output used for a resource in the UCAP accreditation method does not exceed that resource's tested transmission deliverability level.*

Illustration of the Need to Incorporate Tested Deliverability Levels into Hourly Analysis

- Imagine the entire 100,000 MW PJM wind fleet produces 30,000 MW on Monday and 0 MW on Tuesday. There is equally high loads on both Monday and Tuesday.
- The ELCC model has been calibrated to 1-in-10 LOLE based on zero load shed on Monday, and one load shed event on Tuesday.
- However, the transmission system has not been tested to withstand 30,000 MW of wind in peak load conditions.
  - It has only been tested to 13,000 MW of wind in peak load conditions.
- Therefore, 17,000 MW of wind is being counted on in the ELCC model to avoid load shed on Monday, without any tested basis for ensuring the transmission system can withstand that scenario.
- If the transmission could not withstand that higher level of wind output, the risk of load shed on Monday would be higher than expected.
- The risk associated with this type of scenario could be characteristic of a high-renewables future. It is not captured in the ELCC model today.

Example—Pre-ELCC Accreditation for Wind/Solar: Output Above Tested Deliverability Level Counts

- The “368-hour Rule” in Manual 21 Appendix B sets both the pre-ELCC UCAP levels & the ongoing CIR eligibility/retention of wind/solar based on the **average output across all summer afternoons*** of the last 3 years.

- For example, a hypothetical 100 MW wind unit that during summer afternoons makes 26 MW half the time, and 0 MW the other half of the time, has a 13 MW average summer afternoon output→ 13 MW UCAP, can retain 13 MW of CIRs.

Note: w/ 13 MW of CIRs, there is 13 MW of tested deliverability

Note: even though the 13 MW of capacity is deliverable under today’s standards, ***half of the 26 MW hourly output is above the tested deliverability level. Further note: those MWs can & will still flow in operations if the transmission system has the capability.***

Note: such a wind resource is today not eligible to request 26 MW of CIRs—they are limited to only 13 MW.

**Summer is June, July, and August, afternoon is hour ending 3, 4, 5, and 6 PM Local Prevailing Time*

*Note: w/ 13 MW of CIRs, there is 13 MW of tested deliverability → **half of the 26 MW hourly output is above the tested deliverability level.***

PJM believes that, under high renewables deployment, it will be important that the transmission system is tested for all meaningful hourly injection levels accounted for in the ELCC accreditation process.

- *I.e., that **the hourly output used for a resource in the UCAP accreditation method does not exceed that resource's tested transmission deliverability level**.*

Example—Theoretical Alternative Approach to Status Quo Deliverability Levels for Wind/Solar

- *For example, a hypothetical 100 MW wind unit that during summer afternoons makes 26 MW half the time, and 0 MW the other half of the time, has a 13 MW UCAP and can retain 13 MW of CIRs for 13 MW of tested deliverability*
- If this resource were studied for tested deliverability up to the maximum (not average) summer afternoon output (i.e., 26 MW), then it (and PJM) could ensure that all of its output would be at or below the tested deliverability level.
- In that case, the unit would have a UCAP of 13 MW but a tested deliverability level of 26 MW.

Example for Illustration Only—Cap Hourly Output at Deliverability Level in Pre-ELCC Accreditation Method

- *For example, a hypothetical 100 MW wind unit that during summer afternoons makes 26 MW half the time, and 0 MW the other half of the time, has a 13 MW UCAP and can retain 13 MW of CIRs for 13 MW of tested deliverability.*
- *If this resource were studied for tested deliverability up to the maximum (not average) summer afternoon output (i.e., 26 MW), then it (and PJM) could ensure that all of its output would be at or below the tested deliverability level.*
- How to handle two identical 100 MW wind farms, where Farm A has 26 MW of tested deliverability, and Farm B has only 20 MW?
- UCAP of Farm A is 13 MW, and all hourly output is at or below the tested deliverability level of 26 MW.
- Under high wind and solar levels, UCAP of Farm B should be lower, since 6 of the 26 MW are above the tested deliverability level.
- Solution: cap the hourly output values used for UCAP accreditation at the tested deliverability level (that is, at 20 MW for Farm B). Half the time the unit makes 0 MW, and half the time it makes 26 MW, but each 26 MW value is capped at 20 MW, and **so the resulting UCAP value for Farm B is 10 MW**.
  – Farm B is still eligible to request an uprate in tested deliverability up to the full 26 MW level, in which case its UCAP would rise to 13 MW.

Example Reflecting PJM Proposal—Cap Hourly Output at Tested Deliverability Level in ELCC Method

- **Under ELCC, different hours “count” more or less towards accreditation, with a pattern that shifts in time. Such pattern shifts are what drive changing ELCC Class Ratings.**
- Imagine that in 2023, the 26MW hours and 0MW hours “count” equally under ELCC (and no other hours “count”). This ELCC would have the same outcome as the 368-hour rule.
  - *How to handle two identical 100 MW wind farms, where Farm A has 26 MW of tested deliverability, and Farm B has only 20 MW?*
  - ***ELCC UCAP of Farm A is 13 MW****, & all hourly output is at or below the tested deliverability level of 26 MW.*
  - *Under high wind and solar levels, UCAP of Farm B should be lower, since 6 of the 26 MW are above the tested deliverability level. Solution: cap the hourly output values used for UCAP accreditation at the tested deliverability level (that is, at 20 MW for Farm B). Half the time the unit makes 0 MW, and half the time it makes 26 MW, but each 26 MW value is capped at 20 MW, and* ***so the resulting ELCC UCAP value for Farm B is 10 MW****.*
- Imagine that in 2026, ELCC results are 3x more sensitive to output in the 26 MW hours vs the 0MW hours (and no other hours “count”):
  - Each hour’s output capped at TestDelivMW, so HourlyOutputForELCC = MIN(ActualOutput,TestDelivMW).
  - Farm A, with 26 MW of TestDelivMW, has a **UCAP** now of 0.75*MIN(26,26) + 0.25*MIN(0,26) = **19.5 MW**, and all output is at or below tested deliverability level.
  - **Farm B, with 20 MW of TestDelivMW, has a UCAP now of** 0.75*MIN(26,20) + 0.25*MIN(0,20) = **15 MW**, since 6 MW is above the tested deliverability level.

Treatment Under ELCC with Changing ELCC Class Ratings

- Battery example: in 2023, the ELCC Class Rating for 4-hour storage is 75% (not the real value). In 2026, it goes up to 100% (also not real).
- Battery X and Battery Y both have 100 MW, 400 MWh and are in the 4 hour class.
- Battery X has 100 MW of CIRs and 100 MW of tested deliverability. Battery Y has 75 MW of CIRs and 75 MW of tested deliverability.
- The AUCAP of batteries is: EffectiveNameplateCapacity*ClassRating*(1-EFORd). Assume a 0% EFORd for this example (not the actual class average EFORd for batteries).
- **PJM proposes that the EffectiveNameplateCapacity of a battery cannot exceed the resource's tested deliverability level.**
- In 2023, the AUCAPs are:
  - Battery X = 100*75%*1 = 75 MW
  - Battery Y = 75*75%*1 = 56.25 MW
- In 2026, the AUCAPs are:
  - Battery X = 100*100%*1 = 100 MW
  - Battery Y = 75*100%*1 = 75 MW

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Examples of Solutions Incorporating CIRs into Accreditation

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