

## **RAA Definitions Section**

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

**“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.

**“Effective UCAP”** is a unit of measure that represents the resource adequacy value exchanged in the Capacity Market. One megawatt of Effective UCAP has the same resource adequacy value of one megawatt of Unforced Capacity.

**“ELCC Class”** shall mean a defined group of ELCC Resources that share a common set of operational characteristics and for which effective load carrying capability analysis will establish a unique ELCC Class UCAP and corresponding ELCC Class Rating. ELCC Classes shall be defined in the PJM Manuals. Members of an ELCC Class share a common method of calculating the ELCC Resource Performance Adjustment, provided that the individual ELCC Resource Performance Adjustment values will generally differ among ELCC Resources. ELCC Classes shall be defined such that the members of each ELCC Class are reasonably homogeneous in character and with respect to impact on system resource adequacy. ELCC Classes shall be defined for Limited Duration Resources of no less than 4 hours duration, and shall include 4-hour, 6-hour, 8-hour, and 10-hour duration characteristics, with matching duration classes for Combination Resources composed in part of one or more such ELCC Classes.

**“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 Class UCAP”** shall mean the aggregate Effective UCAP all ELCC Resources in a given ELCC Class are capable of providing in a given Delivery Year.

**“ELCC Portfolio UCAP”** shall mean the aggregate Effective UCAP that all ELCC Resources are 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.

**“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.

**“Exigent Water Storage”** shall mean water stored in the pondage or reservoir of a hydropower resource which is not typically available during normal operating conditions (as those conditions are described in the relevant FERC hydropower license), but which can be drawn upon during emergency conditions (as described in the FERC license), including in order to avoid a load shed. Exigent storage capability from an upstream hydro facility can be considered relative to a downstream hydro facility by assessing cascading storage and flows.

**“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.

**“Ordinary Water Storage”** shall mean water stored in the pondage or reservoir of a hydropower resource which is typically available during normal operating conditions pursuant to the FERC license governing the operation of the hydropower resource.

**“Unlimited Resource”** shall mean a generating unit having the ability to maintain output at stated capability continuously on a daily basis without interruption. An Unlimited Resource is a Generation Capacity Resource that is not an ELCC 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 alternate fuel source. All Intermittent Resources are Variable Resources, with the exception of run of river hydroelectric power with non-pumped storage.

## **RAA SCHEDULE 9: PROCEDURES FOR ESTABLISHING THE CAPABILITY OF GENERATION CAPACITY RESOURCES**

A. Such rules and procedures as may be required to determine and demonstrate the capability of Generation Capacity Resources for the purposes of meeting a Load Serving Entity's obligations under the Agreement shall be developed by the Office of the Interconnection and maintained in the PJM Manuals.

B. The rules and procedures shall recognize the difference in the relative ability of units to maintain output at stated capability over a specified period of time. Factors affecting such ability include, but are not limited to, fuel availability, stream flow and/or reservoir storage for hydro units, energy storage capability for Energy Storage Resources, energy source variability and intermittency, mechanical limitations, and system operating policies. For this purpose, the basis for determining and demonstrating the capability of a particular generating unit shall be as described in sections C and D.

### **C. Provisions for Unlimited Resources**

For Unlimited Resources, the capability of the generating unit is based on the level of output that the unit can provide under the site conditions expected to exist at the time of PJM system peak load where such conditions include, but are not limited to, ambient air temperature, humidity, barometric pressure, intake water temperature, and cooling system performance. Generating units with the ability to operate continuously across all hours of an Operating Day without interruption if needed include, but are not limited to, nuclear and fossil-fired steam units, combined cycle units, combustion turbine units, reciprocating engine units, and fuel cell units.

### **D. Provisions for ELCC Resources**

The Office of the Interconnection shall determine the capability of ELCC Resources to meet a Load Serving Entity's obligations under the Agreement using an effective load carrying capability analysis, as set forth in Schedule 9.1, with additional implementation details provided in the PJM Manuals.

## **SCHEDULE 9.1: EFFECTIVE LOAD CARRYING CAPABILITY ANALYSIS**

The Accredited UCAP of an ELCC Resource shall be calculated based on the ELCC Class Rating calculated using an effective load carrying capability analysis, as well as the ELCC Resource Performance Adjustment for the resource, consistent with the methods described below and in the PJM Manuals.

The inputs of the effective load carrying capability analysis include:

1. Historical weather and load data;
2. Historical output of existing Variable Resources;
3. Estimates of putative historical output for planned Variable Energy Resources;
4. Forced outage patterns for Unlimited Resources; and
5. Modeling parameters for Limited Duration Resources and Combination Resources.

The outputs of the effective load carrying capability analysis include:

- the ELCC Portfolio UCAP;
- ELCC Class UCAP values; and
- ELCC Class Rating values.

### **A. Calculation of ELCC Portfolio UCAP**

The effective load carrying capability analysis shall identify a scenario in which the aggregate installed capacity “X” of a group of perfect Unlimited Resources with no outages yields the same resource adequacy metric as the one produced by the scenario with all ELCC Resources that are expected to offer in an auction, or otherwise deliver in the Delivery Year being analyzed. The ELCC Portfolio UCAP shall be the value “X”.

### **B. Allocation from ELCC Portfolio UCAP to ELCC Class UCAP**

The ELCC Portfolio UCAP shall be allocated to ELCC Class UCAP values using further effective load carrying capability analysis such that the aggregate of all ELCC Class UCAP values (except for a margin of error of up to 250 megawatts) does not exceed the ELCC Portfolio UCAP. The method of allocating ELCC Portfolio UCAP to the ELCC Classes shall be specified in the PJM Manuals.

### **C. Calculation of ELCC Class Rating**

The ELCC Class Rating shall be the ratio of the applicable ELCC Class UCAP to the aggregate effective nameplate of that ELCC Class. The effective nameplate for Variable Resources and Combination Resources is the Maximum Facility Output; the effective nameplate for Limited Duration Resources is based on the sustained level of output that the unit can provide and maintain over a continuous period, whereby the duration of that period matches the characteristic duration of the corresponding ELCC Class, with consideration given to conditions expected to

exist at the time of PJM system peak load, to the extent that such conditions impact such capability.

#### **D. ELCC Resource Performance Adjustment and Allocation from ELCC Class UCAP to Accredited UCAP**

The ELCC Class UCAP values for each class shall be allocated to individual units of the class such that the aggregate of all Accredited UCAP values for the class does not exceed the ELCC Class UCAP. The ELCC Class UCAP values shall be allocated to units of the class as follows:

- i. For Variable Resources: based on the ELCC Resource Performance Adjustment.
- ii. For Limited Duration Resources: in proportion to their effective nameplate, where effective nameplate is based on the sustained level of output that the unit can provide and maintain over a continuous period, whereby the duration of that period matches the characteristic duration of the corresponding ELCC Class, with consideration given to conditions expected to exist at the time of PJM system peak load, to the extent that such conditions impact such capability.
- iii. For Combination Resources that are not hydropower with non-pumped storage: based on unit performance and EFORD using the method described in the PJM Manuals.
- iv. Hydropower with non-pumped storage shall have resource-specific effective load carrying capability and Accredited UCAP values calculated based on the unique parameters of each individual hydro resource.

The ELCC Resource Performance Adjustment shall be calculated according to the following methods, as further detailed in the PJM Manuals.

- i. The ELCC Resource Performance Adjustment of Variable Resources shall be based on the average of i) actual output during the 200 highest coincident peak load hours over the preceding ten years, regardless of the year in which they occur, and ii) actual output during the 200 highest coincident peak putative net load hours over the preceding ten years, regardless of the year 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.
- ii. The ELCC Resource Performance Adjustment of Limited Duration Resources shall be based on EFORD.
- iii. Combination Resources with only an Unlimited Resource component and a Limited Duration Resource component shall have an ELCC Resource Performance Adjustment based on EFORD.
- iv. Combination Resources with a Variable Resource component (except for hydropower with non-pumped storage) shall have two ELCC Resource Performance Adjustments; the first of the ELCC Resource Performance Adjustments shall be based on the direct metered or estimated output of the Variable Resource component, which is then assessed according to the methodology described above for Variable Resources; the second of the

ELCC Resource Performance Adjustments shall be based on the EFORD of the Combination Resource.

- v. Hydropower with non-pumped storage shall have an ELCC Resource Performance Adjustment based on EFORD.

#### **E. Installed Capacity of ELCC Resources**

Rules and procedures for technically determining and demonstrating the installed capacity of ELCC Resources shall be developed by the Office of the Interconnection and maintained in the PJM Manuals. The installed capacity of a Limited Duration Resource is based on the sustained level of output that the unit can provide and maintain over a continuous period, whereby the duration of that period matches the characteristic duration of the corresponding ELCC Class, with consideration given to conditions expected to exist at the time of PJM system peak load as described in the PJM Manuals. The installed capacity of a Combination Resource (other than hydro with non-pumped water storage) is based on the lesser of the Maximum Facility Output or the sum of the effective nameplate values of the constituent components.

#### **F. Details of the Effective Load Carrying Capability Methodology**

The effective load carrying capability analysis shall compare expected hourly load levels (based on historical weather) with the expected hourly output of the expected future resource mix in order to identify the relative resource adequacy value of the portfolio of all ELCC Classes, as well of each individual ELCC Class, compared to a group of perfect Unlimited Resources with no outages. In performing this analysis, the model inputs shall be scaled to meet the applicable resource adequacy reliability criteria of the Office of the Interconnection consistent with other resource adequacy studies. The effective load carrying capability analysis shall compare hourly values for: i) expected load based on historical weather; ii) expected Variable Resource output; and iii) expected output of Limited Duration Resources and of Combination Resources as described below. These expected quantities are based on actual values for load and actual and putative values for Variable Resource output (standalone or as a component of Combination Resources) after June 1, 2012 (inclusive) through the most recent Delivery Year for which complete data exist. For resources that have not existed each year since June 1, 2012, putative output is an estimate of the hourly output that resource would have produced in a historical hour if that resource had existed in that hour. This putative output estimate is developed using generally-accepted analytical methods based on historical weather data consistent with the particular site conditions for each such resource.

The effective load carrying capability analysis shall simulate forced outages of thermal resources based on actual historical data, and shall simulate the output of Limited Duration Resources and Combination Resources based on their Office of the Interconnection-validated parameters, including the putative output of the variable resource component of Combination Resources, as described above. Forced outages of Limited Duration Resources and Combination Resources shall not be simulated in the effective load carrying capability analysis.

The quantity of deployed resources studied in the analysis shall be based on resource deployment forecasts and, where applicable, on available information regarding offers for auctions or Fixed Resource Requirement plans for the applicable Delivery Year.

The ELCC Class UCAP and other results of the effective load carrying capability analysis shall be based on the total Effective UCAP of the ELCC Class as a whole—that is, the sum of the Accredited UCAP values of all the members of the class shall be equal to the ELCC Class UCAP, and the sum of all ELCC Class UCAP values shall be equal to the Effective UCAP value of the entire portfolio.

The ELCC Class UCAP and corresponding ELCC Class Rating values may increase or decrease from year to year as the expected resource mix and load shape change.

Energy Resources are not included in the effective load carrying capability analysis. Units that are expected to only offer or deliver a portion of their Accredited UCAP in the Capacity Market are represented in the analysis in proportion to the expected quantity offered or delivered divided by the Accredited UCAP.

#### **G. Methodology to Simulate Output of Certain Resources in the Effective Load Carrying Capability Model**

The effective load carrying capability analysis shall simulate the output of Limited Duration Resources and Combination Resources based on their validated parameters, including limited storage capability, and shall simulate the deployment of Load Management. The analysis shall simulate output from such resources in hours in which all output from thermal resources and available output from Variable Resources is insufficient to meet load. The output of such resources shall be simulated on an hour-by-hour basis in proportion to their installed capacity without foresight to future hours. The simulated deployment of Load Management shall target adequate Primary Reserve levels if sufficient simulated Load Management is available. Simulated Primary Reserves shall be allocated among economic resources in order to maximize simulated reliability, provided that allocation among Limited Duration Resources and Combination Resources shall be pro rata according to installed capacity. Primary Reserves shall be exhausted prior to identifying a loss of load event in the analysis. Energy Storage Resource charging is during hours with sufficient margin, including between daily peaks if necessary.

#### **H. Administration of Effective Load Carrying Capability Analysis**

The Office of the Interconnection shall publish final ELCC Class UCAP and ELCC Class Rating values once per year in a report that also includes appropriate details regarding methodology and inputs. The Office of the Interconnection shall publish this report and shall publish ELCC Resource Performance Adjustment values no later than six months prior to the start of the target Delivery Year, as described in the PJM Manuals.

Accredited UCAP values based on the published ELCC Class Rating values and published ELCC Resource Performance Adjustment values establish the maximum Unforced Capacity that a resource can physically provide in the Delivery Year that starts the following June.

The Office of the Interconnection shall also publish preliminary ELCC Class Rating values for nine subsequent Delivery Years. The Accredited UCAP of an ELCC Resource as applied to a future Delivery Year for which final ELCC Class Rating values have not yet been published shall be based on the most recent preliminary Limited Class Rating value for that Delivery Year, together with the most recently published ELCC Resource Performance Adjustment value for that resource. Except to the extent specified above or otherwise specified, the preliminary Limited Class Rating values for future years are non-binding and are only for indicative purposes.

In order to facilitate the effective load carrying capability analysis, owner/operators of ELCC Resources must submit to the Office of the Interconnection the required information as specified in the PJM Manuals by no later than the July 1 immediately preceding the calendar year in which the ELCC Resource intends to offer or commit Capacity. The required information may include relevant physical parameters, relevant historical data such as weather data and actual or estimated historical energy output, and documentation to support such submissions. 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.

The Office of the Interconnection shall evaluate, validate, and approve the foregoing information in accordance with the process set forth in the PJM Manuals. In evaluating the validity of submitted information, the Office of the Interconnection may assess the consistency of such information with observed conditions. If the Office of the Interconnection observes that ELCC modeling parameters provided by the ELCC Resource are inconsistent with observed conditions, the Office of the Interconnection will coordinate with the ELCC Resource owner to understand the observed conditions before making a determination regarding the validity of the applicable parameters. The Office of the Interconnection may engage the services of a consultant with technical expertise to evaluate the foregoing information.

After the Office of the Interconnection has completed its evaluation of the foregoing information, the Office of the Interconnection shall notify the owner/operator in writing whether the submitted information is considered invalid by no later than September 1. The effective date of the valid data, if approved by the Office of the Interconnection, shall be no earlier than June 1 of the applicable Delivery Year. The Office of the Interconnection's determination on the validity of the foregoing information shall continue for the applicable Delivery Year and, if requested, for such longer period as the Office of the Interconnection may determine is supported by the data.



In the event that the Office of the Interconnection is unable to validate the required data, unit parameters, supporting documentation, or other related information submitted by the owner/operator of an ELCC Resource, then the Office of the Interconnection shall not calculate Accredited UCAP values for that ELCC Resource.

Owners/operators of ELCC Resources that are hydropower plants with water storage must provide documentation to support the parameters provided for ELCC modeling, as specified in the PJM Manuals. 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, river basin commissions, and any other applicable authorities to meet those capabilities.