NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Industry Webinar

Project 2020-06 Verification of Data and Models for Generators (IBR Definitions)

December 5, 2023

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- Notice of Open Meeting
  - Participants are reminded that this webinar is public. The access number was widely distributed. Speakers on the call should keep in mind that the listening audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.

Webinar Agenda

- Project Background
- IBR Definitions
- Technical Rationale
- Frequently Asked Questions
- Implementation Plan
- Project Timeline
- Questions & Answers

Drafting Team (DT) Members

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Project Background

- Model accuracy is essential in transmission planning
- Increased use of inverter-based resources (IBR)
- Standard Authorization Request (SAR) prepared by the Inverter-Based Resource Performance Task Force (IRPTF)
- Initial SAR accepted by SC – September 2020
- SAR Drafting Team formed – March 2021
- Increased emphasis on IBR performance, modeling, and supporting programs
- **Industry comments from additional ballot requesting IBR definitions**

IBR definitions

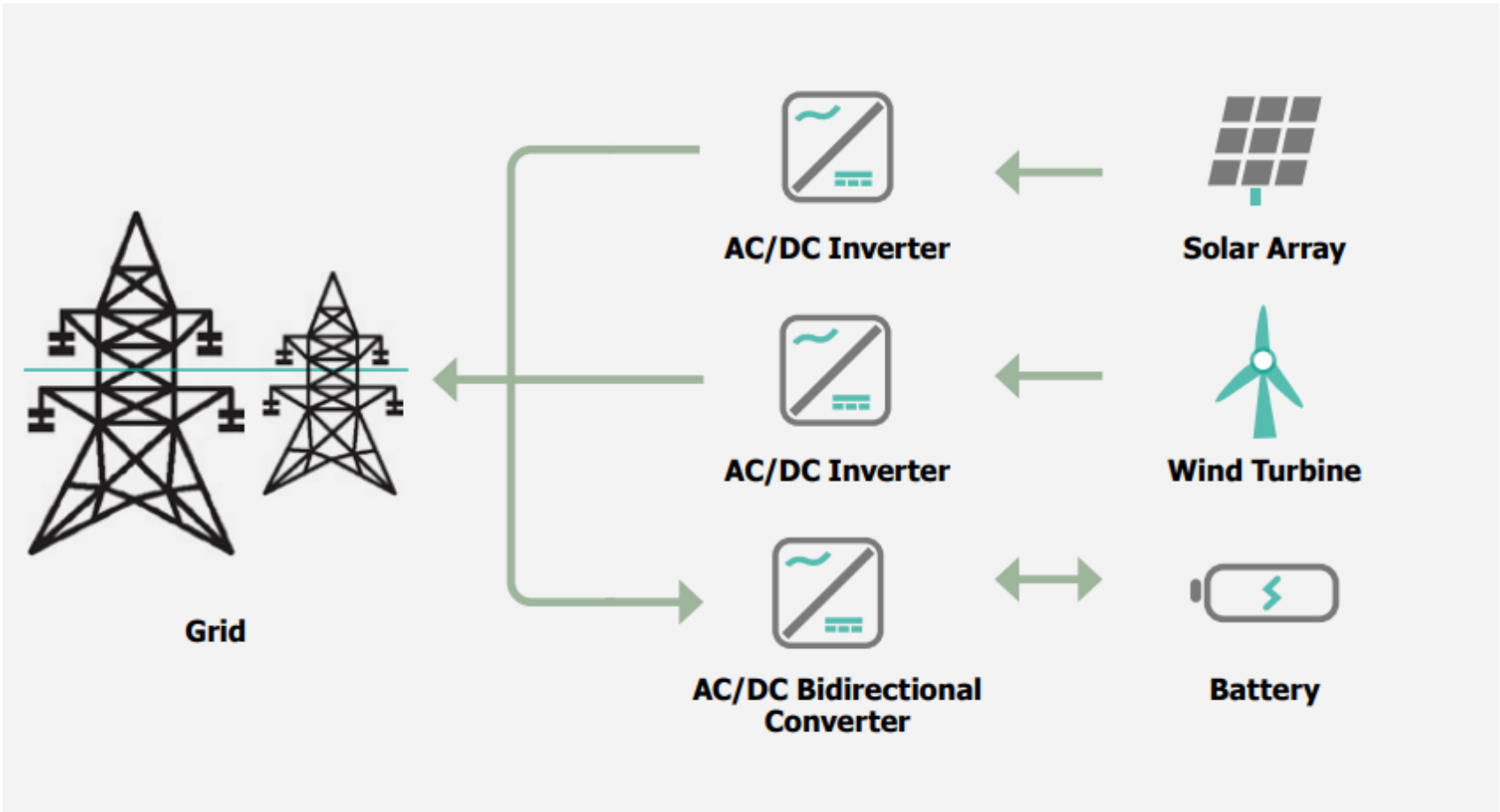
- **Inverter-Based Resource (IBR):** A source (or sink in the case of a charging battery energy storage system (BESS)) of electric power that is connected to the electric power system (transmission, sub-transmission, or distribution system), and that consists of one or more IBR Unit(s) operated as a single resource at a common point of interconnection. IBRs include solar photovoltaic (PV), Type 3 and Type 4 wind, BESS, and fuel cell.

- **IBR Unit:** An individual device, or a grouping of multiple devices, that uses a power electronic interface(s), such as an inverter or converter, capable of exporting Real Power from a primary energy source or energy storage system, and that connect together at a single point on the collector system.

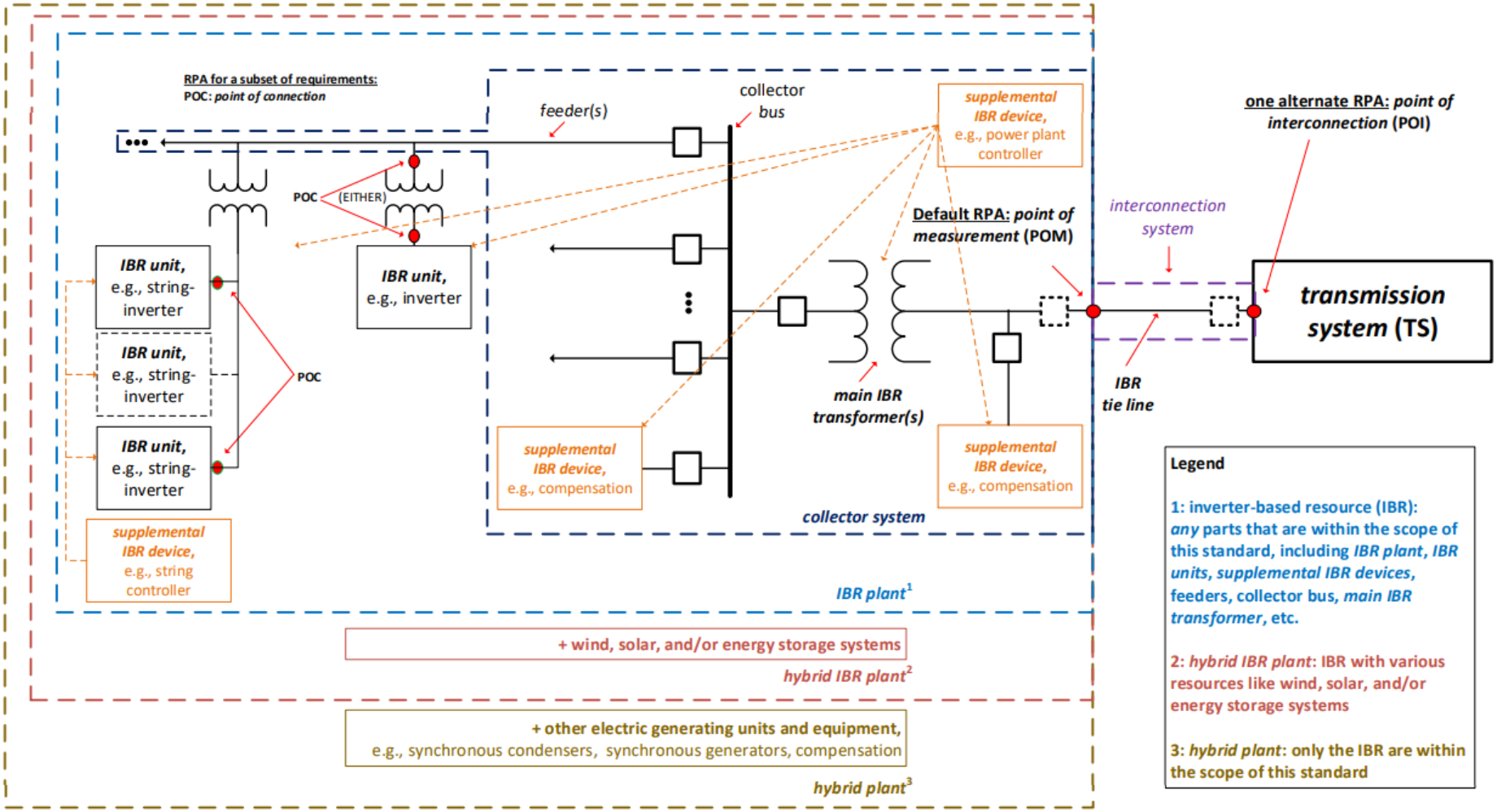
- An inverter is a power electronic device that inverts DC power to AC sinusoidal power. A rectifier is a power electronic device that rectifies AC sinusoidal power to DC power. A converter is a power electronic device that performs rectification and/or inversion.

IBR Unit examples

electrical power system	IBR Unit (inverter/converter)	primary energy source or energy storage system



IBR Unit relative to IBR



Examples of IBR

IBR	Not an IBR
• Solar photovoltaic (PV) • Type 3 wind • Type 4 wind • Battery energy storage system (BESS) • Fuel cell(s) • Hybrid combination of IBR • Portions of collocated/hybrid facility that are IBR • VSC HVDC with dedicated connection to IBR	• Type 1 or 2 wind • FACTS device • STATCOM • SVC • Flywheels • Synchronous generator • Synchronous condenser • VSC HVDC • LCC HVDC

IBR (BES-connected) example

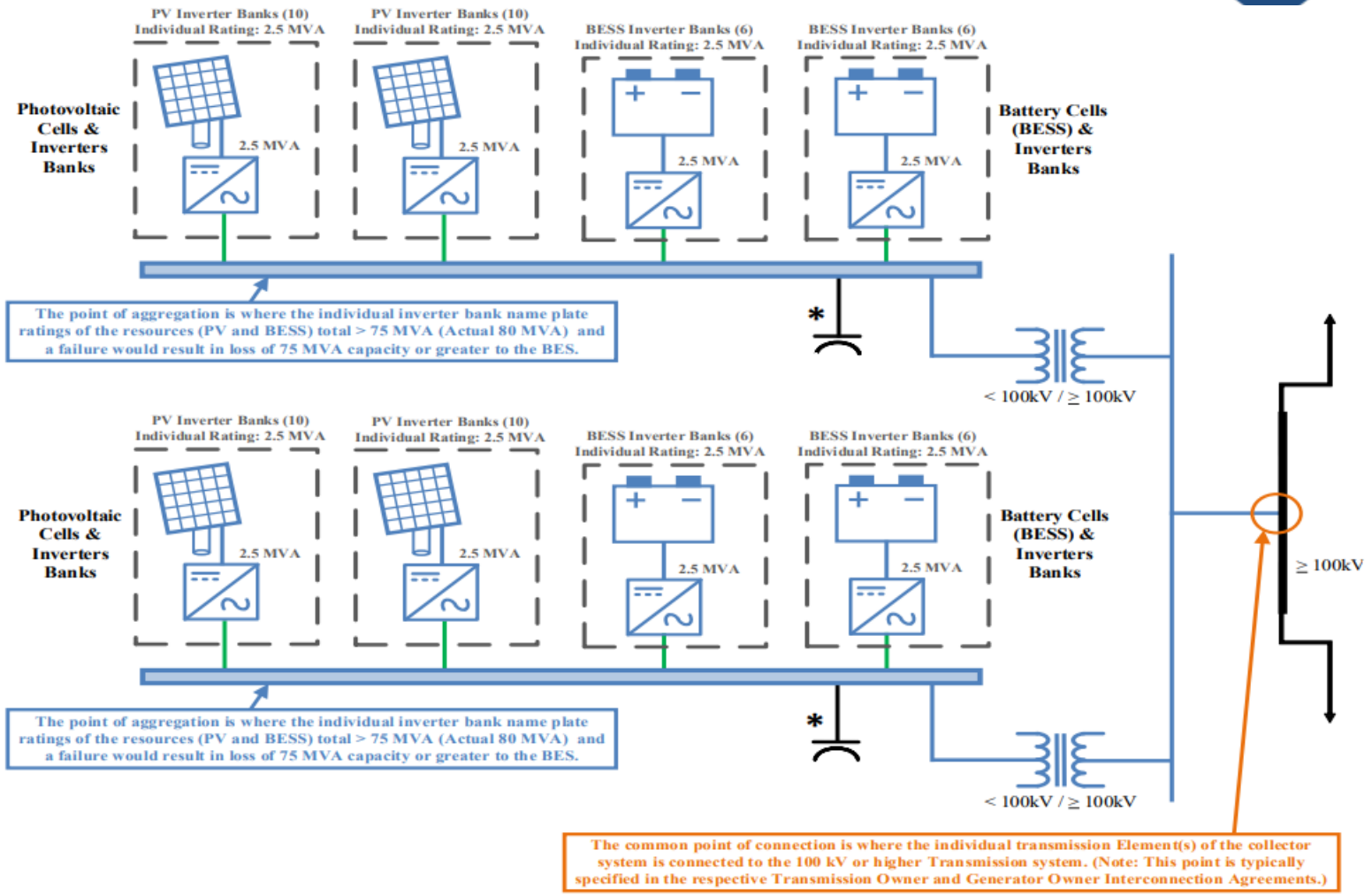


Figure 5: 2 x Solar PV + BESS (AC coupled), Aggregate Nameplate Rating 160 MVA, BES Resources

IBR examples

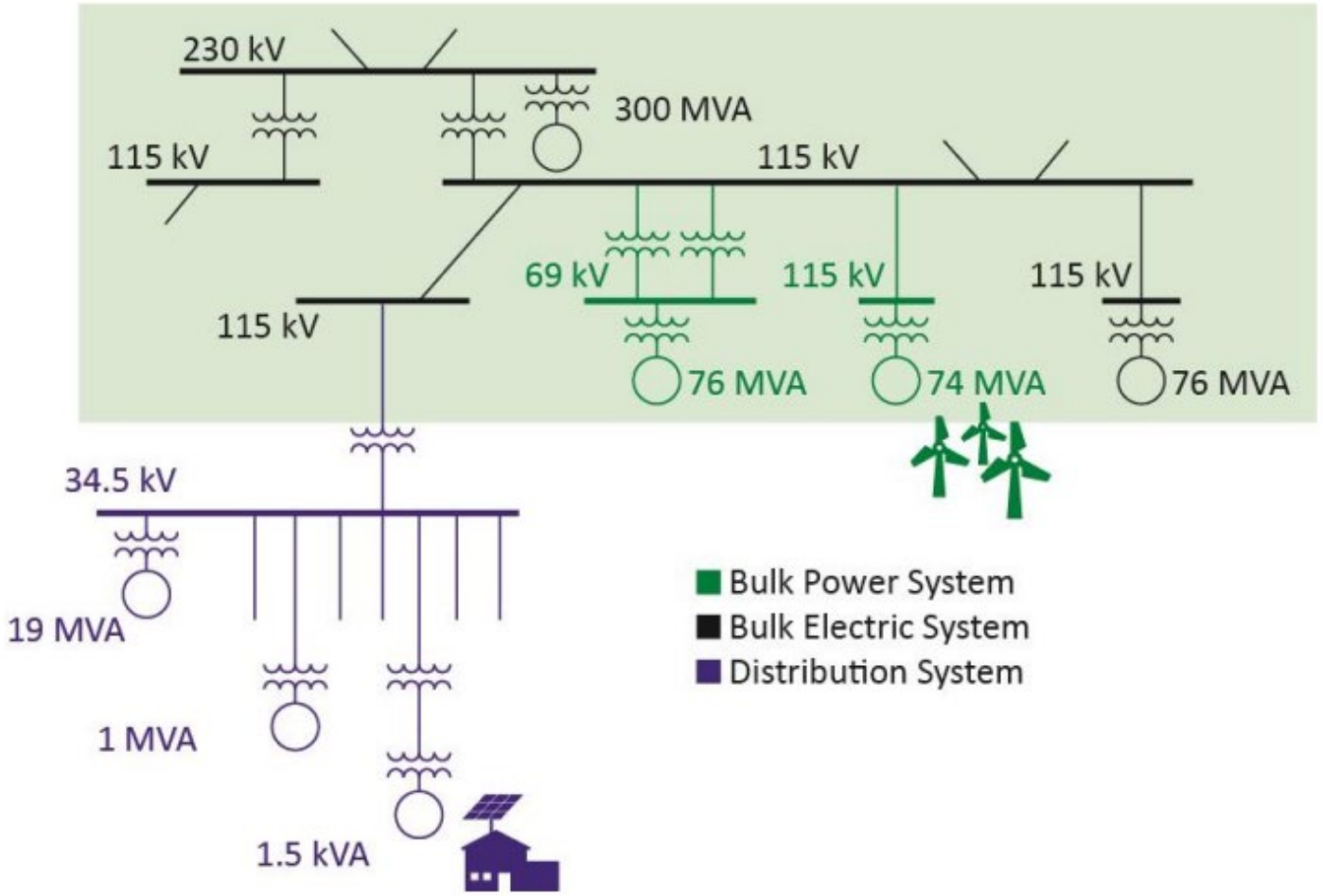


Figure 1: Designation of BPS, BES, and Distribution-Connected Resources

Technical Rationale

- The DT utilized the IEEE 2800-2022 definitions as an initial basis for the inverter-based resource terms for the NERC Glossary of Terms and adjusted as necessary. The DT acknowledges the efforts of the P2800 Wind and Solar Plant Interconnection Performance Working Group and IEEE members in developing those definitions.
- IBR and IBR Unit definitions are intended to describe the technology and which types of technologies are considered IBR.
- IBR is not defined by voltage connection level or size (MVA values). The applicability of IBR will be defined in the Applicability section of the respective Reliability Standards. This is the reasoning to include the phrase "connected to the electric power system (transmission, sub-transmission, or distribution system)".
- There is a need to distinguish between the individual "IBR unit or device" and the "IBR plant/facility" as a whole, so that standards or requirements can be written for each as necessary.

Applicable Facilities example

4.2. Facilities: For the purpose of this standard, the term "applicable Facility" or "Facility" shall mean any one of the following:

4.2.1 Individual generating unit meeting the criteria set by Inclusion I2 of the BES definition.

4.2.2 Generating plant/Facility meeting the criteria set by Inclusion I2 of the BES definition.

4.2.3 **Inverter-Based Resource (IBR)** plant/Facility meeting the criteria set by Inclusion I4 of the BES definition.

4.2.4 Dynamic reactive resources meeting the criteria set by Inclusion I5 of the BES definition with a gross (individual or aggregate) nameplate rating greater than 20 MVA including, but not limited to:

4.2.4.1 Synchronous condenser; and

4.2.4.2 Flexible alternating current transmission system (FACTS) devices.

4.2.5 High-voltage direct current (HVDC) systems including:

4.2.5.1 Line commutated converter (LCC); and

4.2.5.2 Voltage source converter (VSC).

4.2.6 Facilities meeting an exclusion of the BES definition are exempt as an applicable Facility.

Example MOD-026-2 R6

Inverter-Based Resource – EMT Model(s)

R6. For each Facility identified by the Transmission Planner in Requirement R1, Part 1.2.1, each asset owner (Generator Owner or Transmission Owner) shall provide a verified EMT model(s) with associated parameters and accompanying information that represent the in-service equipment of the Facility to its Transmission Planner according to the requirements and processes developed by its Transmission Planner and its Planning Coordinator in Requirement R1, within the timeframe in MOD-026-2 Attachment 1. The verified model(s) and accompanying information shall include at a minimum the following: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

6.1. Device test[13] results demonstrating a comparison of the **IBR Unit's** response and the IBR Unit's EMT model response for large signal disturbances.[14] If device test results are not obtainable, the Generator Owner or Transmission Owner shall document the reason;

6.2. Verification documentation demonstrating the configurable, site-specific parameters of **IBR Unit** model(s), power plant controller model, and auxiliary control devices model(s), if applicable, match the parameters of the in-service equipment of the Facility, for those parameters that can be confirmed by the Generator Owner or Transmission Owner;

6.3. Facility EMT model with associated parameters representing the **IBR Unit(s)**, collector system, auxiliary control devices, power plant controller, main transformer(s), and enabled protective and limiting functions that act on voltage, frequency, and/or current, or act on quantities derived from voltage, frequency, and/or current, which directly trip the IBR Unit(s) or Facility, or limit active/reactive output of the **IBR Unit** or Facility;[15]

Technical Rationale

- The term IBR is synonymous with the term “IBR plant/facility.” An IBR includes the IBR Units, and the equipment designed primarily for delivering the power to a common point of interconnection (e.g. step-up transformers, collector system(s), main power transformer(s), power plant controller(s), reactive resources within the IBR plant, and a voltage source converter high-voltage direct current (VSC HVDC) system with a dedicated connection to the IBR).
- IBRs have traditionally been considered “generating resources.” An IBR is not a HVDC system (except for a VSC HVDC with a dedicated connection to an IBR), flexible ac transmission systems (FACTS) (e.g. static synchronous compensators (STATCOM) and static VAR compensators (SVC)), or any resources that are not inverter-based, e.g., gas and steam power plants with synchronous generators. The DT’s intent with the phrase "IBRs include" is to articulate a specific list of IBRs. Therefore, other technologies not listed would not be considered an IBR.

Technical Rationale

- IBRs are capable of exporting Real Power and may also be capable of providing Reactive Power.
- Battery energy storage systems (BESS) are considered an IBR unit or IBR independent of whether the device is operating in a charging, idle, or discharging mode.

FAQs

- What is the difference between an IBR Unit and IBR? What is an example of how they are used?
- How and why do these definitions differ from those adopted in IEEE 2800-2022?
- Does the IBR definition only relate to generating resources? Does it also include HVDC circuits and transmission-connected reactive devices like STATCOMs and SVCs?
- Does the IBR definition mean that all BES-connected, BPS-connected, and distribution-connected IBRs are applicable for all standards, such as MOD-026-2?
- What is the distinction between IBR definitions and GO-IBR registration?

Implementation Plan

Where approval by an applicable governmental authority is required, the proposed definitions shall become effective on the first day of the first calendar quarter after the applicable governmental authority's order approving the definitions, or as otherwise provided for by the applicable governmental authority

Project Timeline

- 45-day initial ballot and comment period
  - Scheduled for November 16, 2023 to January 9, 2024
- NERC Board Adoption
  - Scheduled for February or May 2024

Related IBR projects

The Project 2020-06 DT intends to use the Glossary Terms of IBR Unit and IBR for MOD-026-2. Additional standards development projects and related standards that may use these defined terms include:

- Project 2020-02 Generator Ride-through (new PRC-029, modified PRC-024)
- Project 2021-01 Modifications to PRC-019 and MOD-025
- Project 2021-04 Modifications to PRC-002 (new PRC-028)
- Project 2022-04 EMT Modeling
- Project 2023-01 EOP-004 IBR Event Reporting
- Project 2023-02 Performance of IBRs (new PRC-030)

GO-IBR & GOP-IBR

IBR & IBR Unit definitions (Glossary of Terms)	GO-IBR, GOP-IBR registration
• Terms for use in Reliability Standards • IBR or IBR Unit may be used in the requirement language • Meant to define/describe the technology • IBR – as a whole or plant/Facility level • IBR Unit – device or inverter level • Specific types listed as IBRs • Not meant to define the applicable Facilities within each standard (each standard has its own Applicability section)	• Defines in NERC Rules of Procedure what needs to be a Registered Entity • Could be listed as "Applicable/Responsible Entities" in upcoming standards • Currently, does not list specific types of inverter-based generating resources

GO-IBR & GOP-IBR

- GO-IBR & GOP-IBR entities of NERC Compliance Registry
- NERC ROP, Appendix 5B IBR redline
- An entity identified in the Notes to Generator Owner or Generator Operator in Section II above shall be included in the Compliance Registry as a Generator Owner-Inverter-Based Resource (GO-IBR) and/or Generator Operator-Inverter-Based Resource (GOP-IBR) if the entity owns, maintains, or operates non-BES inverter based generating resources that have an aggregate nameplate capacity of greater than or equal to 20 MVA, delivering such capacity to a common point of connection at a voltage greater than or equal to 60 kV.
- GO-IBR registration is separate from the IBR definition

Questions and Answers

FAQs

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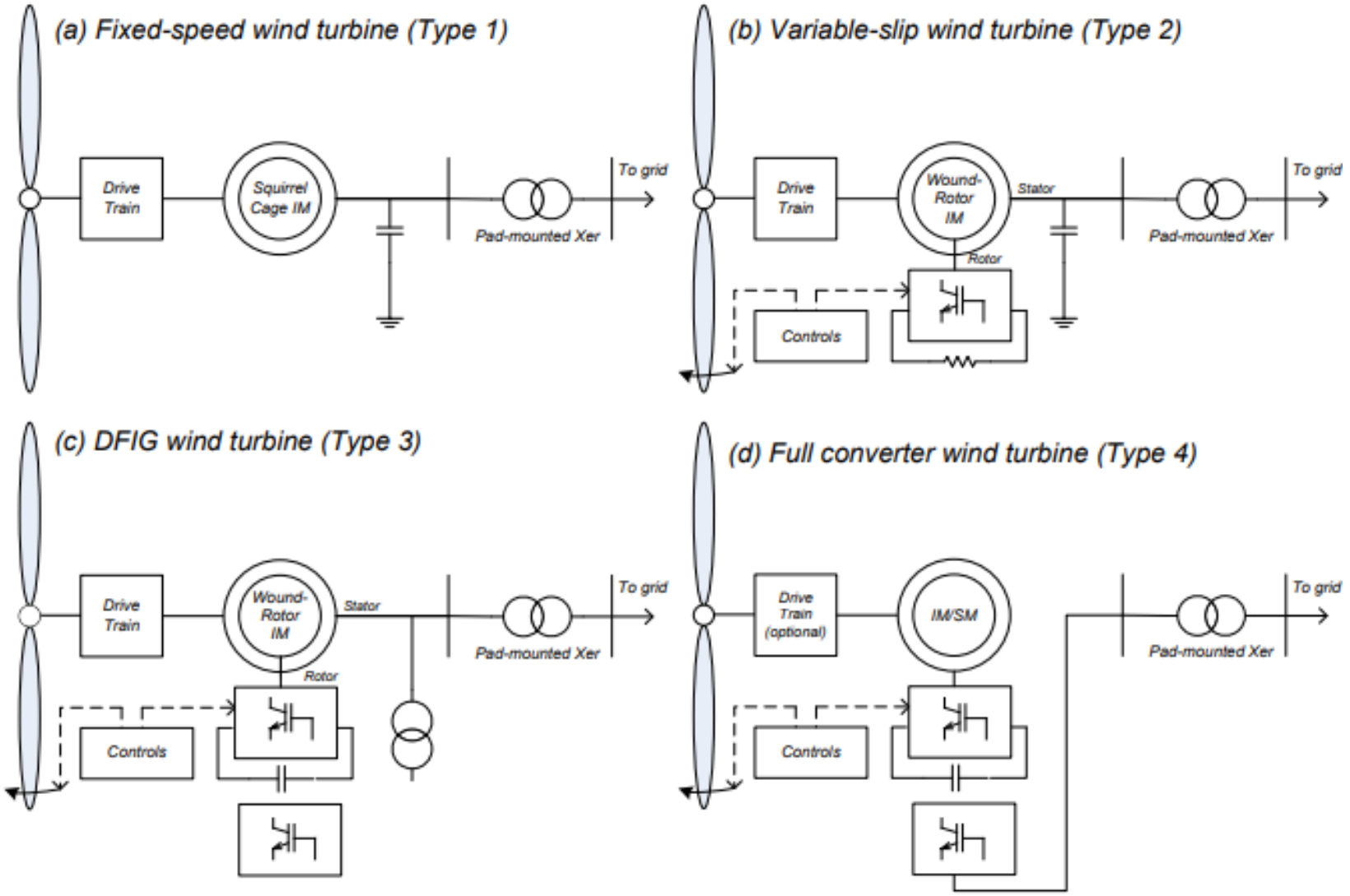
Type 3 and 4 wind



Wind Turbine Generator Types [Source: NREL]