M14B

Attachment D: PJM Reliability Planning Criteria

Attachment D-2: Minimum Voltage Ride-Through Requirements for Large Computational Loads

D-2.1 Purpose

Large Computational Loads ("LCLs"), including data centers and other computational facilities, with aggregate facility demand of 50 MW or greater and containing 25 MW or greater of maximum load served through power electronic conversion equipment, may significantly influence Bulk Electric System (BES) voltage performance and dynamic behavior during transmission disturbances.

PJM recognized that data centers and other non-scalable loads (LCLs) require special consideration within planning analyses and that large block load additions may present reliability considerations not contemplated by historical planning assumptions.

Consistent with the Tariff, the criteria contained in this section establish minimum reliability performance requirements that transmission customers (or Transmission Owners) shall establish for applicable Large Computational Loads connecting in their areas.

D-2.2 Applicability

These requirements are minimum voltage ride-through and frequency ride-through requirements with which transmission customers taking transmission service on behalf of Large Computational Load must comply meeting one or more of the applicability criteria established below:

- **New LCL Facilities**. Any transmission customer taking transmission service for a LCL project that enters the PJM study process on or after January 16, 2027, shall demonstrate compliance with these requirements as a condition of taking transmission service.
- **Material Modifications.** A transmission customer taking transmission service for an existing facility that is modified in a manner resulting in the LCL's aggregate load becoming 50 MW or greater or otherwise constituting a material modification as determined by PJM and the applicable Transmission Owner on or after January 16, 2027, shall comply with these requirements.
- **Transition Large Computational Load Facilities.** Any transmission customer taking transmission service for a LCL, including an LCL undergoing a Material Modification, that prior to January 16, 2027, has:
  - formally initiated or completed an interconnection study with the TO,
  - executed an interconnection agreement, service agreement, or other agreement authorizing interconnection,
  - commenced construction, or
  - achieved commercial operation,

shall be deemed a Transition Customer for purposes of these requirements and shall achieve compliance no later than November 1, 2028, or within one (1) year of its Commercial Operation Date, whichever is later.[1]

- **Reliability-Driven Compliance.** Notwithstanding the provisions above, PJM may require an existing transmission customer taking transmission service for a LCL to comply with these requirements on an accelerated basis where PJM determines that the facility is contributing to:
  - transient voltage instability;
  - cascading loss of load;
  - voltage collapse risk; or
  - other reliability criteria violations.

  In such cases, the facility shall achieve compliance within 90 days,[2] unless PJM determines that a shorter period is necessary to maintain Bulk Electric System reliability.

Compliance shall be achieved through ride-through of the Large Computational Load. Temporary substitution of energy consumption through other resources shall not, by itself, constitute compliance unless specifically approved in writing by PJM and the Transmission Owner. Such approval shall be granted only upon demonstration satisfactory to PJM and the Transmission Owner that compliance by the Large Computational Load is technically infeasible.

D-2.3 Minimum Voltage Ride-Through Performance Requirements

Transmission customers taking transmission service for Large Computational Loads shall ensure that such loads remain connected and shall not experience involuntary block loss of load for voltage disturbances within the ride-through envelope defined below in Table 1 and Figure 1.

Root-Mean-Square Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
V > 1.20	May ride-through or trip
1.10 < V ≤ 1.20	1.0
0.90 ≤ V ≤ 1.10	Continuous
0.80 ≤ V < 0.90	2.0
0.50 ≤ V < 0.80	0.5
V < 0.50	0.25

Table 1 – PJM Minimum LCL Voltage Ride-Through Requirements

[1] PJM exploring options for flexibility/extensions, to extent feasible on a limited exception basis.
[2] PJM exploring options for flexibility/extensions, to extent feasible on a limited exception basis.

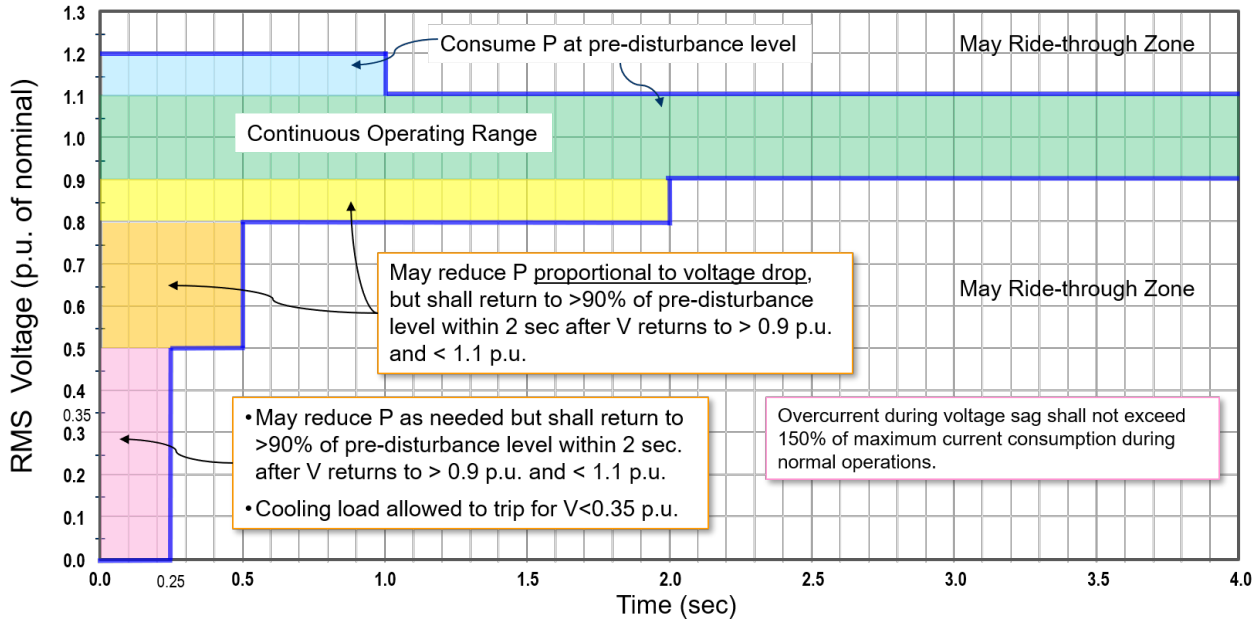

Figure 1 – PJM Minimum LCL Voltage Ride-Through Envelope

A transmission customer taking transmission service for a Large Computational Load ("LCL") shall ensure that such loads ride through the voltage conditions of the magnitude and duration specified in Table 1 and Figure 1, as measured at the LCL's Point of Delivery or, where the LCL is co-located with a Generation Resource or Energy Storage Resource, at the Point of Interconnection ("POI") of such Resource. Further transmission customers shall ensure that an LCL shall remain connected to the Transmission System during voltage conditions requiring ride through. Additional LCL performance requirements applicable during ride-through conditions are satisfied as set forth below:

- Cooling loads associated with the LCL facility may ride through or trip when voltage is below 0.35 per unit for any duration.
- When voltage at the Point of Delivery or, for an LCL co-located with a Generation Resource or Energy Storage Resource, at the POI, remains within the continuous operating range specified in Table 1 during a disturbance, or exceeds 1.10 per unit but remains below 1.20 per unit for less than 1.0 second, the LCL shall continue to consume electric power from the Transmission System at its pre-disturbance level throughout the disturbance.
- When voltage at the Point of Delivery or POI falls below 0.90 per unit but remains above 0.50 per unit and subsequently returns above 0.90 and below 1.10 per unit within the applicable ride-through duration specified in the table above, the LCL shall continue to consume electric power during the low-voltage condition. The LCL may reduce its electric power consumption in proportion to the voltage reduction; however, the LCL shall restore consumption to at least ninety percent (90%) of its pre-disturbance level within two (2) seconds after voltage at the Point of Delivery or POI returns above 0.90 and below 1.10 per unit. This recovery time frame shall serve as the default requirement unless studies demonstrate that a slower recovery is necessary to preserve Bulk Electric System reliability.

- When voltage at the Point of Delivery or POI is below 0.50 per unit, the LCL may reduce electric power consumption as necessary to enable ride through of the disturbance; however, the LCL shall restore consumption to at least ninety percent (90%) of its pre-disturbance level within two (2) seconds after voltage at the Point of Delivery or POI returns above 0.90 and below 1.10 per unit. This recovery time frame shall serve as the default requirements unless studies demonstrate that a slower recovery is necessary to preserve Bulk Electric System reliability.
- If any cooling load at the LCL facility trips during voltage conditions below 0.35 per unit at the Point of Delivery or POI, the pre-disturbance power consumption attributable to such tripped load shall be excluded from the calculation of the LCL's total pre-disturbance consumption level.
- When a voltage disturbance causes voltage at the Point of Delivery or POI to fall below the continuous operating range specified in Table 1 above, the LCL shall not draw current more than one hundred fifty percent (150%) of the maximum current drawn during normal operating conditions. Any such overcurrent not exceeding one hundred fifty percent (150%) shall persist only during the voltage transient and for no longer than 0.5 seconds.
- If instantaneous overcurrent or overvoltage protective functions are installed and configured to trip or transfer the LCL, such functions shall utilize filtered measurements and/or intentional time delays sufficient to prevent undesired operation while maintaining the intended equipment protection. Any alternating-current instantaneous overvoltage protection that could interrupt LCL consumption shall utilize a measurement window of not less than one cycle at nominal system frequency.
- An LCL shall not employ a load-shedding, load-transfer or transfer-to-backup-generation scheme that disconnects the Large Computational Load or transfers the Large Computational Load to backup generation solely on the basis of a specified number of voltage sags or voltage swells occurring within a specified period, where the LCL is otherwise required to ride through. If operation of such a scheme is required because of equipment limitations, the LCL shall be capable of remaining connected to the Transmission System through a minimum of six (6) voltage sags or swells occurring within a 90-second period specified by the applicable Transmission Owner.

D-2.4 Minimum Frequency Ride-Through Performance Requirements

A transmission customer taking transmission service for a LCL shall ensure such loads ride through frequency disturbances of the magnitude and duration specified in Table 2 and Figure 2, as measured at the LCL's Service Delivery Point, or if the LCL is co-located with a Generation Resource or Energy Storage Resource, at the Point of Interconnection (POI) of that Resource.

System Frequency (Hz)	Minimum Ride-Through Time (seconds)
f > 61.8	May ride-through or trip
61.2 < f ≤ 61.8	299
58.8 ≤ f ≤ 61.2	Continuous
57.0 ≤ f < 58.8	299
f < 57.0	May ride-through or trip

Table 2 – PJM Minimum LCL Frequency Ride-Through Requirements

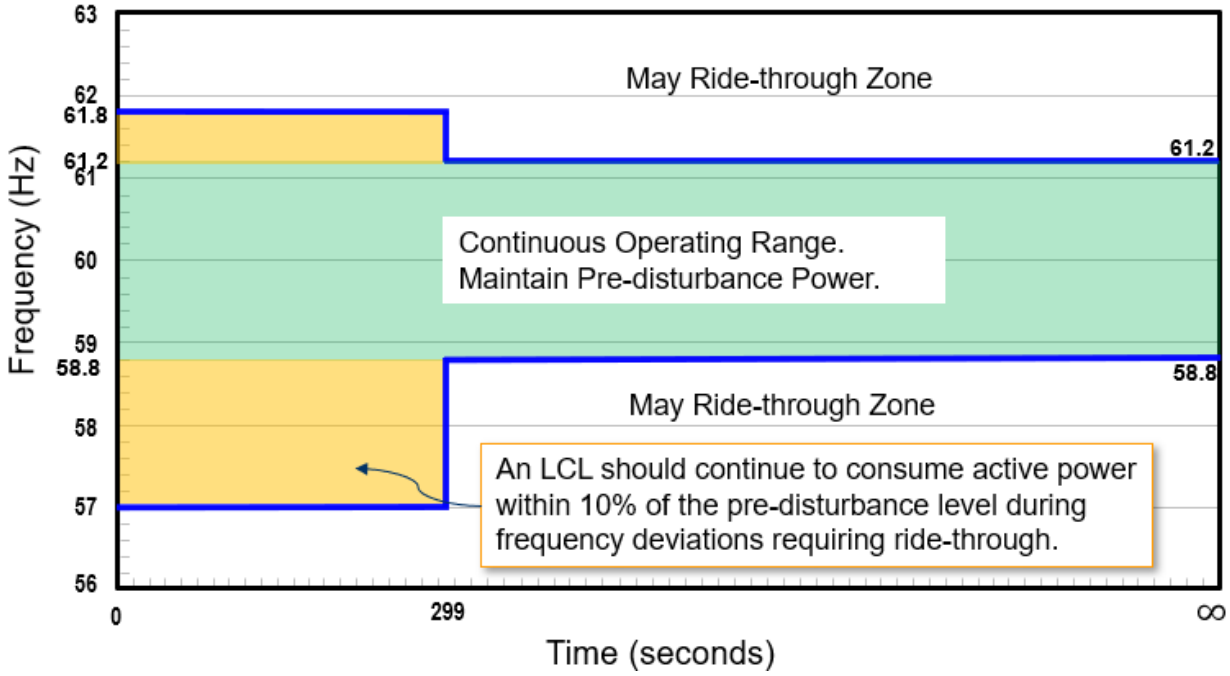

Figure 2 – PJM minimum LCL Frequency Ride-Through Envelope

Transmission customer taking transmission service for LCLs must also ensure additional LCL performance requirements applicable during frequency ride-through conditions are set forth below:

- An LCL is not required to ride through if it is performing in accordance with its Under-Frequency Load Shed (UFLS) program.
- LCLs should maintain pre-disturbance active power consumption while system frequency remains within the continuous operating range of 58.8 Hz to 61.2 Hz.
- For frequency excursions outside the continuous operating range but within 57.0 Hz to 58.8 Hz or 61.2 Hz to 61.8 Hz, LCLs should remain connected and maintain active power consumption within 10% of pre-disturbance levels while maintaining stable operation.
- The specified durations of Table 2 are cumulative over one or more disturbances within a 10-minute time period.
- If frequency protective functions are installed and configured to trip, disconnect, or transfer the LCL, such functions shall utilize filtered frequency measurements and/or intentional time delays sufficient to prevent undesired operation during transient frequency deviations while maintaining the intended equipment protection.
- Frequency protective functions shall not operate based solely upon instantaneous frequency measurements.

PJM OATT Changes

Tariff, Part I, Definitions L – M - N

Large Computational Load

Large Computational Load shall mean load facilities, including data centers and other computational facilities, with aggregate facility demand of 50 MW or greater and containing 25 MW or greater of maximum load served through power electronic conversion equipment, and meeting one or more of the applicability criteria below:

- ***New Large Computational Load Facilities.*** Any Large Computational Load that enters the Transmission Provider or Transmission Owner study processes on or after [61 days from filing] shall demonstrate compliance with these requirements as a condition of interconnection and operation.
- ***Material Modifications.*** An existing facility that is modified in a manner resulting in the Large Computational Load's aggregate load becoming 50 MW or greater or otherwise constituting a material modification as determined by Transmission Provider and the applicable Transmission Owner on or after [61 days from filing], shall comply with these requirements as part of the modification.
- ***Transitional Large Computational Load Facilities.*** Any Large Computational Load, including a Large Computational Load undergoing a Material Modification, that prior to [61 days from filing], has:
  - formally initiated or completed an interconnection study with the Transmission Owner,
  - executed an interconnection agreement, service agreement, or other agreement authorizing interconnection,
  - commenced construction, or
  - achieved commercial operation,

shall be deemed a Transitional Large Computational Load Facility for purposes of these requirements and shall achieve compliance no later than [61 days from filing plus one year], or within one (1) year of its Commercial Operation Date, whichever is later.

Tariff, Part III, Section 28.2, Transmission Provider Responsibilities [Add at end of existing 28.2]

Large Computational Load Ride-Through Requirements

Transmission Provider shall establish minimum voltage ride-through and frequency ride-through requirements with which transmission customers taking transmission service on behalf of Large Computational Load must comply, which shall be set forth in PJM Manual 14B, Attachment D. Such requirements shall establish the minimum performance criteria necessary to support the reliable operation of the Transmission System and Bulk Electric System during voltage disturbances and frequency disturbances.

Each transmission customer (or Transmission Owner) shall establish voltage ride-through and frequency ride-through requirements applicable to Large Computational Load interconnected to its transmission facilities. Such requirements shall be no less stringent than the minimum requirements established by Transmission Provider in Manual 14B, Attachment D.

A transmission customer (or Transmission Owner) may establish requirements that are more stringent than the minimum requirements established by Transmission Provider where the Transmission Owner determines that such requirements are necessary to maintain the reliability, security, or operational performance of its transmission facilities or the Transmission System.

The requirements established by a transmission customer (or Transmission Owner) shall be based upon reliability, planning, operational, stability, protection coordination, voltage performance, frequency performance, restoration, balancing, reserve management or other reliability-related considerations and shall be applied in a not unduly discriminatory manner to similarly situated Large Computational Load.

Nothing in this section shall preclude a transmission customer (or Transmission Owner) from modifying its voltage ride-through or frequency ride-through requirements for Large Computational Load as necessary to address changes in system conditions, reliability needs, applicable NERC Reliability Standards or Transmission Provider operating requirements, provided such requirements continue to meet or exceed the minimum requirements established by Transmission Provider in Manual 14B, Attachment D.

Tariff, Part III, Section 35.1, Operation under the Network Operating Agreement [Add at end of existing 35.1], and Tariff, Part XI, Subpart A, [new] Section 705.8, Large Computational Load Ride-Through Requirements[3]

[Network Customer/Eligible Customer] taking service to serve Large Computational Load shall ensure that the Large Computational Load meets all the requirements established in accordance with Tariff, Part III, section 28.2, Large Computational Load Ride-Through Requirements, and set forth in Manual 14B, Attachment D.

Also note that PJM will clarify the consequences for failure to comply with these requirements.

[3] Will also need to add to the CDS sections of Part XI when we draft them.