PJM Manual 21A:

Determination of Accredited UCAP Using Effective Load Carrying Capability Analysis

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Table of Contents

Approval 4

Current Revision 5

Introduction 6

Section 1: Overview, Applicability, Function of ELCC and Accredited UCAP, Definitions, and Classes 7
1.1 Function and Applicability of ELCC and Accredited UCAP 7
1.2 General Approach to Calculation of Accredited UCAP 8
1.3 ELCC Classes 8
1.3.1 The Hybrid Resource Classes 10
1.3.2 The Other Variable Resource Class 10
1.3.3. Administration of ELCC Classes 11
1.3.4 Mixed Technology Resources 12

Section 2: Overall Timeline for the ELCC Accreditation Process 13
2.1 Schedule for ELCC Results and Applicability 13

Section 3: Calculation of Accredited UCAP 14
3.1 Calculation of Accredited UCAP 14
3.2 Calculation of ELCC Resource Performance Adjustment 14

Section 4: Determination of Effective Nameplate 16
4.1 Effective Nameplate Capacity for Variable Resources and Combination Resources 16
4.2 Parameters for Variable Resources 17
4.3 Parameters for Limited Duration Resources (which Includes Energy Storage Resources) 17
4.4 Parameters for Combination Resources Other than Hydropower with Non-Pumped Storage 17
4.5 Parameters for Hydropower with Non-Pumped Storage 18

Section 5: Data Submission and Validation 20
5.1 Introduction 20
5.2 Required Information 21
5.2.1 Onshore Wind and Solar 22
5.2.2 Variable Resources Other Than Onshore Wind and Solar 23

5.2.3 Energy Storage Resources Including Pumped Storage Hydropower.....24
5.2.4 Combination Resources (Other than Hydropower with Non-Pumped Storage).....25
5.2.5 Hydropower with Non-pumped Storage.....25

Section 6: Backcasts.....28

Revision History..... 29

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- Initial version of Manual 21A describing business practices for collecting information to develop ELCC Class Ratings and for calculating Accredited UCAP values based on ELCC Class Ratings.

Introduction

Welcome to the **PJM Manual for Rules and Procedures for Determination of Generating Capability**. In this Introduction, you will find the following information:

- What you can expect from the PJM Manuals in general (see “About PJM Manuals”).
- What you can expect from this PJM Manual (see “About This Manual”).
- How to use this manual (see “Using This Manual”)

Section 1: Overview, Applicability, Function of ELCC and Accredited UCAP, Definitions, and Classes

1.1 Function and Applicability of ELCC and Accredited UCAP

Effective load carrying capability (ELCC) analysis provides ELCC Class Ratings for each applicable class (e.g., onshore wind, tracking solar, 4-hour energy storage resource, etc.) that in part determine the Accredited UCAP of ELCC Resources (a broad category that includes most renewable resources and storage resources). The Accredited UCAP in turn sets a cap on the amount of UCAP that such resources can offer or otherwise provide in the Capacity Market.

The effective load carrying capability analysis identifies a scenario in which the aggregate installed capacity "Y" of a group of Unlimited Resources with no outages yields the same annual loss of load expectation as the one produced by the scenario with all ELCC Resources that are expected to offer in a given RPM Auction, or otherwise provide capacity, in the Delivery Year being analyzed. The ELCC Portfolio UCAP is the value "Y". The ELCC Portfolio UCAP is allocated to each applicable class to yield the ELCC Class UCAP, from which the ELCC Rating is in turn derived, as described in PJM Manual 20.

The Reliability Assurance Agreement (RAA) provides the following definitions which establish the applicability of ELCC and define broad types of resources that are treated differently in the calculation of Accredited UCAP:

*"**Accredited UCAP**" shall mean the quantity of Unforced Capacity, as denominated in Effective UCAP, that an ELCC Resource is capable of providing in a given Delivery Year.*

***"ELCC Resource"** shall mean a Generation Capacity Resource that is a Variable Resource, a Limited Duration Resource, or a Combination Resource.*

***"Variable Resource"** shall mean a Generation Capacity Resource with output that can vary as a function of its energy source, such as wind, solar, run of river hydroelectric power without storage, and landfill gas units without an alternate fuel source. All Intermittent Resources are Variable Resources, with the exception of Hydropower with Non-Pumped Storage.*

***"Limited Duration Resource"** shall mean a Generation Capacity Resource that is not a Variable Resource, that is not a Combination Resource, and that is not capable of running continuously at Maximum Facility Output for 24 hours or longer. A Capacity Storage Resource is a Limited Duration Resource.*

***"Combination Resource"** shall mean a Generation Capacity Resource that has a component that has the characteristics of a Limited Duration Resource combined with (i) a component that has the characteristics of an Unlimited Resource or (ii) a component that has the characteristics of a Variable Resource.*Examples of combination resources include solar+battery hybrids and Hydropower with Non-Pumped Storage.

*"**Unlimited Resource**" shall mean a generating unit having the ability to maintain output at a stated capability continuously on a daily basis without interruption. An Unlimited Resource is a Generation Capacity Resource that is not an ELCC Resource.*

1.2 General Approach to Calculation of Accredited UCAP

As further described in Section 3 below, the calculation of the Accredited UCAP of an ELCC Resource is generally derived from the product of:

1. The Effective Nameplate Capacity of the resource X
2. The ELCC Class Rating of the applicable class X
3. The ELCC Resource Performance Adjustment

For Hydropower with Non-Pumped Storage, the Accredited UCAP is the product of: [the total ICAP of all units at the plant when running simultaneously]; the plant-specific ELCC Class Rating; and the Performance Adjustment.

The Performance Adjustment (described in detail in Section 3.2) is derived from actual output for Variable Resources, and is derived from (1-EFORd) for other ELCC Resources.

The RAA provides the following definitions for these terms:

*"**Effective Nameplate Capacity**" shall mean (i) for each Variable Resource and Combination Resource, the resource's Maximum Facility Output; (ii) for each Limited Duration Resource, the sustained level of output that the unit can provide and maintain over a continuous period, whereby the duration of that continuous period matches the characteristic duration of the corresponding ELCC Class, with consideration given to ambient conditions expected to exist at the time of PJM system peak load, to the extent that such conditions impact such resource's capability.*

*"**ELCC Class Rating**" shall mean the rating factor, based on effective load carrying capability analysis, that applies to ELCC Resources that are members of an ELCC Class as part of the calculation of their Accredited UCAP.*

*"**ELCC Resource Performance Adjustment**" shall mean the performance of a specific ELCC Resource relative to the aggregate performance of the ELCC Class to which it belongs as further described in RAA, Schedule 9.1, section E.*

1.3 ELCC Classes

The ELCC Classes are as listed and defined in the RAA. ELCC Classes fall into one of three categories: Variable Resources, Limited Duration Resources, and Combination Resources. The listing is reproduced here for convenience:

The following are the ELCC Classes for Variable Resources:

- Tracking Solar Class
- Fixed-Tilt Solar Class
- Onshore Wind Class
- Offshore Wind Class
- Landfill Gas Class
- Intermittent Hydropower Class

- Other Variable Resource Class

The following are the types of ELCC Classes for Limited Duration Resources:

- The type of Capacity Storage Resource Classes, with different classes for 4, 6, 8, and 10-hour durations.
- The type of Other Limited Duration Resource Classes, with different classes for 4, 6, 8, and 10-hour durations.

The following are the ELCC Classes for Combination Resources:

- The types of Hybrid Resource Classes, as further specified below
- Hydropower With Non-Pumped Storage Class
- Complex Hybrid Class
- The types of Other Limited Duration Combination Classes, as further specified below

An Energy Storage Resource of "X" hours duration is capable of running continuously at its Effective Nameplate Capacity power level for X hours starting with a full state of charge under conditions of highest risk of shortage on the PJM system, provided that such calculation excludes any MWh that must be reserved for Black Start service or for other firm commitments, and that such resource is capable of fully recharging in a similar amount of time. For example, a 100 MW, 300 MWh Energy Storage Resource can run at 75 MW for 4 hours, and therefore has an Effective Nameplate Capacity value of 75 MW.

A generic limited duration resource of "X" hours duration is capable of running at its Effective Nameplate Capacity power level for X hours under conditions of highest risk of shortage on the PJM system.

Solar resources with a single energy market metering point that consist of both tracking solar and fixed solar components are included in the class that constitutes the majority of the nameplate capacity as measured by aggregate DC nameplate rating of the respective sets of solar panels. If the DC nameplate ratings of the fixed and tracking components are identical, then the resource will be in the tracking solar class.

The RAA provides that the term "Hydropower With Non-Pumped Storage" shall mean "a hydropower facility that can capture and store incoming stream flow, without use of pumps, in pondage or a reservoir, and the Generation Owner has the ability, within the constraints available in the applicable operating license, to exert material control over the quantity of stored water and output of the facility throughout an operating day". A hydropower resource can exert material control over the quantity of stored water and over the output of the facility when it can consistently produce power in excess of 110% of the daily average power baseline for at least 4 hours. This criterion is demonstrated by evaluating the ratio of the average actual output during the 4 highest load hours of all summer afternoons of the five year period against the average actual output of all other hours on the same days. Such assessment and determination is once per five years. An existing Hydropower with Non-Pumped Storage resource that fails to demonstrate material control over the output of the facility through the foregoing evaluation will be reclassified as an Intermittent Hydropower Resource, provided that PJM may, at its discretion, retain the prior classification of the resource if, due to exceptional circumstances,

such evaluation fails to capture the resource's capability to consistently produce power at least 10% in excess of the daily average power baseline for at least 4 hours. Reasons that such evaluation might fail to capture such capability could include exceptional recreational and public safety factors, unit outages, locational market energy prices, ancillary market participation, and other exceptional operational factors or market factors that may limit a unit with material control capability from meeting the foregoing demonstration evaluation.

1.3.1 The Hybrid Resource Classes

There are Hybrid Resource Classes for all "open-loop" combinations of each Capacity Storage Resource class and each Variable Resource class, as well as all "closed-loop" combinations of each Capacity Storage Resource class and each Variable Resource class. An "open-loop" resource is physically and contractually capable of charging from the grid, while a "closed-loop" resource is not. An example of a Hybrid Resource Class is "Tracking Solar plus 4-hour Storage —Open Loop".

There are "Other Limited Duration Combination Classes" for all combinations of each Variable Resource Class and each Other Limited Duration Resource Class, and for combinations of an Unlimited Resource with each Other Limited Duration Resource Class.

There is also a single Complex Hybrid Class comprised of combinations that include limited duration components and do not fall into one of the above hybrid classes. Regarding this class, the RAA provides the following definition:

> *"Complex Hybrid Class" shall mean an ELCC Class composed of Combination Resources that combine three or more components, whereby one component is a class of Limited Duration Resource, and the other components are different Variable Resource classes, and such Combination Resources cannot be included in any other Combination Resource class. A resource that is a member of a Complex Hybrid Class has a single Point Of Interconnection, unless the resource is controlled in an integrated fashion, is at a single site, and is approved by PJM to be considered a single resource in accordance with the PJM Manuals.*

1.3.2 The Other Variable Resource Class

The RAA provides the following definition of the Other Variable Resource Class:

> *""Other Variable Resource Class" shall mean an ELCC Class consisting of Variable Resources that are not in any other Variable Resource class, including Variable Resources that are composed of multiple components, each of which would be a Variable Resources. A resource composed of both fixed-tilt solar panels and tracking solar panels is not in this class. A resource that is a member of a Other Variable Resource Class has a single Point*

> *Of Interconnection, unless the resource is controlled in an integrated fashion, is at a single site, and is approved by PJM to be considered a single resource in accordance with the PJM Manuals."*

1.3.3. Administration of ELCC Classes

For a given Delivery Year, ELCC Class Ratings will not be calculated for any ELCC Class to the extent that no member of the class is expected to provide, or offer to provide capacity, in the applicable Delivery Year. PJM will determine the ELCC Class Ratings for an ELCC Class when any one of the following criteria are met:

1. An Existing Generation Capacity Resource is in such class; or
2. A Planned Generation Capacity Resource has submitted timely and valid data through the ELCC data submission process and is in such class; or
3. The resource deployment forecast contains a resource in such class.

For each ELCC Resource, except an ELCC Resource that is a Capacity Storage Resource or includes a Capacity Storage Resource component, PJM shall determine the ELCC Class of which such resource is a member by matching the physical characteristics of such resource with the definition of the ELCC Class.

For each ELCC Resource that is a Capacity Storage Resource or includes a Capacity Storage Resource component, PJM shall determine, by matching the physical characteristics of such resource with the definition of the ELCC Class, the type of ELCC Class of which such resource is a member; provided however, the Generation Capacity Resource Provider shall choose the specific ELCC Class within the type ELCC Class identified by PJM that corresponds to the chosen characteristic duration.

If the Generation Capacity Resource Provider fails to choose, PJM will choose a specific ELCC Class to assign to such resource.

The election of the specific ELCC Class corresponding to the chosen characteristic duration shall be for a term of five consecutive Delivery Years. During such five Delivery Year period, a Generation Capacity Resource Provider may request a change in the ELCC Class, based on choosing a different characteristic duration, by submitting to the Office of the Interconnection a written request to switch ELCC Classes and provide documentation supporting such change. A Generation Capacity Resource Provider must submit such a request, and supporting documentation, by August 15 prior to the calendar year for the RPM Auction in which the ELCC Resource intends to submit a Sell Offer or otherwise commit to provide capacity, except for Delivery Years prior to the 2026/2027 Delivery Year such required information must be provided to the Office of the Interconnection in accordance with the PJM Manuals. The Office of the Interconnection shall provide no later than following November 15 written notification to the Generation Capacity Resource Provider of its determination. If the request is granted, the ELCC Resource shall be considered in the new ELCC Class starting with the next Delivery Year for which no RPM Auction has been conducted and for subsequent Delivery Years. If the request is denied, the Office of the Interconnection shall include in the notice a written explanation for the denial.

A change in ELCC class or in ELCC modeling is initiated by emailing ELCC@pjm.com.

1.3.4 Mixed Technology Resources

Mixed-technology resources are composed of components with different generation technologies, at least one of which would be an ELCC Resource, behind a single Point of Interconnection. For a mixed-technology resource composed of components that do not have significant interaction, the components are eligible to participate as separate resources. A mixed-technology resource composed of components that have significant interaction must participate as a single Combination Resource (or, if the components would all be Variable Resources, then as a single Variable Resource).

The Generation Capacity Resource Provider of a mixed-technology resource eligible to participate as either a single ELCC Resource or as multiple stand-alone resources shall elect, for a term of five consecutive Delivery Years, whether PJM is to model it as a single ELCC Resource or as multiple stand-alone resources. During such five Delivery Year period, a Generation Capacity Resource Provider may request a change in such modelling approach by submitting to the Office of the Interconnection a written request to change the modelling approach and provide documentation supporting such change. A Generation Capacity Resource Provider must submit such a request, and supporting documentation, by August 15 prior to the calendar year for the RPM Auction in which the ELCC Resource(s) intend(s) to submit a Sell Offer or otherwise commit to provide capacity, except for Delivery Years prior to the 2026/2027 Delivery Year such required information must be provided to the Office of the Interconnection in accordance with the PJM Manuals. The Office of the Interconnection shall provide no later than following November 15 written notification to the Generation Capacity Resource Provider of its determination. If the request is granted, the ELCC Resource(s) shall be modelled as requested starting with the next Delivery Year for which no RPM Auction has been conducted and for subsequent Delivery Years. If the request is denied, the Office of the Interconnection shall include in the notice a written explanation for the denial.

A change in ELCC class or in ELCC modeling is initiated by emailing ELCC@pjm.com.

Section 2: Overall Timeline for the ELCC Accreditation Process

2.1 Schedule for ELCC Results and Applicability

ELCC Round	Applicable to Auctions	Posting Date	Note
Round 1	2023/24 BRA	June, 2021	
Round 2	2024/25 BRA	December, 2021	
Round 3	2025/26 BRA	July, 2022	Updated results, but no report
Round 4	• 2026/27 BRA • Any IA's run in calendar year 2023	No later than December 31, 2022	
2023 and Subsequent Years	Results and report generally posted in November and apply to all activities and auctions in the following calendar year, including the Delivery Year that starts the following calendar year.		

PJM will post final ELCC Class UCAP and ELCC Class Rating values for use in the upcoming Delivery Year in an annual report that also includes appropriate details regarding methodology and inputs. PJM will post this report and communicate ELCC Resource Performance Adjustment values to applicable Generation Capacity Resource Providers no later than five months prior to the start of the upcoming Delivery Year, as further described in the table above. The report will also include ELCC Class Rating values for nine subsequent Delivery Years. ELCC Ratings and ELCC Resource Performance Adjustment values from the report will apply to Capacity provided in the upcoming Delivery Year, as well as to all auctions and activities executed in the following calendar year, using the applicable ELCC Ratings for the corresponding Delivery Year.

Starting with the 2023/2024 Delivery Year, Accredited UCAP values for the applicable Delivery Year shall establish an upper limit on the amount of Unforced Capacity that an ELCC Resource can physically provide or offer to provide in the applicable Delivery Year.

For any Delivery Year, the Accredited UCAP of an ELCC Resource shall be based on the most recent ELCC Class Rating value for that Delivery Year, together with the most recently calculated ELCC Resource Performance Adjustment value for that ELCC Resource. Except to the extent specified above or otherwise specified, the ELCC Class Rating values for future years are non-binding and are only for indicative purposes.

A Generation Capacity Resource Provider can offer or provide capacity from an ELCC Resource that is not subject to a capacity market must offer obligation (as specified in Tariff, Attachment DD, Section 6.6) at a level less than the Accredited UCAP for such resource (not to exceed the resource's CIRs).

Section 3: Calculation of Accredited UCAP

3.1 Calculation of Accredited UCAP

(a) For Variable Resources and Limited Duration Resources (which includes Energy Storage Resources), Accredited UCAP values shall be equal to the product of:

(i) the Effective Nameplate Capacity;(ii) the applicable ELCC Class Rating; and(iii) the ELCC Resource Performance Adjustment.

(b) For Combination Resources, Accredited UCAP values shall be equal to the sum of the Accredited UCAP of each component, but not to exceed the Maximum Facility Output of the resource, where:

(i) The value for a Variable Resource component shall be determined in accordance with subsection (a) above.

(ii) The value for a Limited Duration Resource component shall be equal to the product of:

(A) the Effective Nameplate Capacity determined for the Limited Duration Resource component;

(C) the applicable Limited Duration Resource component ELCC Class Rating; and

(B) the applicable Limited Duration Resource component ELCC Resource Performance Adjustment (i.e., one minus the EFORd for the Limited Duration Resource component);

(iii) The value for an Unlimited Resource component shall be equal to the product of the installed capacity of the Unlimited Resource component and [one minus the EFORd for the Unlimited Resource component].

(iv) The Accredited UCAP for Hydropower With Non-Pumped Storage, and for each member of an ELCC Class whose members are so distinct from one another that a single ELCC Class Rating fails to capture their physical characteristics, shall be based on a resource-specific effective load carrying capability analysis based on the resource's unique parameters. The Accredited UCAP value shall be equal to the product of: (i) the resource-specific ELCC rating; (ii) the Installed Capacity corresponding to the plant with all units running simultaneously; and (iii) one minus the EFORd of the aggregate plant.

3.2 Calculation of ELCC Resource Performance Adjustment

(a) For a Variable Resource, the ELCC Resource Performance Adjustment is based on a metric consisting of the average of (1) actual output during the 200 highest coincident peak load hours over the preceding ten years, regardless of the years in which they occur, and (2) actual output during the 200 highest coincident peak putative net load hours over the preceding ten years, regardless of the years in which they occur, where putative net load is actual load minus the putative hourly output of Variable Resources based on the resource mix of the target year (the "200CPX2" metric). For Planned Resources or resources less than 10 years old, estimated hypothetical historical output will be used to develop this metric. For a given resource or component, the Performance Adjustment shall equal the ratio of such metric to the average (weighted by the Effective Nameplate Capacity) of such metrics for all units in the applicable Variable Resource ELCC Class. The intent of this ELCC Resource Performance Adjustment for Variable Resources is to allocate 100% of the ELCC Class UCAP to the modeled members of

the class, with a greater-than-average allocation to better performing units and vice versa. The purpose of the twin metric components (one based on output during gross load peak, the other during net load peak) is to capture the concept of an “average total ELCC”, which allocates 100% of the ELCC Portfolio UCAP to all modeled ELCC Classes and in turn to all modeled resources. In principle, an average total ELCC approach is dependent on both effects at the margin (analogous to output during the net load peak) as well as effects in the absence of any ELCC Resources (analogous to output during the gross load peaks).

(b) For Limited Duration Resources (which includes Energy Storage Resources), the ELCC Resource Performance Adjustment is equal to 1 minus EFORd.

(c) For Combination Resources with only an Unlimited Resource component and a Limited Duration Resource component, the ELCC Resource Performance Adjustment is equal to 1 minus EFORd.

(d) For Combination Resources with a Variable Resource component (except for Hydropower With Non-Pumped Storage), the ELCC Resource Performance Adjustment is: (1) based on the direct metered or estimated output of the Variable Resource component, which is then assessed according to the methodology described in subsection (a) above for Variable Resources; and (2) based on the EFORd that is applicable to the Limited Duration Resource component. Providers of Combination Resources with one or more Variable Resource components (for example, solar + battery hybrids) shall provide to PJM direct measurement of the power output of each Variable Resource component with at least hourly time granularity. Such data shall be adjusted for the effect of any electrical losses between the measurement point and the Point of Interconnection. When such data is provided via real-time telemetry, it shall meet the accuracy requirements for general telemetry data as described in Manual 01 Section 5.2.6.

(e) For Hydropower With Non-Pumped Storage and other Combination Resources that do not fall into the above categories, the ELCC Resource Performance Adjustment is equal to 1 minus EFORd.

For all of the foregoing resource categories that use EFORd:

- The applicable class average EFORd value is used for Planned Resources.
- For Existing Resources with less than 12 months of GADS data at the time that EFORd values are evaluated, the class average EFORd value is used to represent any months without data.

The EFORd used for deriving the ELCC Resource Performance Adjustment as part of the calculation of Accredited UCAP for any auction or FRR plan, as well as for the actual Delivery Year, is based on forced outage data from the October through September period prior to the posting of the ELCC results report.

Section 4: Determination of Effective Nameplate

The installed capacity of a resource is defined in Manual 21, Section 1.2, as further described here in the context of ELCC Resources. Manual 21 specifies that the “Installed Capacity (ICAP) of a generation resource is defined as the summer net capability of a generating unit…” and further that “The CIR level of a generating unit is reflective of the net capability of the generating unit at the time of the expected summer peak”.

Accredited UCAP values are calculated on a plant-wide basis; ELCC Resources comprising multiple units are assessed under ELCC as a single facility, with the various units aggregated up to the plant level. Therefore, the parameters for such resources reflect the aggregate plant parameters, with all units at the plant running simultaneously; the parameters for such resources do not reflect the parameters of any one unit at the plant.

4.1 Effective Nameplate Capacity for Variable Resources and Combination Resources

The Effective Nameplate Capacity for a Variable Resource or Combination Resource is identified as follows:

- For such a resource with a PJM Interconnection Service Agreement or Wholesale Market Participation Agreement executed on or after January 1, 2000, the Effective Nameplate Capacity is the Maximum Facility Output specified in the Interconnection Service Agreement or Wholesale Market Participation Agreement, except:
    - If there are multiple Generation Capacity Resources corresponding to a single PJM Interconnection Service Agreement or Wholesale Market Participation Agreement, then the Effective Nameplate Capacity of each resource is allocated as a share of the Maximum Facility Output proportionate to the the maximum hourly output of each resource over the last 3 years (or, if immature, then the estimated such maximum), unless the PJM can clearly discern from the corresponding PJM Interconnection Service Agreement or Wholesale Market Participation Agreement which fraction of the Maximum Facility Output corresponds to which resource, or unless the Generation Capacity Resource Provider submits a valid value that represents the current maximum power capability of each such resource.
- For such a resource that does not have a PJM Interconnection Service Agreement or Wholesale Market Participation Agreement executed after January 1, 2000, the Effective Nameplate Capacity is the maximum hourly output over the last 3 years, unless the Generation Capacity Resource Provider submits a valid value that represents the maximum power capability of the resource.

Starting June 1, 2023, a Generation Capacity Resource Provider shall notify PJM of a permanent reduction in the maximum power capability of a Variable Resource or a Combination Resource.

4.2 Parameters for Variable Resources

Starting June 1, 2023, a Generation Capacity Resource Provider shall notify PJM of a significant permanent reduction in the effectiveness of a Variable Resource at converting the underlying energy source to electric energy (excluding ordinary solar panel degradation). Such reduction is recognized by reducing the resource's ELCC Resource Performance Adjustment.

4.3 Parameters for Limited Duration Resources (which Includes Energy Storage Resources)

In order for a Limited Duration Resource to retain its Effective Nameplate Capacity and Installed Capacity levels, it must demonstrate the level of output the resource can reach under the conditions expected to exist at the time of highest risk of shortage on the PJM system, to the extent that such conditions impact such resource's capability.

For the purposes of Delivery Year 2023/24 and later, including for CIR requests in the Queue that will be in service date on or before June 1, 2023, the Installed Capacity value and the Effective Nameplate Capacity value of a Limited Duration Resource cannot exceed the lowest of:

1. The sustained level of output that the resource can provide and maintain over a continuous period, whereby the duration of that period matches the characteristic duration of the corresponding ELCC Class (e.g., 4 hours, 8 hours, etc), with consideration given to ambient conditions expected to exist at the time of PJM system peak load.
2. The highest of the most recent three consecutive years' Summer Net Corrected Test Capability values.
3. The Maximum Facility Output.

A Generation Capacity Resource Provider of an Energy Storage Resource shall notify PJM of a permanent reduction in the MWh energy storage capability of an Energy Storage Resource. Permanent reductions in the MWh energy storage capability of an Energy Storage Resource due to ordinary battery cell degradation shall be reported once every 5 years. A permanent reduction in the MWh energy storage capability of an Energy Storage Resource is recognized with a decrease in Effective Nameplate Capacity.

4.4 Parameters for Combination Resources Other than Hydropower with Non-Pumped Storage

In order for a Combination Resource (other than Hydropower with Non-Pumped Storage) to retain its Installed Capacity level and the equivalent Effective Nameplate Capacity level of its components, it must demonstrate the level of output each component can reach under the conditions expected to exist at the time of highest risk of shortage on the PJM system, to the extent that such conditions impact such resource's capability.

For the purposes of Delivery Year 2023/24 and later, including for CIR requests in the Queue that will be in service date on or before June 1, 2023, the Installed Capacity of a Combination Resource (other than Hydropower With Non-Pumped Storage) is based on the lesser of the

Maximum Facility Output or the sum of the equivalent Effective Nameplate Capacity values of the resource's constituent components considered on a stand-alone basis, with consideration given to ambient conditions expected to exist at the time of PJM system peak load.

The contribution to the Installed Capacity of a Combination Resource from a Limited Duration Resource component (e.g., an Energy Storage Resource component) cannot exceed the lowest of:

1. The sustained level of output that the component can provide and maintain over a continuous period, whereby the duration of that period matches the characteristic duration of the corresponding ELCC Class (e.g., 4 hours, 8 hours, etc), with consideration given to ambient conditions expected to exist at the time of PJM system peak load.
2. The highest of the most recent three consecutive years' Summer Net Corrected Test Capability values for the component.

Due to ambient conditions expected to exist at the time of PJM system peak load, the contribution to the Installed Capacity of a Combination Resource from a component that would, if standalone, be a Variable Resource in the Onshore Wind Class, the Offshore Wind Class, the Tracking Solar Class, or the Fixed-Tilt Solar Class, cannot exceed:

1. The highest single-year Capacity Value of the most recent three summer periods, as specified in Manual 21, Appendix B.

The contribution to the Installed Capacity of a Combination Resource from a component that would, if standalone, be an Unlimited Resource or a Variable Resource that is not in the Onshore Wind Class, the Offshore Wind Class, the Tracking Solar Class, or the Fixed-Tilt Solar Class, cannot exceed:

- The highest of the most recent three consecutive years' Summer Net Corrected Test Capability values for the component, as specified in Manual 21 Section 2.

A permanent reduction in the physical capability of a component of a Combination Resource is handled in the same way as the equivalent standalone resource.

4.5 Parameters for Hydropower with Non-Pumped Storage

In order for a Hydropower with Non-Pumped Storage resource to retain its Maximum Power and Installed Capacity levels, it must demonstrate the level of output the resource can reach under the conditions expected to exist at the time of highest risk of shortage on the PJM system, to the extent that such conditions impact such resource's capability.

The "Minimum Allowable Water Flow" parameter for Hydropower with Non-Pumped Storage resources is the minimum sustained water flow allowable under applicable licenses, contracts, and/or other agreements. This parameter represents incoming streamflow that cannot be retained in storage during off-peak hours due to contractual or other legal obligations to maintain minimum water flows downstream of the facility. For any given day, the minimum sustained water flow is the average of the lowest contractually-allowable water flow levels in CFS that may be derived for a) 14 consecutive off-peak hours in the summer (i.e., June 21 through September 21, inclusive); or b) 6 consecutive off-peak hours in the rest of the year.

Different values of this parameter may be submitted for different modeled days. Submitted values must cover each modeled day from June 1, 2012 through the most recent May 31. These values are not historical actual water flow values, but instead based on the contracts that will be in place in the target Delivery Year. These values reflect governing agreements (such as FERC licenses), river sharing agreements, and any other governing contracts that will be in place in the target Delivery Year. If such contract levels are dependent on water flow levels or other conditions, these values should reflect the impact of those historical conditions.

“Ordinary Water Storage” capability must only include water storage capability specific to the hydro plant in question— storage from upstream plants must not be included, since the ELCC model captures those cascading relationships already.

“Exigent Water Storage” capability is water storage that is only available on exceptionally high load days or during a PJM-declared emergency. Ordinary Water Storage capability must not be included in the reported number for Exigent Water Storage—the ELCC model will add the two parameters in determining total storage capability. Only water storage capability specific to the hydro plant in question should be included—storage from upstream plants must not be included, since the ELCC model captures those cascading relationships already. When both the maximum exigent pond elevation is above its normal limit, and also the minimum exigent pond elevation is below its normal limit, both the additional pond bottom volume and the additional pond top volume should be included in the Exigent Water Storage. The sum of Exigent Water Storage and Ordinary Water Storage matches the volume of water between the exigent minimum pond elevation and exigent maximum pond elevation (as expressed in MWh).

The “Maximum Power” parameter for a Hydropower with Non-Pumped Storage resource is the maximum net power the resource can maintain in a given month over the hours of highest risk of shortage on the PJM system in that month. The Maximum Power parameter can never exceed the Maximum Facility Output. For summer months, the Maximum Power parameter cannot exceed the sum of the Installed Capacity values of all units that comprise the resource when running simultaneously.

A Generation Capacity Resource Provider of a Hydropower with Non-Pumped Storage resource shall notify PJM of a permanent degradation in any of the ELCC parameters.

Section 5: Data Submission and Validation

5.1 Introduction

The ELCC methodology developed by PJM requires modeling hourly output from ELCC Resources (i.e., Generation Capacity Resources that are not capable of running continuously at their summer rated power level for 24 or more hours). To perform the hourly modeling, PJM needs specific information about such resources (such information may go beyond the information the resources supplied during the interconnection process).

Those Variable Resources (e.g., wind, solar, hydro without storage or pondage, landfill gas without alternate fuel), Limited Duration Resources (e.g., Energy Storage Resources including pumped hydro), and Combination Resources (e.g., hybrids of generation plus energy storage, hydro with non-pumped storage) that wish to offer in any auctions, or otherwise provide Capacity, for Delivery Year 2023/24 or subsequent Delivery Years shall provide the required information and supporting documentation as detailed below by the deadlines also outlined below in order to ensure that PJM can perform the necessary ELCC analysis.

Data Submission Deadlines

Delivery Year	Deadline
2023/24 BRA	Feb. 15, 2021 For Hydropower with Non-Pumped Storage and pumped storage hydropower resources, this deadline is March 1, 2021.
2024/25 BRA	Aug. 15, 2021
2025/26 BRA	Feb. 15, 2022

For subsequent delivery years, the data submission deadline is August 1 of each calendar year prior to the calendar year in which the applicable RPM auction is held, or in which the applicable Delivery Year begins, or in which the applicable FRR plan is submitted.

A Planned Resource that does not submit any valid data may be issued an Accredited UCAP value calculated on the basis of its apparent class and physical characteristics, provided that such class has a rating included in the most recent ELCC report.

The required information may include relevant physical parameters, relevant historical data such as weather data and actual or estimated historical energy output, and documentation supporting such parameters and historical data. The relevant physical parameters are those that are incorporated into the effective load carrying capability analysis. The parameters required for Hydropower With Non-Pumped Storage shall include Ordinary Water Storage and any applicable Exigent Water Storage. Submitted parameters must indicate the expected duration for which any submitted physical parameters are valid.

PJM will evaluate, validate, and approve the foregoing information. In evaluating the validity of submitted information, PJM may assess the consistency of such information with observed conditions. If PJM observes that the information provided by the Generation Capacity Resource Provider of the ELCC Resource is inconsistent with observed conditions, PJM will coordinate

with the Generation Capacity Resource Provider of the ELCC Resource to understand the information and observed conditions before making a determination regarding the validity of the applicable parameters. PJM may engage the services of a consultant with technical expertise to evaluate the foregoing information.

After PJM has completed its evaluation of the foregoing information, PJM will notify the Generation Capacity Resource Provider in writing whether the submitted information is considered invalid by no later than September 1 following the submission of the information. PJM's determination on the validity of the foregoing information will continue for the applicable Delivery Year and, if requested, for such longer period as PJM may determine is supported by the data.

In the event that PJM is unable to validate any of the required information, physical parameters, supporting documentation, or other related information submitted by the Generation Capacity Resource Provider of an ELCC Resource, then PJM will calculate Accredited UCAP values for that ELCC Resource based only on the validated information. Such ELCC Resource shall not be permitted to offer or otherwise provide capacity above such Accredited UCAP values until PJM determines new Accredited UCAP values for such resource.

Generation Capacity Resource Providers of Hydropower with Non-Pumped Storage resources must provide documentation to support the physical parameters provided for expected load carrying capability analysis modeling, as specified in Section 5.2.5 below. This documentation must: (a) support the plant's physical capabilities; (b) demonstrate that the parameters do not violate any federal, state, river basin, or other applicable authority operating limitations of the plant; and (c) demonstrate full authorization from FERC, any river basin commissions, and any other applicable authorities to meet those capabilities.

5.2 Required Information

Note: Generation Capacity Resource Providers of solar, onshore wind, and landfill gas resources do not have any ELCC data submission requirement prior to March 1, 2022.

For members planning to offer or otherwise include certain hydro, storage, hybrids, offshore wind, landfill gas, and certain other resources in the Capacity Market for the 2023/24 Delivery Year and after, certain data (as described in detail in the subsections below) must be submitted by the deadlines outlined in section 5.1 above. This submission facilitates calculation of Accredited UCAP values for such resources using PJM's effective load carrying capability ("ELCC") method.

ELCC Data Submission Process:

1. Visit the ELCC web page:https://www.pjm.com/planning/resource-adequacy-planning/effective-load-carrying-capability
2. From the ELCC web page, download the data submission template corresponding to the applicable ELCC Class. For all ELCC Classes except Hydro With Non-Pumped Storage, a separate template for each RPM Resource ID must be submitted (except for hydropower resources for which multiple RPM Resource ID's apply to a single hydropower plant).
3. Review all the sheets in the data submission template. Input all the required data following the data submission standards provided in the template.

4. Access the ELCC portal linked on the ELCC web page. If access has not already been granted, access will need to be requested following the instructions available on the ELCC web page.
5. Use the ELCC portal to submit the filled in data submission template together with the accompany form.

Resubmission of Data:

Generation Capacity Resource Providers who must resubmit data in a subsequent ELCC round (where a "round" is as described in Section 2.1 above) should do so in a complete new data submission template including the full time series and complete set of parameters, as applicable. Supporting documentation does not need to be resubmitted unless it has changed. Members who already submitted ELCC-related data through the above process do not need to submit new data in a subsequent ELCC round except in the following circumstances:

1. If the previously submitted data did not include the complete time series from June 1, 2012 through the most recent May 31, or was deemed by PJM to not be valid;
2. If the data has changed since the prior submission;
3. If the PJM data template for the applicable class has been updated since the most recent submission.

In general, providers of all resources other than onshore wind and solar must provide basic physical details of the resource, including geographic coordinates, Effective Nameplate Capacity, technology type, generator make and model, and other relevant physical characteristic of the plant. Providers of Variable Resources other than onshore wind and solar that have not been in service since June 1, 2012 must provide an hourly backcast of estimated hypothetical output of the resource from June 1, 2012 through the most recent May 31. In addition, they must provide the underlying data and method used to develop such backcast (for example, hourly streamflow data from the USGS in the case of hydropower, together with the method to convert streamflow to MWh using the generator characteristics).

The information and data required for specific technology types is as follows:

5.2.1 Onshore Wind and Solar

Starting with ELCC data submission on or after March 1, 2022, providers of onshore wind and solar resources must provide the following data. Prior to March 1, 2022, providers of onshore wind and solar resources must provide the following data only if requesting a unit-specific backcast, otherwise they may provide it if desired.

For onshore wind plants (optional prior to March 1, 2022):

- Latitude and longitude in decimal degrees
- Turbine make, model, rating, and number of such turbines
- Turbine power curves
- Hub height

For solar plants (optional prior to March 1, 2022):

- Latitude and longitude in decimal degrees
- Inverter and panel make, model, DC and AC power ratings, and other specifications
- Number of inverters and total AC power rating of inverters
- Number of panels and total DC power rating of panels
- Physical configuration of the panels: fixed tilt, single axis tracking, or dual axis tracking
- For tracking: brand of tracker
- For fixed-tilt: azimuth angle and tilt angle

For onshore wind and solar resource providers that wish to provide their own hourly backcast instead of a PJM-provided backcast, such backcasts must meet the following requirements and are subject to PJM validation:

- Planned Resources and Existing Resources that entered service after June 1, 2012: hourly backcast from June 1, 2012, through the most recent May 21, together with the underlying data and method used to develop such backcast.
- Existing resources that entered service on or before June 1, 2012: data submission is only required if there was a change in physical plant configuration as specified in Section YYYYYY below.

After an onshore wind or solar resource enters service, PJM may update its backcast annually by using new production data to calibrate previously developed backcasts.

5.2.2 Variable Resources Other Than Onshore Wind and Solar

Providers of offshore wind must provide the data specified below. In order to derive the most accurate ELCC analysis, providers of landfill gas units and intermittent hydro units should, if possible, provide the data specified below. In the case of landfill gas and intermittent hydro, PJM may utilize existing data and publicly available data to perform ELCC analysis and calculate Accredited UCAP values when no valid data or incomplete valid data has been submitted.

- Latitude and longitude in decimal degrees.
- Planned Resources and Existing Resources that entered service after June 1, 2012: hourly backcast for all years from June 1, 2012 through the most recent May 31, together with the underlying data and method used to develop such backcast.
- Existing resources that entered service on or before June 1, 2012: data submission is only required if there was a change in physical plant configuration as specified in Section YYYYYY below.

For offshore wind plants:

- Turbine make, model, rating, and number of such turbines
- Turbine power curves
- Hub height
- Rotor diameter

Supporting Documentation for Run-of-river Hydropower without Storage and Landfill Gas Resources that are Planned Resources or that Entered Service after June 1, 2012

Run-of-River Hydro without Storage:

- FERC license and any other agreements by which they are required to operate

Landfill gas:

- Expected landfill life
- Size (acreage)

5.2.3 Energy Storage Resources Including Pumped Storage Hydropower

Examples of Energy Storage Resources include standalone batteries and pumped storage hydropower. Providers of Energy Storage Resources must provide the following data and information:

1. Maximum combined power output capability of the plant while running all generators simultaneously under conditions corresponding to PJM peak loads (MW)
2. Maximum number of hours plant can run at maximum output. For pumped storage hydropower, this metric accounts for the water storage capability of upper and lower ponds, assumes conditions corresponding to PJM peak loads, and assumes the plant starts with an upper pond at its maximum elevation. (Hours)
3. Storage inventory capacity in MWh (A times B)
4. Black Start commitments in MW
5. Any other firm commitments in MW and either MWh or duration (hours)
6. Duration class (e.g., 4 hours, 6 hours, 8 hours, etc.)
7. Charging/discharging roundtrip efficiency

In addition, Pumped Storage Hydropower plants must submit monthly average values for the ratio of the number of cubic feet of water required to pump a single MWh, as well as for the ratio of the number of cubic feet of water required to produce a single MWh. These parameters should not be submitted in cubic-feet-per-second per MW; note that these parameters are equivalent to (cubic-feet-per-second per MW) times (3600 seconds per hour).

Supporting Documentation for Pumped Storage Hydropower

This documentation is intended to support the information requested for pumped storage hydropower plants a detailed above.

- FERC-related documents
- Documents from river basin authorities
- Any relevant river-sharing agreements
- Prime mover ratings, power curve and elevation
- Upper and lower ponds volumes (minimum and maximum)
- Pond elevations (minimum and maximum)

- Daily average hourly inflows and outflows (if any) of upper and lower ponds
- Requirements related to elevation changes or discharge rates

Supporting Documentation for Batteries

- Battery specifications
- Inverter specifications

5.2.4 Combination Resources (Other than Hydropower with Non-Pumped Storage)

Combination Resources (other than Hydropower with Non-Pumped Storage) include hybrids of generation plus storage located at the same site with a single shared Point of Interconnection. Such resources must provide the following data and information:

- All data required for the equivalent standalone components (e.g., solar data listed in Section 5.2.1 above)
- Maximum Output Facility (MFO) in MW
- Power rating capability associated with each component (in MW)
- Storage inventory capacity for energy storage resource component in MWh
- Contractually and physically capable of charging from the grid (yes/no)
- Components are DC-coupled (that is, they share inverters) (yes/no)
- Duration class of Limited Duration Resource component (including storage) (e.g., 4 hours, 6 hours, 8 hours, etc.)
- Black Start commitments in MW
- Any other firm commitments in MW and MWh
- Charging/discharging roundtrip efficiency of storage component (%)

Providers of a Combination Resource that includes a component that is itself a type of ELCC Resource must additionally meet the requirements of the applicable section above for standalone equivalents of such resource. For example, providers of Combination Resources with a wind or solar component must meet the requirements in Section 5.2.1. Providers of Combination Resources with a component that is another types of variable resource must meet the requirements in Section 5.2.2.

5.2.5 Hydropower with Non-pumped Storage

A Hydropower with Non-pumped Storage plant is one that has water pondage, a water reservoir, or other water storage that is passively filled from incoming streamflow, and which can actively control the hour-by-hour output of the plant. Providers of such resources must submit the following data and information:

- Hourly Maximum Power capability, as specified in Section 4.3 above, for each month since June 2012 through the most recent May 31 (in MW).
- Minimum Allowable Water Flow. As specified in Section 4.3 above, this parameter represents the minimum sustained water flow allowable under applicable licenses, contracts, and/or other agreements. The ELCC model uses this parameter to indicate incoming streamflow that cannot be retained in storage during off-peak hours due to

contractual or other legal obligations to maintain minimum water flows downstream of the facility.

- Monthly average values for the ratio of the number of cubic feet of water required to produce a single MWh for each month from June 2012 through the most recent May. This parameter should not be submitted in cubic-feet-per-second per MW; note that this parameter is equivalent to (cubic-feet-per-second per MW) times (3600 seconds per hour).
- 24-hour rolling average streamflow data in cubic-feet per hour, for each hour from June 1, 2012, through the most recent May 31, and 24-hour rolling average data on incoming available water energy in MWh per hour, for each hour from June 1, 2012 through the most recent May 31, together with a description and justification for the method for converting streamflow to available MWh. If a valid source of such data is not available, PJM will work with the corresponding owner/operator to identify an alternate data source
- Ordinary Water Storage capability, which can vary monthly, in various forms: cubic feet, converted to MWh, and in terms of daily minimum and maximum forebay elevations, together with a description and justification for the method for converting water storage in cubic feet or forebay elevation to MWh. Only water storage capability specific to the specified hydro plant should be included— storage from upstream plants must not be included, since the ELCC model captures those cascading relationships already.
- Exigent Water Storage capability—water storage that is only available on exceptionally high load days or on a PJM-declared emergency, which can vary monthly, in various forms: cubic feet, converted to MWh, and in terms of daily minimum and maximum forebay elevations, together with a description and justification for the method for converting water storage in cubic feet or forebay elevation to MWh. Do not include Ordinary Water Storage capability in the reported number for Exigent Water Storage—the ELCC model will add the two parameters in determining total storage capability. Only water storage capability specific to the specified hydro plant should be included—storage from upstream plants must not be included, since the ELCC model captures those cascading relationships already.
- Any cascading relationships to Hydropower with Non-Pumped Storage plants on the same river system in MW. In the ELCC model, water discharges from upstream hydro plants with cascading relationships will be available to downstream hydro plants for generation or storage.
- Any Black Start commitments, in MW.
- Any other firm commitments, in MW and MWh, together with a description of the nature of such firm commitments.

Supporting Documentation for Hydropower with Non-pumped Storage

Owners of Hydropower with Non-pumped Storage plants must provide documentation to support the parameters provided for dispatch modeling. This documentation must support a) their plants' physical capabilities; b) show that the parameters do not violate any operational limits of the plant; and c) show full authorization from FERC, river basin commissions, and any other applicable authorities to meet those capabilities.

- FERC license

- Documents from river basin authorities
- Any relevant river-sharing agreements
- Geographical information
- Storage information to support storage MWh values (ordinary and exigent)

Section 6: Backcasts

For resources that entered service after June 1, 2012, a backcast is required so that a complete time series of estimated output stretching from June 1, 2012 until the most recent May 31 can be identified. This time series is used in developing the ELCC Resource hourly output shapes and in calculating the ELCC Resource Performance Adjustments.

For onshore wind and solar resources, and for Combination Resources with an onshore wind or solar component, PJM will develop the backcasts based on historical weather data consistent with the particular site conditions and generator configurations for each such resource, unless a Generation Capacity Resource Provider requests to use their own PJM-validated backcast. Where data is available prior to development of a given backcast, PJM will use the actual plant characteristics to develop a unit-specific backcast; otherwise, PJM will use a generic backcast that corresponds to the overall technology type and location of the resource. In order to improve the accuracy of backcasts, PJM may update onshore wind and solar backcasts on a regular basis, including using additional available data to enhance backcasts developed in prior years.

For landfill gas resources that entered service after June 1, 2012 or otherwise require a backcast, PJM will use the average historical output of the landfill gas fleet to derive an estimate of historical production of a given landfill gas resource, unless the provider of such resource submits an alternative backcast that is validated by PJM.

For offshore wind resources, PJM will work with the Generation Capacity Resource Provider to develop a backcast.

For other Variable Resources and Combination Resources (except solar hybrids and onshore wind hybrids) that entered service after June 1, 2012, or otherwise require a backcast, the resource provider should provide that backcast based on generator parameters, site conditions, and historical weather.

Where possible, backcasts should reflect relevant changes (including prospective changes) in plant characteristics, including deterioration, enhancements to control systems, derates, uprates, and other physical changes.

Revision History