NYSRC Procedure for Application of IEEE 2800-2022 Standard for Large IBR Generating Facilities for the New York Control Area

All normative mandatory requirements[1] specified in IEEE 2800-2022 (the Standard) shall be mandatory for NYISO's *Interconnection Studies*[2] of *Large IBR Generating Facilities*[2] in the New York Control Area with the exceptions, modifications, clarifications, and additional requirements as specified in this document.

All other italicized words in this procedure document are terms specifically defined in IEEE 2800 and these definitions shall apply.

IEEE 2800-2022 Requirements as amended by NYSRC

CLAUSE 1 – OVERVIEW

1. Clause 1.4 – General Remarks and Limitations

Application of the Standard is specified by New York State Reliability Council's Reliability Rule B.5 - NYISO's Interconnection Studies for Large (>20 MW) IBR Generating Facilities shall be based on IBR Plants compliant with the IEEE 2800-2022 Standard as amended for NYCA application, and their associated IBR models and data.

CLAUSE 2 – NORMATIVE REFERENCES

Adopted in full.

CLAUSE 3 –DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

Adopted in full.

CLAUSE 4 – GENERAL INTERCONNECTION TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

1. Clause 4.2 – Reference Point of Applicability (RPA location)

The *Reference Point of Applicability (RPA*) shall be the *Point of Interconnection* (*POI*) with the exception of requirements specified in Clauses 7.2.2.3.4 and 7.2.2.3.5 of the Standard to have the *RPA* at the *Point of Connection (POC)*.

[1] IEEE standards use "shall" as the operative verb for mandatory requirements. Standards may include recommendations, using the verb "should" or guidelines using the verb "may" which are not mandatory.
[2] NYSRC Glossary definitions

CLAUSE 5 – REACTIVE POWER-VOLTAGE CONTROL REQUIREMENTS WITHIN THE CONTINUOUS OPERATION REGION

1. **Clause 5.1 – Reactive Power Capability (Supply of reactive power support)**
   Reactive power support shall be supplied to the *Transmission System*, within the defined range of reactive power capability specified in Clause 5 of the Standard whenever active power is delivered to the *Transmission System,* or absorbed from the *Transmission System* at a level greater than electrical losses within the *IBR plant* and the *Interconnection System* between the *POI* and *POM* . Supply of reactive power and voltage support, and related voltage setpoint and regulation droop parameters, shall be as directed by the *Transmission System Operator* (NYISO).[3]

2. **Clause 5.1 – Reactive Power Capability (reactive power support at or near zero active power)**
   Plant capability for reactive power at all active power levels between zero and *ICR*, or *ICAR* and *ICR* in the case of bidirectional *IBR plants* having energy storage capability, is required as specified in Clause 5 of the Standard. Except for *IBR plants* having energy storage capability, supply of reactive power support at net active power export levels less than or equal to zero shall not be required unless agreed to by the NYISO and *IBR owner* as an Ancillary Service. For *IBR plants* containing energy storage capability, supply of reactive power support shall not be required at levels of power import required to meet plant standby loss (i.e., provide power to plant auxiliary loads). Reactive power supply may be required when the plant is in standby mode if agreed to by the NYISO and IBR owner as an Ancillary Service. In that case, reactive power support within the ranges defined by Clause 5 of the Standard shall be continuously maintained during transitions from power export to import and import to export. Supply of reactive power support at net power levels within these exclusions is optional.

3. **Clause 5.1 – Reactive Power Capability (dynamic reactive power)**
   The definition of dynamic reactive power is further defined to mean that the net reactive power flow of the *IBR plant* can move between any points within the reactive power capability plot shown in Figure 8 of the Standard, while active power flow is held constant, with time response characteristics as specified in Table 5 of the Standard. The time response shall not be degraded by repetition of voltage change events or changes of required reactive power. Dynamic reactive power is further defined to mean net reactive power that is continuously variable, without discrete steps greater than 1% of the required reactive capability.

4. **Clause 5.2.2 – Voltage Control (clarification of target voltage)**
   The first sentence Clause 5.2.2 of the Standard, for application in the New York Control Area, shall be modified to: “When in this mode, the *IBR plant* shall operate in closed-loop automatic voltage

[3]The Standard only requires that the IBR be designed to have the capability to provide reactive power. This additional requirement mandates that this reactive capability be provided (supplied) to the transmission system in order to hold voltage schedule or as otherwise directed by NYISO operations.

control mode to regulate the steady-state voltage at the *RPA* to the reference value, as adjusted by the droop function, to within ±0.01 p.u. of the adjusted voltage set point unless to do so requires reactive power exceeding the reactive power capability of the *IBR plant*."[4]

5. **Clause 5.2.2 – Voltage Control (dynamic performance)**
   The voltage control small-signal dynamic performance specified in Table 5 of the Standard shall be applicable when the system short-circuit strength at the RPA is the minimum short-circuit strength identified in cases provided by the NYISO for a minimum feasible generation scenario and NYSRC Reliability Rules, Table B-1, Category I, Item 2 contingencies (Opening of elements without fault) local to the POI. The maximum step response time for this condition shall be less than 10 seconds.

For any transmission system conditions within the planning design criteria defined by the New York State Reliability Council, voltage control performance shall be positively damped.

CLAUSE 6 – ACTIVE-POWER—FREQUENCY RESPONSE REQUIREMENTS

1. **Clause 6.1.1 – PFR Capability (supply of primary frequency response)**
   Primary frequency response, for which the capability is defined in Clause 6.1.1, shall be supplied to the *Transmission System* as a mandatory requirement, within the constraints of the *available active power* and the *IBR plant's minimum active power capability,* and is not subject to *IBR owner* mutual agreement. Supply of primary frequency response and the relevant control frequency response control parameters (e.g., droop, dead band) shall be as directed by the *Transmission System Operator* (NYISO).[5] Pre-curtailment of active power to provide an underfrequency response is not required. If the *IBR plant* active power has been curtailed to less than the *available active power* for any reason, supply of underfrequency response, to the extent of the *available active power*, is mandatory. The IBR plant shall be designed such that there is capability for underfrequency response to override power curtailment limits. In operation, selection of whether the underfrequency response or the power curtailment limits have priority shall be at the discretion of the NYISO System Operator.

[4]As an example, consider an IBR plant rated 150 MW connected to a 230 kV system and with a 236 kV voltage reference value and 6% voltage droop (on ICR base, as defined in the Standard) specified by the NYISO system operator. The voltage control shall hold the RPA voltage to 236 kV ±2.3 kV ± the droop value. If the reactive power injection to hold voltage to the reference, as adjusted for droop, is 30 MVAR, the droop value is -30/150 ´ 0.06 ´ 230 = -2.76 kV. Therefore, the actual RPA voltage must be between 230.9 kV and 235.6 kV for compliance in this example.

[5]The Standard only requires that the IBR be designed to have the capability to provide primary frequency response. This additional requirement mandates that primary frequency response be provided (supplied) to the transmission system as directed by NYISO operations.

SECTION 7 – RESPONSE TO TS ABNORMAL CONDITIONS

1. **Clause 7.2.2.1 – General Requirements and Exceptions (RPA location)**
   The *Reference Point of Applicability* (*RPA*) for voltage *ride-through* requirements shall be the *Point of Interconnection* with the exception of requirements specified in the Standard to be applicable at the *IBR unit Points of Connection (POC*s).

2. **Clause 7.2.2.2 – Voltage Disturbances Within Continuous Operating Region (temporary power deviations)**
   Active power changes, due to voltage deviations for which all *applicable voltages* at the *RPA* remain within the *continuous operating regio*n shall not cause a change in active power greater, in per-unit of the *ICR* (or the *ICAR* for energy storage in the charging mode), than twice the magnitude of abrupt voltage change, in per-unit of the nominal voltage. The active power output shall return to within ± 0.05 p.u. of the lesser of the pre-disturbance active power and the *available active power*, on the base of the *ICR* or *ICAR*, as applicable, within one second of the disturbance.

3. **Clause 7.2.2.2 – Voltage Disturbances Within Continuous Operating Region (extended voltage imbalance)**
   In addition to the exceptions to requirements for *continuous operation* stated in this clause of the Standard, the *IBR plant* may also trip for negative sequence component of the *applicable voltage* exceeding 6.7% of the *nominal voltage* for a duration exceeding two seconds.

4. **Clause 7.2.2.3.2 – Low and High-Voltage Ride-Through Capability (reactive power priority in mandatory operation range)**
   The *IBR plant* shall operate in *reactive current priority mode* during high- and low-voltage *ride-through* events within the *mandatory operating range*. The relationships between voltage deviation at the *POCs* of *IBR units* and the reactive components of current from these units shall be determined by NYISO based on interconnection studies with consideration of the characteristics of the *IBR units*, with default relationships as proposed by the *IBR owner*. The *IBR plant* shall perform according to these specifications determined by NYISO, which may differ for voltage deviations above and below the *continuous operating range*.

5. **Clause 7.2.2.3.4 – Current Injection During *Ride-Through* Mode (negative sequence current injection during *ride-through*)**
   The relationship between the negative sequence component of *IBR unit* currents and the negative sequence components of the respective *POC* negative sequence voltage components is not specified by this document. The required relationship may be specified by the Connecting Transmission Owner in the Interconnection Agreement.

6. **Clause 7.2.2.3.4 – Current Injection During Ride-Through Mode (negative sequence current injection from type 3 wind turbines)**
   Negative sequence currents of Type 3 (doubly fed asynchronous generator) wind turbines, shall not be required to follow a predefined proportional relationship to the negative sequence voltages at the *POC*s.

7. **Clause 7.2.2.3.5 – Performance Specifications (ride-through dynamic performance requirement applicability)**
   The dynamic performance requirements specified in Table 13 of the Standard, with the exception of the settling time and settling band requirements, shall be applicable to all contingencies within the Planning Design Criteria defined by the New York State Reliability Council. The settling time and settling band requirements of Table 13 are recommended goals but are not mandatory.

8. **Clause 7.2.2.4 – Consecutive Voltage Deviations Ride-Through Capability (*ride-through* for dynamic voltage oscillations)**
   Where interconnection system impact studies for an *IBR plant* indicate post-fault voltage oscillations repeatedly exceeding the limits of the *continuous operating region*, the studies shall define voltage *ride-through* performance requirements applicable to such situations. The *IBR plant* shall provide the performance thus required.

9. **Clause 7.2.2.4 – Consecutive Voltage Deviations Ride-Through Capability (energy dissipative device limitations)**
   Where *IBR plants* interconnected to the New York Transmission System via HVDC transmission apply energy dissipative devices to meet *ride-through* requirements, the *IBR plant* interconnection studies shall define the credible magnitude and duration of repeated fault events, within the timeframe of the energy dissipative device's thermal cool-down period, that may be credibly experienced within New York Reliability Council planning design criteria and reasonable engineering judgement. The defined event scenario shall be applied as the minimum duty cycle requirements and energy ratings of the dissipative devices. Exception to the requirements of Clause 7.2.2.4 of the Standard shall be defined by the NYISO. This exception shall specifically include dc choppers and similar devices used for interconnection of generation resources with the New York Transmission System via HVDC tie lines.

10. **Clause 7.2.2.6 – Restore Output after Voltage Ride-Through (Recovery Time)**
    If interconnection studies reveal that IBR plant voltage disturbance recovery times less than or equal to one second may result in voltage collapse, delayed voltage recovery, or other adverse system performance consequences and a slower recovery time is deemed to be favorable , to the New York Transmission System, a suitable recovery time less than ten seconds shall be specified by the NYISO.

CLAUSE 8 – POWER QUALITY

Excluded.

CLAUSE 9 – PROTECTION

Adopted in full.

CLAUSE 10 – MODELING DATA

Excluded

CLAUSE 11 – MEASUREMENT DATA FOR PERFORMANCE MONITORING AND VALIDATION

Excluded.

CLAUSE 12 – TEST AND VERIFICATION REQUIREMENTS

This clause is excluded. However, the following shall apply in substitution:

1. Forthcoming IEEE 2800.2

It is recognized that IEEE 2800.2 "Guide for Test and Verification Procedures for Inverter Based Resources Interconnecting with Bulk Power Systems" is undergoing development and will include test, evaluation, model validation and monitoring criteria.

2. Self-certification of compliance

The attestation of IBR plant compliance with IEEE 2800-2022, as amended by this document, will be based on IBR plant performance in the fundamental frequency phasor-domain using system models (e.g., PSSE loadflow, short-circuit and dynamic models and databases) that are provided to the IBR Developer by NYISO.

IBR performance constraints that can only be identified by EMT representations of the external transmission system are excluded from Reliability Rule B.5, to be covered in future Reliability Rules.

Background notes and comments from PRR 151: Establish minimum interconnection standards for Large Inverter Based Resource (IBR) Generating Facilities based on IEEE Standard 2800-2022

1. Need for rule change, including advantages and disadvantages

The NYISO Interconnection Queue as of 6/30/23 has approximately 120,000 MWs of Large Facility (>20 MW) Inverter Based Resources (IBR). NYSRC does not presently have specific IBR interconnection criteria in its Reliability Rules. PRR 151 is therefore proposed for EC approval to be applicable to all future IBR projects seeking interconnection to the NYCA.

This proposal is based upon: (1) recent disturbances in Texas, California and Utah where IBRs failed to perform reliably; (2) the cumulative magnitude of IBRs in NYCA per New York State's CLCPA mandates; (3) NERC's recommendation for Authorities Governing Interconnection Requirements (AGIR) to immediately adopt IEEE Standard 2800-2022; (4) FERC's RM22-12-000 NOPR on Reliability Standards to Address Inverter Based Resources; and (5) FERC Order 2023 on Improvements to Generator Interconnection Procedures and Agreements.

It is noted that IEEE 2800-2022 compliant IBR Plant specifications will evolve from the as-designed stage through the as-built stage. Corresponding models and data likewise will evolve from those required for interconnection studies (as-designed IBR Plant) to those required for test and verification studies (as-built IBR Plant).

PRR 151 is focused on the interconnection study stage for the as-designed IBR Plant with the adoption of a critical subset of IEEE Standard 2800-2022 requirements, as amended for NYCA applicability. Further revisions to incorporate and adopt all pertinent IEEE Standard 2800-2022 requirements will be included in subsequent PRRs.

The advantage to immediate adoption of PRR 151 is that it establishes minimum IBR interconnection criteria critical to NYCA reliability as NYCA transitions to higher penetration of inverter-based resources per CLCPA mandates. There are no disadvantages.

Comments

1. IEEE Standard 2800-2022: "IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems" is covered by IEEE Copyright, available through IEEE Xplore: https://ieeexplore.ieee.org/document/9762253

2. New Glossary Terms:

- "Large IBR Generating Facility" in this PRR is based on:
  - IEEE Standard 2800-2022 definition of a grouping of one or more IBR unit(s) and possibly supplemental IBR device(s) operated by a common Facility level controller along with a collector system to achieve the performance requirements of this standard at a single reference point of applicability (RPA), and
  - FERC's definition of Large Generating Facilities having capacities greater than 20 MWs.
- "Interconnection Studies" in this PRR are based upon the studies outlined in NYISO's OATT Attachment X and Transmission Expansion and Interconnection Manual.
- "IBR Plant Developer" as used in this PRR includes an IBR Plant Developer or IBR Plant Owner or IBR Plant Operator.

3. IEEE 2800-2022 requirements for this PRR specifically apply to the IBR Developer where:

- Requirements designated with the word "shall" are mandatory.
- Requirements designated with the words "should", "may" or "can" are not mandatory.

4. Exclusions from the requirements in IEEE 2800-2022 for this PRR are:

- Section 8: Power Quality
- Section 10: Modeling Data
- Section 11: Measurement Data for Performance Monitoring and Validation
- Section 12: Test and Verification Requirements

5. Miscellaneous Notes

- EMT models and studies are not required by this PRR but may be required by the as-built requirements, to be covered in future PRRs.
- IEEE Standard 2800-2022 does not explicitly specify requirements for HVDC facilities. However, it does include requirements for VSC-HVDC transmission facilities connecting isolated IBR to the AC transmission system.
- IBR models and data for IBR plant compliant with IEEE Standard 2800-2022 may be modified as the IBR plant progresses through the interconnection process. The procedures for obtaining the as-designed models and data, and their updating during the various stages of interconnection are addressed by NYSRC's existing Reliability Rule I - Modeling and Data, I.4 - Transmission Data.