Request to Develop or Modify Reliability Rules and Requirements (NYSRC Policy No. 1-11)
Submit comments to herb@poweradvisorsllc.com on or before by April 27, 2023

Item	Information
1. PRR No. & Title of Reliability Rule or Requirement change	**PRR 151: Establish minimum interconnection standards for Large Inverter Based Resources (IBR) Generating Facilities based on IEEE Standard 2800-2022**
2. Rule Change Requester Information	
Name	RRS
Organization	NYSRC
3. New rule or revision to existing rule?	New rule. B.5: Establishing NYCA Interconnection Standards for Large IBR Generating Facilities
4. Need for rule change, including advantages and disadvantages	The NYISO Interconnection Queue as of 1/5/23 has greater than 50,000 MWs of Large Facility (>20 MW) Inverter Based Resources. NYSRC does not presently have specific IBR interconnection criteria in its Reliability Rules. PRR 151 is proposed for EC approval to be applicable to all NYISO interconnection studies involving IBRs. This proposal is based upon: (1) recent disturbances in Texas and California 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; and (4) FERC's RM22-12-000 NOPR on Reliability Standards to Address Inverter Based Resources. RR 151 is based upon a critical subset of IEEE Standard 2800-2022 requirements, as amended for NYCA. Further revisions to encompass 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 IBR interconnection criteria critical to NYCA reliability as NYCA transitions to renewable resources per CLCPA mandates. There are no disadvantages.
5. Related NYSRC rules	Reliability Rule B.4
6. Section A – Reliability Rule Elements	
1. Reliability Rule	**NYISO's Interconnection Studies for Large (>20 MW) IBR Generating Facilities shall include applicable IBR models, data bases, model validation methods and performance criteria.**
2. Associated NERC Standards & NPCC Standards and Criteria	NPCC: Directory 1 NERC: All Standards under review for IBR application

	IEEE Standard 2800-2022: "IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems"[1]
3. Applicability	Interconnection Studies of Large IBR Generating Facilities
7. Section B - Requirements	R1. The NYISO shall prepare and maintain procedures for Large IBR Generating Facility interconnection studies based on uniform technical minimum requirements for interconnection, capability and performance of IBRs interconnecting with Transmission Systems, as follows: R1.1 IEEE Standard 2800-2022: Section 1 "Overview"; Section 2 "Normative references"; Section 3 "Definitions, acronyms and abbreviations"; Section 4 "General interconnection technical specifications and performance requirements", as amended for NYCA application in Attachment A. R1.2 IEEE Standard 2800-2022: Section 5 "Reactive power-voltage control requirements within the continuous operation region"; Section 6 "Active power-frequency response requirements"; Section 7 "Response to TS abnormal conditions"; Section 9 "Protection", as amended for NYCA application in Attachment A. R1.3 IEEE Standard 2800-2022: Section 10 "Modeling data"; Section 11 "Measurement data for performance monitoring and validation"; Section 12 "Test and verification requirements", as amended for NYCA application in Attachment A. R2. The NYISO shall develop procedures for ensuring each Transmission Owner's IBR interconnection requirements are coordinated with requirements R1.1, R1.2 and R1.3. R3. The NYISO shall develop procedures for ensuring each Large IBR Generating Facility Owner's compliance with requirements R1.1, R1.2 and R1.3. R4. The NYISO shall annually submit a technical report documenting the assumptions, models and methodology of Large IBR Generating Facility interconnection studies in accordance with requirements R1.1, R1.2, R1.3, R2 and R3. R5. Each Transmission Owner shall provide their local IBR interconnection requirements to the NYISO. R6. Each Large IBR Generating Facility Owner shall provide all applicable IBR models, data bases, model validation methods and performance criteria per requirements R1.1, R1.2 and R1.3.
8. Section C – Compliance Elements	
1. Measures	M1. The NYISO certified that it had procedures in place for implementing the IBR interconnection requirements in R1.1, R1.2, R1.3, R2, R3.

[1] IEEE Standard 2800-2022: https://ieeexplore.ieee.org/document/9762253

	M2. The NYISO annually submitted a technical report per requirement R4. M3. The NYISO certified that each Transmission Owner submitted their local IBR interconnection requirements in accordance with requirement R5. M4. The NYISO certified that each Large IBR Generating Facility Owner submitted their IBR models, data bases, model validation methods and performance criteria in accordance with requirement R6.
2. Levels of Non-Compliance	2.1 Measure 1: Level 1: Not applicable Level 2: Not applicable. Level 3: The NYISO had procedures covering requirements R1.1, R1.2 and R1.3 but failed to comply with requirement(s) R2 and/or R3. Level 4: The NYISO failed to comply with one or more of the requirements R1.1, R1.2 and R1.3. 2.2 Measure 2: Level 1: Not applicable. Level 2: Not applicable. Level 3: The NYISO had procedures covering requirements R1.1, R1.2, R1.3, R2, and R3 but failed to comply with requirement R4. Level 4: Not applicable. 2.3 Measure 3: Level 1: Not applicable Level 2: Not applicable. Level 3: The NYISO had procedures covering requirements R1.1, R1.2, R1.3, R2 and R3 but one or more of the Transmission Owner(s) failed to comply with requirement R5. Level 4: Not applicable. 2.4 Measure 4: Level 1: Not applicable Level 2: Not applicable. Level 3: The NYISO had procedures covering requirements R1.1, R1.2, R1.3, R2 and R3 but one or more of the Large IBR Generating Facility Owner(s) failed to comply with requirement R6. Level 4: Not applicable.

3. Compliance Monitoring Process (See Policy 4):	No change.
3.1 Compliance Monitoring Responsibility	No change.
3.2 Reporting Frequency	No change
3.3 Compliance Reporting Requirements	No change
9. Implementation Plan	This rule change will be implemented within six months following EC approval of PRR 151 subject to comments received during the 45-day posting process. The six month implementation period is proposed in recognition of the time required for the NYISO, Transmission Owners and Large IBR Generating Facility Owners to develop compliance procedures. However, if a longer implementation period is deemed appropriate per comments received, the objective is to have implementation of PRR 151 complete prior to the next Class Year which would begin after CY2023 is completed.
10. 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 Term: "Large IBR Generating Facility" in this PRR is based on: (1) the 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 (2) FERC's definition of Large Generating Facilities having capacities greater than 20 MWs. 3. IEEE Standard 2800-2022: Section 8 "Power quality" is excluded from this PRR as a requirement. 4. IEEE Standard 2800-2022 does not explicitly specify requirements for HVDC. However, it does include requirements for VSC-HVDC transmission facilities connecting isolated IBR to the AC transmission system.

11. Date Rule Adopted	
12. PRR Revision Dates	1/8/2023; 1/9/23, 2/16/23, 2/22/23, 3/1/23, 3/6/23

ATTACHMENT A - IEEE 2800 ADOPTION DOCUMENT

All requirements specified in IEEE 2800-2022 (the Standard) shall be mandatory in the New York Control Area with the exceptions, modifications, clarifications, and additional requirements as specified in this document.

Italicized words in this document are terms specifically defined in IEEE 2800 and these definitions shall apply.

ATTACHMENT A: SECTIONS 1 - 4

SECTION 1 – OVERVIEW

1. **Clause 1.4 – General Remarks and Limitations**
   Application of the Standard shall be limited to all projects in the NYISO Interconnection Queue that fall under the Large Generating Facility definition with project capacities greater than 20 MW.

SECTION 2 – NORMATIVE REFERENCES

Adopted in full.

SECTION 3 –DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

Adopted in full.

SECTION 4 – GENERAL INTERCONNECTION TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

1. **Clause 4.2 – Reference Points 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)*.

ATTACHMENT A: SECTIONS 5 - 9

SECTION 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 shall be as directed by the *Transmission System Operator* (NYISO).[2]

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 no greater than is required to meet plant standby loss demand, except that 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 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*."[3]

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 at least 90% of the minimum short-

[2]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.

[3]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 $-30/150 \times 0.06 \times 230 = -2.76$ kV. Therefore, the actual *RPA* voltage must be between 230.9 kV and 235.6 kV for compliance in this example.

circuit strength identified in the system impact study for a minimum feasible generation scenario without transmission system contingencies (N-0). The maximum step response time for this condition shall be less than 10 seconds.

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

SECTION 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. Pre-curtailment of active power to provide 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 underfrequency response shall override power curtailment limits.

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 or design evaluation studies and 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 required relationship between the negative sequence component of *IBR unit* currents and the negative sequence components of the respective *POC* negative sequence voltage components shall be determined by NYISO based on interconnection studies or design evaluation studies and 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 in these studies by NYISO.

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 shall be applicable to all contingencies within the Planning Criteria defined by the New York State Reliability Council. NYISO may relax the requirements for specific *IBR plants* via the NYSRC Exception Process based on the characteristics of the *IBR units* and the New York Transmission System in the vicinity of the Point of Interconnection, provided that the security and reliability of the New York State Transmission System is not materially compromised by the performance requirements modification.

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 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 voltage disturbance recovery times greater than one second, but less than or equal to ten seconds, are determined to be beneficial to the New York Transmission System by the interconnection studies, the recovery times shall be specified by the NYISO.

SECTION 8 – POWER QUALITY

Excluded.

SECTION 9 – PROTECTION

Adopted in full.

ATTACHMENT A: SECTIONS 10 - 12

SECTION 10 – MODELING DATA

1. **Submission of models**

   The NYISO shall require the *IBR owner* to provide verified plant level models including steady state, positive sequence dynamic, EMT, and short-circuit models, including associated documentation. These models shall be used to perform *IBR plant* interconnection and design evaluation studies.

2. **Schedule of model submission**

   The timing of each category of model submission to the NYISO by the *IBR owner* shall be determined by the NYISO based on the phase of the study process for which the models are required. Not all models are necessarily required for the *interconnection study* process but are required for *IBR plant* design evaluation.

3. Model validation

The NYISO shall define the acceptable methods and criteria for model verification.

4. Changes to plant design or characteristics

The NYISO shall define criteria for changes to *IBR plant* design or characteristics, including control software and firmware, for which revised models shall be required. NYISO shall establish submission requirements, including timing, for revised models.

CLAUSE 11 – MEASUREMENT DATA FOR PERFORMANCE MONITORING AND VALIDATION

Adopted in full.

CLAUSE 12 – TEST AND VERIFICATION REQUIREMENTS

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 pass/fail test, evaluation, model validation and monitoring criteria.

2. Self-certification of compliance

Pending approval of IEEE 2800.2, the NYISO shall require the *IBR owner* to self-certify compliance with IEEE 2800. The *IBR owner* shall be required to provide supporting documentation for all test and verification requirements in Clauses 4 through 11 of the Standard as to method, timing and pass/fail criteria.