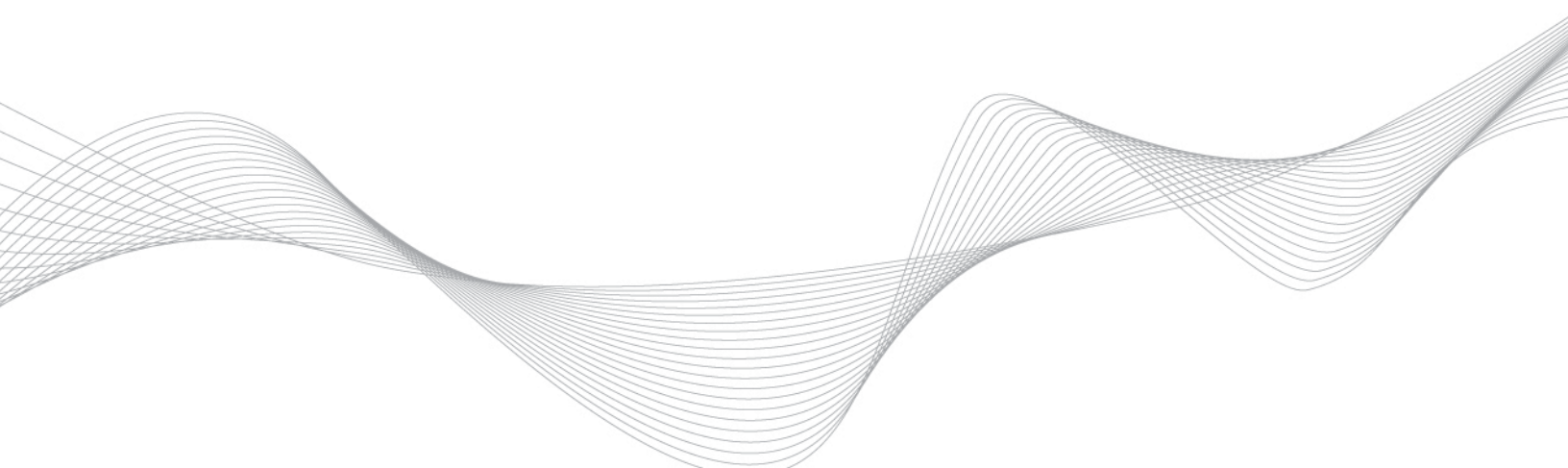




PJM Guideline for Ride Through Performance of Distribution-Connected Generators

Revision 1
PJM Interconnection
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I. Summary

This non-binding document provides the PJM guideline for ride through and minimum trip clearing time performance during abnormal frequency and voltage conditions for distribution-connected generators. This guideline is applicable only to distribution-connected generators. For the purposes of this document, distribution-connected generators means all generators connected to radial distribution lines of voltage < 50 kV that are operating in parallel with the grid. This document should not be construed as applying to generators connected to Transmission Facilities.

II. Performance During Abnormal Conditions

Generators generally have contractual obligations to follow the standards referenced in the interconnection agreement with the local Transmission Owner or distribution utility or the Interconnection Service Agreement (ISA) with PJM. These standards may include trip settings and ride-through performance requirements in accordance with IEEE Std 1547™-2018. Current versions of engineering and construction standards for all PJM Transmission Owners are found at:

<https://www.pjm.com/planning/design-engineering/to-tech-standards.aspx>

III. Ride Through Capability and Trip Settings

Distribution-connected generators installed after January 1, 2022 should have the capability to ride through abnormal frequency and voltage events according to either Category II or Category III of IEEE Std 1547™-2018, as specified by the electric distribution company, except that generators using technology types that are generally incapable of meeting Category II or Category III performance should instead meet the ride through requirements specified by the electric distribution company¹.

Generators that are designed and configured to effectively ride through abnormal low voltage conditions according to the voltages and durations in the following table provide adequate ride through for Bulk Power System stability and reliability needs in PJM^{2,3}.

Table 1: Minimum Ride Through Capability and Effective Ride Through Time

| | Minimum Ride Through Capability | Minimum ride through time | Acceptable ride through modes |
|----------------------------|---------------------------------|---------------------------|---|
| Voltages between 65% - 88% | Category II or Category III | 1.84 seconds | Mandatory Operation |
| Voltages between 30% - 65% | Category II or Category III | 0.16 seconds | Mandatory Operation, Permissive Operation, or Momentary Cessation |

¹ Inverter-based technology is capable of meeting Category II and Category III performance requirements.² Longer trip settings should be considered in areas that may exhibit fault induced delayed voltage recovery of greater than 1.84 seconds, or that utilize transmission fault clearing times of greater than 1.84 seconds.

² Longer trip settings should be considered in areas that may exhibit fault induced delayed voltage recovery of greater than 1.84 seconds, or that utilize transmission fault clearing times of greater than 1.84 seconds.

³ Note that, under IEEE Std 1547™-2018, where the trip duration settings are equal to or less than the ride through duration, the effective ride-through requirements duration requirement only applies until 160ms prior to the prescribed tripping time. For trip durations of greater than 16 seconds, this “grace period” is extended to equal 1% of the trip time.

Distribution-connected generators configured with trip clearing times greater than or equal to the values in the below table provide effective ride through that meets the above minimum effective ride through need. The following table is provided only as a guide; specific units, or specific individual company practices, may provide for different periods of operation in these specified voltage ranges. However, in considering the possible consequences during a wide area low voltage condition, it is recommended that the following table be used in developing operating practices other than those that apply to specific generating plants or individual units.

Table 2: Minimum Trip Clearing Times to Provide Adequate Effective Ride Through

| Minimum trip clearing time | |
|------------------------------|--------------|
| Voltages between 50% and 88% | 2 seconds |
| Voltages between 0% and 50% | 0.32 seconds |

For abnormal overvoltage and for abnormal over- or underfrequency, the provisions of IEEE Std 1547™ -2018 for Category II and Category III ride through capability requirements (including momentary cessation), for default trip clearing times, and for any other trip clearing times within the allowable range of adjustable settings, generally provide adequate effective ride through for Bulk Power System stability and reliability needs in PJM.

The default abnormal overvoltage trip times and ride through modes are different for Category II and Category III, and are as follows in Table 3.

Table 3. Default Overvoltage Trip Times and Ride Through Modes for Category II and Category III

| | Category II | | Category III | |
|-----------------------------|--------------------|----------------------|--------------------|---------------------|
| | Trip clearing time | Ride through mode | Trip clearing time | Ride through mode |
| Voltage above 120% | 0.16 seconds | None | 0.16 seconds | None |
| Voltage between 110% - 120% | 2.0 seconds | Permissive operation | 13.0 seconds | Momentary cessation |

The default abnormal over- and underfrequency trip clearing times as well as the ride through modes are the same for Category II and Category III, and are as follows in Table 4.

Table 4. Default Abnormal Frequency Trip Times for both Category II and Category III

| | Default trip clearing time | Ride through mode |
|---------------------------------------|----------------------------|---|
| Frequency above 62 Hz | 0.16 seconds | None |
| Frequency between 61.2 Hz and 62 Hz | 300.0 seconds | Mandatory operation for frequency below 61.8 Hz |
| Frequency between 58.5 Hz and 56.5 Hz | 300.0 seconds | Mandatory operation for frequency above 57.0 Hz |
| Frequency below 56.5 Hz | 0.16 seconds | None |

IV. Voltage Measurement and Reference Point of Applicability

The above voltages should be measured consistent with the provisions in IEEE Std 1547™ -2018 regarding the reference point of applicability, the applicable voltage, and measurement accuracy, unless otherwise superseded by the interconnection agreement or applicable interconnection laws and regulations.

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