



Item 6: Addressing Subsynchronous Resonance – NPRR562 Overview and Series Capacitors Go-Live Update

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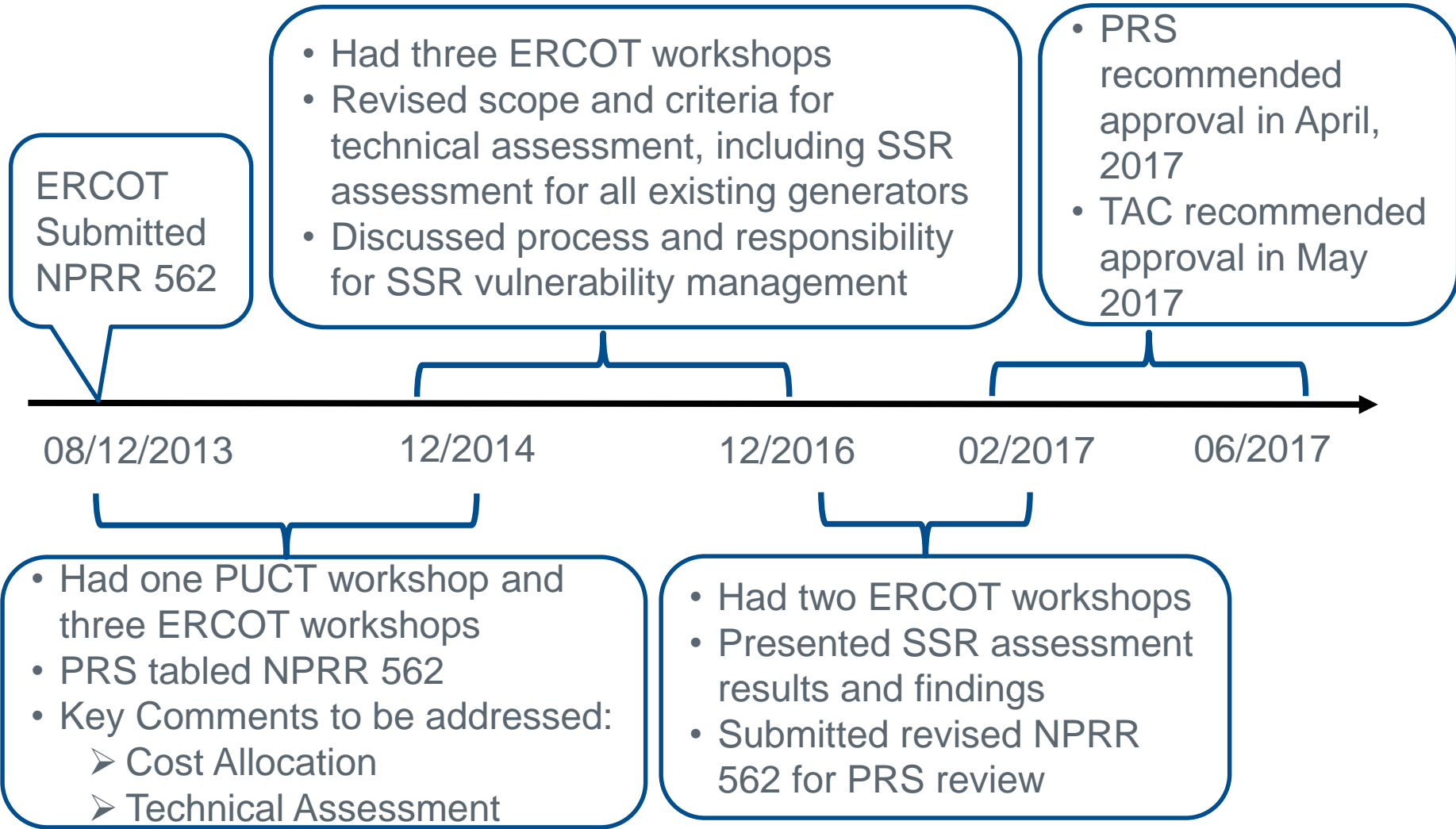
Board of Directors Meeting

ERCOT Public
June 13, 2017

Series Capacitor and Subsynchronous Resonance (SSR)

- Series capacitors can increase transfer capability and improve dynamic stability.
- But also can cause SSR that has the potential to damage generator shafts, protection, and series capacitors.
- SSR: Coincident oscillation between Generation Resources and a series capacitor compensated transmission system at a frequency lower than ERCOT nominal frequency (60Hz)

NPRR 562 History



NPRR 562 Revision

- To address SSR for all generators and the related series capacitors

Technical Assessment

- Scope
- Methodology
- Criteria

Process and Responsibility

- Existing Gen
- New Gen
- New Transmission
- Annual Review
- Operation
- Outage Coordination

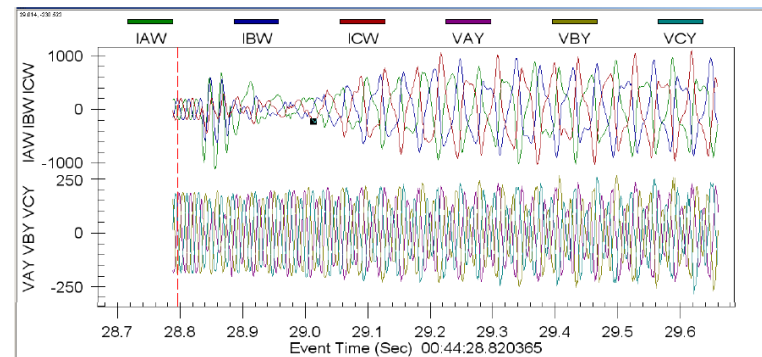
Subsynchronous Resonance Taxonomy

	Synchronous Generator	Inverter-Based Generator
Subsynchronous Resonance (SSR)	Induction Generation Effect (IGE)	IGE / Subsynchronous Control Interaction (SSCI)
	Torsional Interaction	
	Torque Amplification	



Mohave incident (1970): Torsional Interaction

Steam Turbine-Generator Torsional Vibration Interaction with the Electrical Network, EPRI, 2005



South Texas Incident (2009): SSCI

From AEP presentation by Paul Hassink, "Sub-synchronous Control Interaction," Utility Wind Integration Group Spring Workshop April 15, 2011

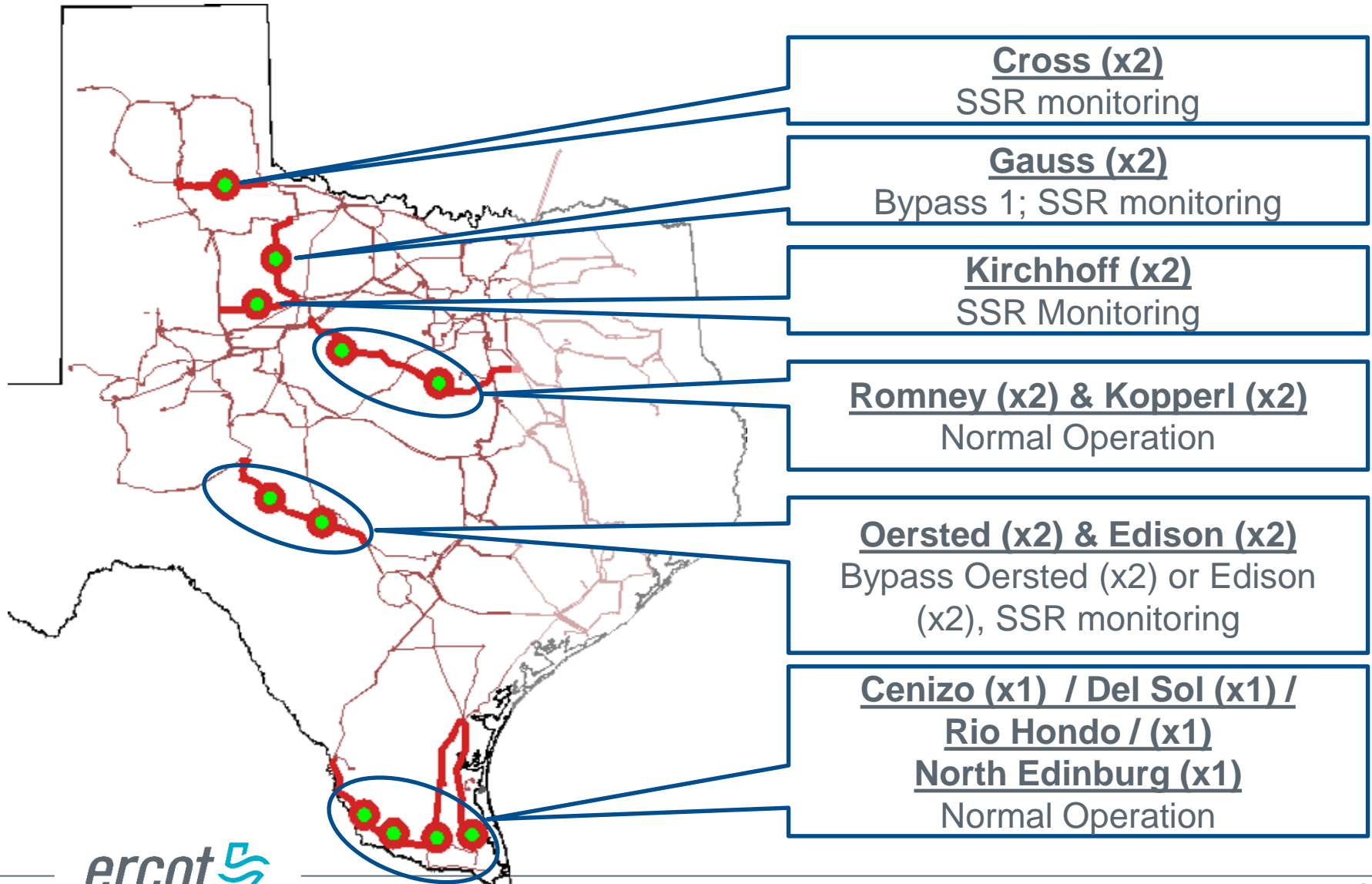
ERCOT SSR Assessment Results

- Torsional Interaction was identified for synchronous generators.
- SSCI was identified for inverter-based generator.
- Generators identified with SSR vulnerability are electrically very close to the series capacitors.
 - Most identified ones are connected to 345 kV grid.

Operational Controls

- Generators are vulnerable within N-4 outages
 - Bypass series capacitors until implementation of transmission options to mitigate the concern.
- Generators are vulnerable for N-5 or N-6 outages
 - Operate series capacitors with SSR monitoring.
- Generators are vulnerability for more than N-6 outages
 - Operate series capacitors as normal operation.

Initial Series Capacitors Operations



Next Steps

- ERCOT has communicated SSR results with all affected Resource Entities and TSPs.
- ERCOT will complete operator training and procedures in July.
- ERCOT will coordinate with TSPs to identify transmission options for generators with SSR vulnerability within N-4 outages.

Acknowledgement

