NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Technical Rationale

Project 2020-06 Verifications of Models and Data for Generators Inverter-based Resource Definitions

1. The drafting team (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. The DT also used recent FERC and NERC documents, which included inverter-based resource related terms and descriptions, as the basis for the IBR definitions.

2. The IBR and IBR Unit definitions are intended to describe technologies that shall be considered IBR and to distinguish between a unit and resource. An IBR is defined by technology, thus voltage connection level (kV), facility capability level (MW/MVA), or other factors do not impact the inclusion as an IBR. An IBR can be connected to any part the transmission system, sub-transmission system, or distribution system. For a Reliability Standard(s) that use either the IBR or IBR Unit terms, the Applicability Section for that Reliability Standard(s) will specify which IBRs are applicable. Each of these Reliability Standards, including the Applicability Section(s) will be balloted in accordance with the NERC Rules of Procedure, and the Applicability Section. For example, an Applicability Section may specify that IBR Facilities (BES), IBRs that are owned by a Generator Owner meeting the new registry criteria for sub-BES resources, or IBRs that are operated by a Generator Operator meeting the new registry criteria for sub-BES resources, are considered applicable.

3. IBRs have commonly been referred to as “generating resources.” An IBR is not a HVDC system (except for a VSC HVDC with a dedicated connection to an IBR, as this is part of the IBR facility), stand-alone 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. A list of IBRs is provided in Table 1 below.

4. IBRs may include any hybrid combination of IBR types (e.g., BESS and solar PV), see Table 1.

5. IBRs also include co-located portions of a facility that are IBR technologies (e.g., a BESS, which is co-located at synchronous generation facility), see Table 1.

6. Examples of IBRs include:

IBRs	Not an IBR
• Solar photovoltaic • Type 3 wind • Type 4 wind • Battery energy storage system (BESS) • Fuel cell(s) • Hybrid combination of IBRs • Portions of co-located facility that are IBR • VSC HVDC with dedicated connection to IBR • This is not an all-inclusive list.	• Stand-alone FACTS device (e.g., STATCOM or SVC) • Flywheels • Synchronous generator • Synchronous condenser • VSC HVDC • LCC HVDC • This is not an all-inclusive list.

Table 1: Inverter-Based Resource (IBR) examples

7. When drafting Reliability Standards and Requirements for IBR, an IBR unit and IBR plant/facility must be distinguishable from one another. Examples from current Reliability Standards usage include the following:

   - MOD-026, MOD-027: An IBR model that has been tested makes up a crucial element of the IBR plant/facility model. Thus, the new standard includes IBR Unit conditions for that testing. Many of the IBR Unit level parameters cannot be validated with plant/facility validation, staged testing.
   - PRC-019: Changes made to IBR Unit control system firmware or settings changes may be subject to updating protection coordination, as would an IBR plant/facility power plant controller firmware or settings changes.
   - PRC-028: Disturbance monitoring at IBR Unit levels may be necessary for disturbance recording.
   - PRC-029: Each Generator Owner or Transmission Owner of an applicable IBR shall ensure that each facility remains electrically connected and continues to exchange current in accordance with the no-trip zones and Operation Regions as specified in Attachment 1 unless needed to clear a fault.

8. 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.

9. Figure 2.1 shows an example diagram of an IBR. The IBR (red box) includes the IBR Units (blue boxes), collection system (green boxes), power plant controller(s) (not shown), and reactive resources within the IBR plant. If the IBR is connected to the electric system via a dedicated voltage source converter high-voltage direct current (VSC HVDC) system, the VSC HVDC system is part of the IBR.

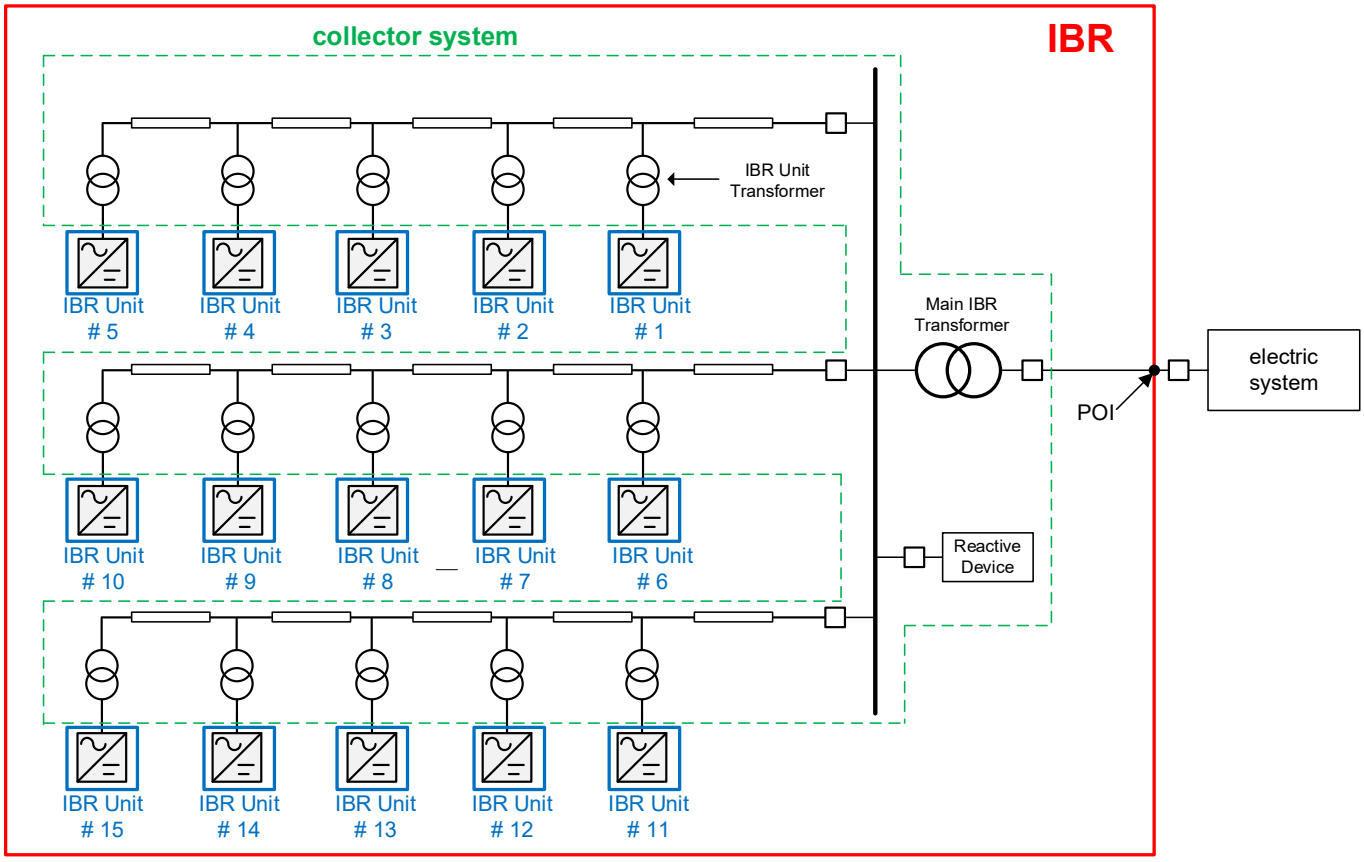

Figure 2.1 Example diagram of an IBR depicting the IBR (red box), collector system (green box), and IBR Units (blue boxes)

10. Examples of common IBR Unit configurations are shown in Figures 2.2 and Figure 2.3.

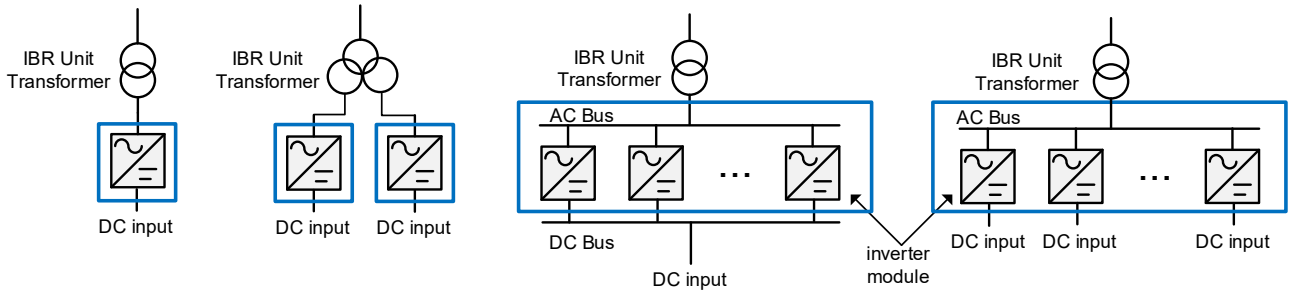

Figure 2.2. Example configurations of full converter-based IBR Units

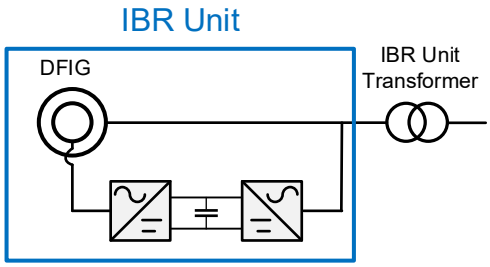

Figure 2.3. Type III wind IBR Unit example

11. The inclusion of 'capable of exporting Real Power' is to clarify that loads connected to the electric system via power electronics are not IBRs. IBRs are capable of exporting Real Power and may also be capable of providing Reactive Power. The DT contemplated adding the phrase "may also be capable of providing Reactive Power" in the definition(s). However, the DT believed this may be misinterpreted that IBRs include technologies such as FACTS devices or HVDC.
12. Battery energy storage systems (BESS) are considered IBRs whether the device is operating in a charging, idle, or discharging mode. Within each Reliability Standard, a DT may draft operating mode-specific Requirements, as needed.
13. 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)
14. Distributed Energy Resources (DER) related projects that may or may not need to use IBR/IBR Unit if they end up with their own definition)
    - Project 2022-02 Modifications to TPL-001 and MOD-032 (DER)
    - Project 2023-05 FAC-001/FAC-002 DER
    - Project 2023-08 MOD-031 Demand and Energy (DER)