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IBRs Negative-Sequence Current Injection (NSCI) Performance Considerations

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August 17, 2026

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Background

1 Requirement established

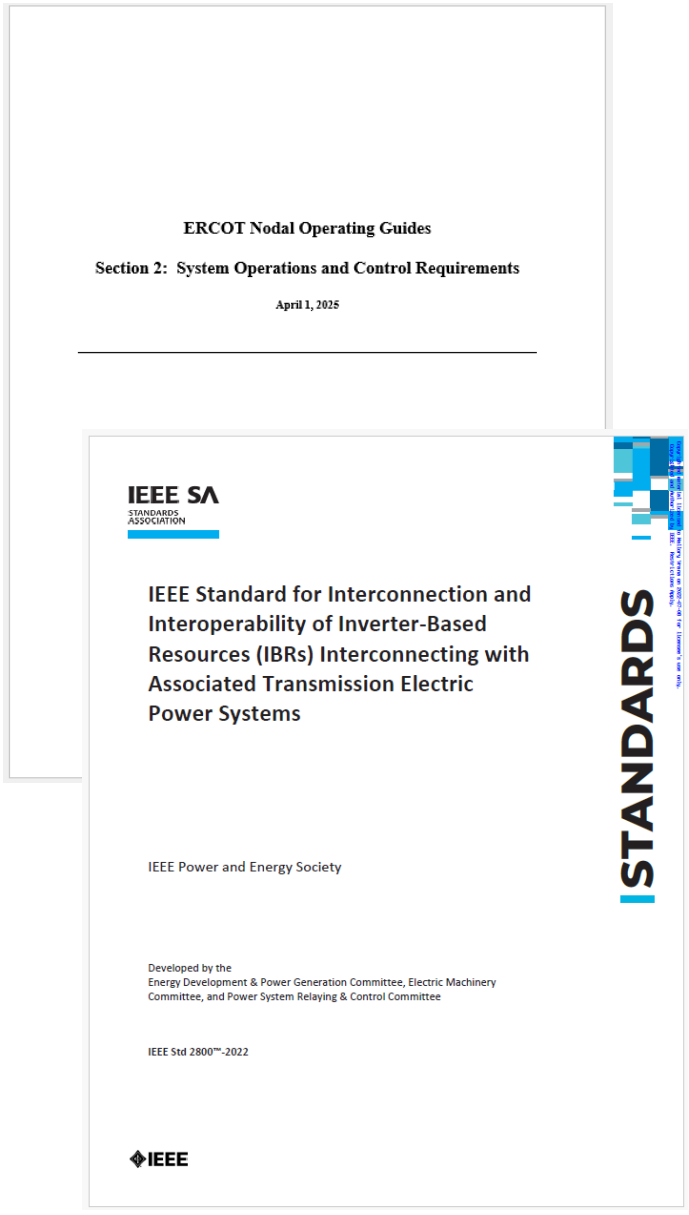
- Applicable new and modified IBR projects are required to provide NSCI under the ERCOT Nodal Operating Guide through NOGRR 245, which adopted relevant IEEE Std 2800 requirements.

2 Detailed profile left open

- IEEE 2800 establishes the NSCI requirement, but detailed performance characteristics must be defined based on system needs.

3 Cross-domain implementation gap

- The NSCI supports protection coordination, while remaining compatible with ride-through, converter current limits, stability objectives, and short-circuit modeling capability.



Purpose: Align protection needs with achievable IBR capability and limitations, define a coordinated path for NSCI performance guidance to support ERCOT system reliability.

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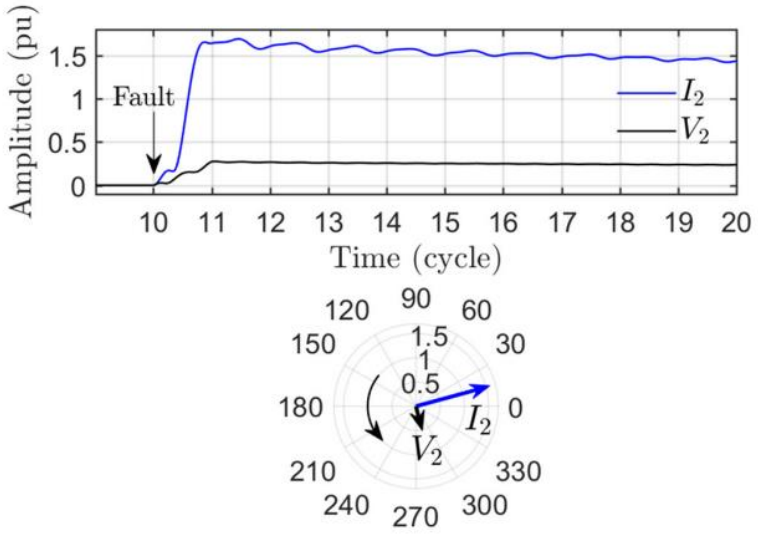
Fault Response and Protection Implications

The key difference is not only fault response magnitude and angle, but also predictability.

Synchronous generator

Physics-driven response



Negative-sequence current is mainly governed by machine and network negative-sequence impedance; magnitude and angle are comparatively predictable.

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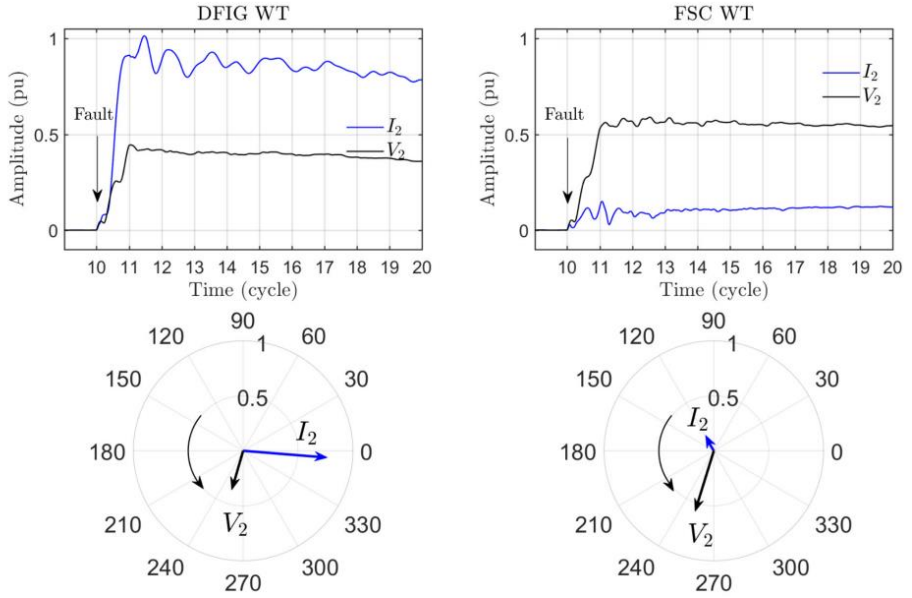
Control-driven response



Negative-sequence response depends on IBR type, control mode, priority logic, current limits, OEM logic, and plant impedance.

Protection functions exposed: 50Q/51Q • 67Q • POTT/PUTT/DCB/DCUB • phase selection / FID • backup coordination

Source: EPRI Report- Impact of Inverter-Based Resources on Protection Schemes Based on Negative Sequence Components.

Key Findings from TSP Survey Feedback

14 TSP responses

showed converging practices and common implementation gaps.

Weak-source-tolerant protection:

TSPs are increasingly using weak source tolerant protection in high IBR areas.

Legacy directional elements need review:

Low or control-dependent I_2 can challenge directional sensitivity, security, and existing polarization assumptions.

NSCI profile must be explicit:

Protection studies need defined magnitude, angle, response time, duration, and current-priority behavior.

Utility guidance remains limited:

Many respondents rely on project specific or manufacturer guidance rather than a common implementation practice.

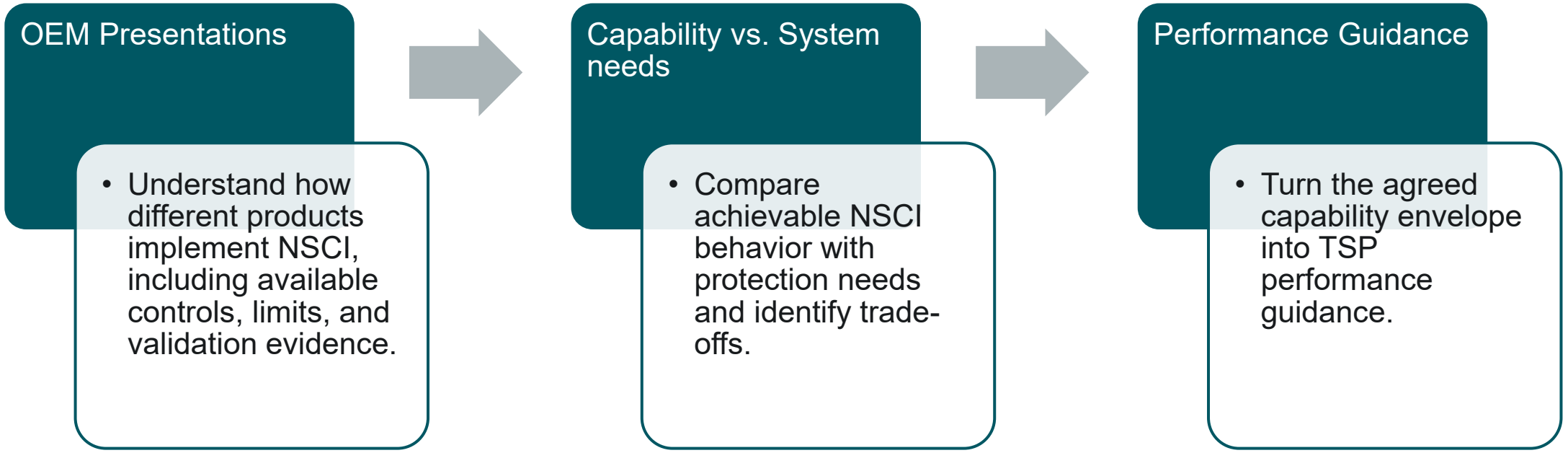
Model and data gaps remain a barrier:

Protection settings need models and data that reproduce sequence current behavior and converter limits.

Mutual Need: Define an NSCI profile that is predictable for protection coordination and achievable for IBR design, control implementation, and modeling.

SPWG-IBRWG Collaboration

SPWG reached consensus to advance the development of TSP informed NSCI performance guidance.



Key Takeaway: Define the protection needs and IBR capabilities together, use that common target for settings, models, validation, and event monitoring.

Questions or comments?

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Thank you !