IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems (IEEE 2800)

Summary

- In recent years, there has been a rapid pace of inverter-based resources (IBRs) interconnecting to the bulk power system, including transmission and sub-transmission systems.
- IEEE 2800 was published in April 2022 to address the gap in interconnection requirements of IBRs into the bulk power system and the misapplication of IEEE 1547, and to complement the North American Reliability Standard and Guidelines set by FERC and NERC.
- IEEE 2800-2022 establishes the recommended interconnection capabilities and performance criteria for IBRs interconnected with transmission and sub-transmission systems.
- This performance standard identifies the minimum requirement, but does not necessarily require the utilization of these requirements. The associated testing and verification standard (IEEE P2800.2) is still under development.

What has changed?

There is a rapid increase in the installation of the inverter-based resources (IBRs), especially solar energy. These installations are not only interconnected with the distribution systems (i.e., DER), but also with the associated transmission and sub-transmission systems. In 2021, the U.S. Department of Energy published its *Solar Futures Study*[1] exploring pathways for solar energy to drive deep decarbonization of the U.S. grid. The study considered three decarbonization scenarios and found that the best scenario (i.e., scenario that resulted in the highest reduction in carbon emissions) assumed electrifying additional 30% of

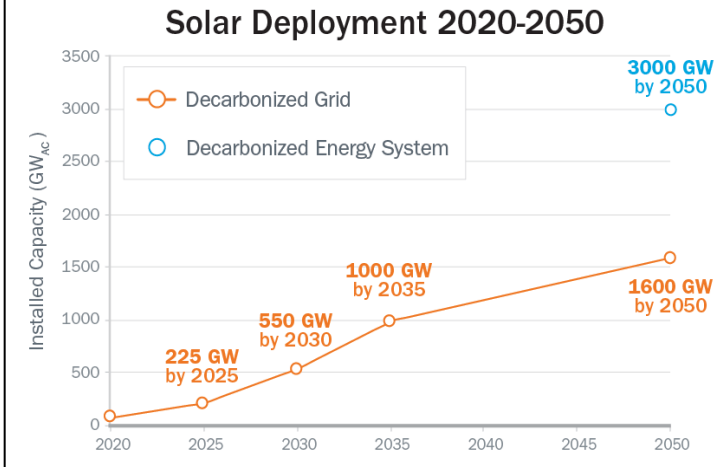

Figure 1: The Solar Futures Study modeled the deployment of solar necessary for a decarbonized grid.[1]

[1] NREL Solar Future Study: https://www.nrel.gov/analysis/solar-futures.html and DOE report: https://www.energy.gov/eere/solar/solar-futures-study

building energy loads, 14% of transportation energy loads, and 8% of industrial energy loads by 2050. Furthermore, this "best" scenario concluded that solar will grow from 3% of the U.S. electricity supply in 2020, to 40% by 2035, and to 45% by 2050. To achieve 95% grid decarbonization by 2035, the U.S. would need to install 30 GW_{AC} of solar PV annually between 2021 and 2025, ramping up to 60 GW_{AC} annually from 2025 to 2030. This kind of growth, or even a lower level along the same trajectory, would mean a dramatic increase in installing IBRs in the upcoming years.

Due to the fact that IBRs have different behavior and performance from synchronous generators, varying interconnection requirements for different jurisdictions, and other issues related to tripping, cessation of power and isolation, there was a need for standardization for IBRs connected into bulk power system. Another driver was the misapplication of IEEE 1547[2] standard (for generators interconnected with the distribution systems) to transmission and sub-transmission-connected resources. The resulting standard (IEEE 2800) was published on April 22, 2022 and is available here.

What is the impact on cooperatives?

As a response to recent events, the North American Electric Reliability Corporation (NERC) has issued multiple reports and guidelines regarding IBRs' operation. These resources focus particularly on operation during disturbances and provide suggested improvements to NERC reliability standards pertaining to issues with IBRs. For generation and transmission cooperatives (G&Ts), the purpose of this standard is to set the required interconnection capability and performance criteria for IBRs interconnected with transmission and sub-transmission systems, including solar PV, battery storage and wind, doubly-fed induction generator (Type III wind turbines), generator connected to the grid through an inverter (Type IV wind turbines), and HVDC-VSC connected resources.

What do cooperatives need to know or do about it?

The standard leaves the applicability and enforcement of this standard at the discretion of the Authority Governing the Interconnection Requirements (AGIR), such as the transmission system owner or the transmission system operator.

It includes recommendations on performance for reliable integration of IBR into the bulk power system, including but not limited to, "***voltage and frequency ride-through (VRT and FRT), active power control, reactive power control, dynamic active power support under abnormal frequency conditions, dynamic voltage support under abnormal voltage conditions, power quality, negative sequence current injection, and system protection.***"

The standard complements the North American electric reliability electric corporation (NERC) standards and fills the gaps needed when considering IBRs. The capability requirements/functionality

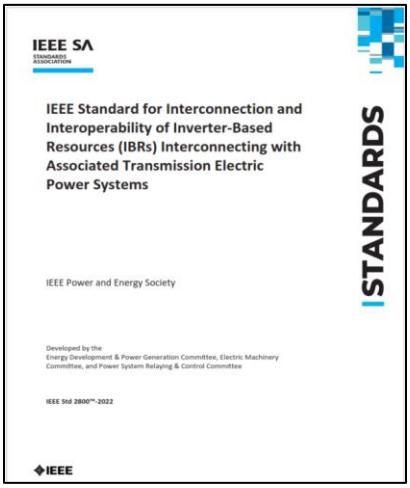

Figure 2: Available from IEEE at https://standards.ieee.org/project/2800.html

[2] IEEE 1547 standard: https://standards.ieee.org/ieee/1547/5915/

do not mean that performance requirements/function have to be utilized. The standard has general inter-connection technical specifications and performance requirements, including the following:

- Reactive power
- Frequency ride-through (FRT), frequency response (FR), and fast frequency response (FFR)
- Voltage disturbances and voltage ride-through (VRT)
- Power Quality requirements
- Protection requirements

Additional Resources

IEEE 2800-2022: https://standards.ieee.org/project/2800.html

Contact for Questions

Fathalla Eldali
Senior Distribution Optimization Engineer
NRECA Business and Technology Strategies
Fatahalla.Eldali@nreca.coop