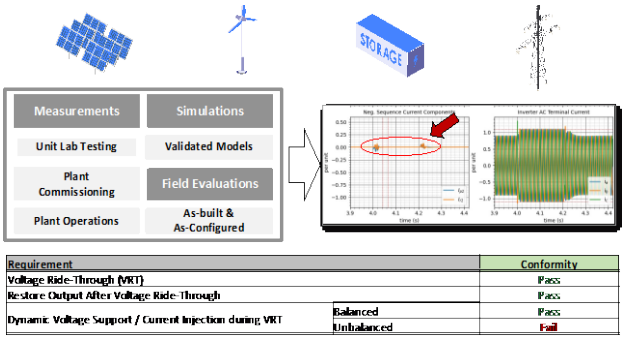
Verifying Performance of Bulk Power-System-Connected Solar, Wind, and Storage Plants



Project Highlights

- Improve technical interconnection requirements to address recent reliability issues with large inverter-based resources plant performance
- Understand applicability of IEEE 2800 vs. IEEE 1547 for sub-transmission connected resources
- Implement new procedures to verify conformity of plant performance prior to commercial operation, and continuously during operation
- Provide a collaborative forum to exchange IBR interconnection challenges and learnings

Background, Objectives, and New Learnings

Planning and operation of power systems are rapidly being adapted to integrate increasing amounts of large-scale inverter-based resources (IBRs). Still, a growing number of grid events have exposed serious reliability issues with IBRs plant performance as reported by entities like the North American Reliability Corporation (NERC). In response, the electric and renewable power industry is collaborating to meet the challenges by enhancing existing IBRs interconnection standards and introducing new ones.

The recently published IEEE Std 2800™-2022 specifies capability and performance requirements for large IBR plants connected to bulk power systems. IEEE Std 1547™-2018 and IEEE Std 1547a™-2020 set the requirements for distributed energy resources (DERs), and intentionally overlap with IEEE 2800 for utility-scale inverter-based DERs that are connected to radial sub-transmission systems. Even though these leading IEEE standards firmly establish consensus technical minimum requirements for large IBRs, the verification of plant-level conformity with these standards remains a challenge for the industry.

While calls for more scrutiny in plant-level conformity assessment prior to an IBR plant's commercial operation are increasing, utilities also face growing connection queues and backlog in their interconnection process. The U.S. Federal Energy Regulatory Commission (FERC) responded in 2022 by issuing two Notices of Proposed Rulemaking (NOPR).

This project supports participants in their efforts to improve technical interconnection requirements for large IBRs connected to transmission systems to at least the level of minimum capability requirements that is specified in IEEE 2800-2022. This includes the provision of an IEEE 2800 users' responsibility matrix that lists the ~120 decisions that participants should consider when adopting the standard. The project further intends to help participants that plan and operate sub-transmission systems to establish criteria that determine which of the two IEEE standards, i.e., IEEE 2800 or IEEE 1547, should be applied to interconnecting utility-scale resources. New learnings that consider established practices from regions, like Europe, could help resolve many of the IBR performance reliability issues recently reported. Examples include procedures to configure plant performance and verify large disturbance conformity prior to commercial operation, and then continuously during operation. The project also provides participants with a forum to exchange their experiences with the adoption and enforcement of IEEE interconnection standards. As a result, the project intends to identify practical procedures for interconnection process reform that balance process efficiency and system reliability.

Benefits

- Ready IBR plants with capabilities to operate more reliably and without interruption of service to customers, and to offer essential reliability services.
- Increased understanding of how transmission and sub-transmission systems can be planned and operated reliably and cost-effectively with increasing amounts of large IBRs potentially leading to improved safety, reliability, and efficiency of customers' electric service.

- Practical guidance that informs interconnection reform, such as ISO/RTO tariff revisions, FERC and state public utility commission (PUC) proceedings, which may aim to update interconnection requirements and processes for large IBRs, including plant-level conformity assessment.

Project Approach and Summary

All participants will engage in the collaborative project Tasks 1, 2, and 3, and may add participant-specific scope and deliverables through Task 4.

Task 1. Training Participant's Engineers and Access Decision Tools for Efficient IEEE Standards Adoption

Participants access pre-recorded webinars and decision tools that can support in efficiently adopting IEEE 2800 for large IBRs, including the use of IBR modeling to determine site-specific functional settings in interconnection studies.

Task 2. Interconnection Studies and Plant-Level Performance Verification Working Group

EPRI intends to host monthly meetings among participants to exchange questions, experience, and peer discussions in a utility-focused space supplementing public industry forums like NERC IRPS and IEEE P2800.2.

Task 3. Technology Transfer Workshop

EPRI intends to close out the project with a technology transfer workshop to summarize the findings and recommendations to all participants, address remaining questions, and facilitate exchange of new learnings.

Task 4. Assess Participant-Specific Requirements and Processes and Determine Improvement Opportunities (Individually scoped and priced)

EPRI intends to review participant's existing interconnection requirements, processes, impact study approaches, and commissioning practices and identify potential gaps with respect to IEEE standards and leading industry practices. EPRI will provide participant-specific suggestions for improvements that can assist in revising interconnection requirements, processes, and impact study approaches.

Deliverables

- Training recordings and slides on IEEE 2800 and the use of IBR modeling in interconnection and planning studies.
- Decision tools like (i) IEEE 2800 adoption users' responsibilities and decisions spreadsheet; (ii) Generic technical interconnection requirements template; (iii) IEEE 2800/1547 applicability decision matrix for large IBRs connected to sub-transmission systems.
- Plant performance verification procedures report with (i) interim and (ii) recommended approach for IEEE P2800.2, including Responsibility Assignment (RACI) matrix.
- Monthly collaboration meetings and one technology transfer workshop (hybrid) at the end of the project.

Participant-specific deliverables (Task 4 Only):

- Technical report with detailed comments summarizing participant potential gaps and improvement opportunities.

The non-proprietary results will be incorporated into EPRI's R&D programs and made available to the public for purchase or otherwise.

Price of Project

Pricing is tiered based on the higher of participant's annual distribution TWh or peak transmission MW with Tier 1 at $30,000 (>50 TWh annual distribution or 10,000 MW peak transmission) and all others at Tier 2 $20,000). Pricing of Task 4 depends on participant-specific scope. This project qualifies for self-directed (SDF) and tailored collaboration (TC) funds and can be paid over two years.

Project Status and Schedule

The project is expected to start in early 2023. The project is expected to last for approximately 18 months The duration for each participant will vary, depending on the selected tier.

Who Should Join

Bulk system planners, operators, interconnection engineers, decision makers and staff involved in large IBR interconnection strategies, research, and regulatory affairs.

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