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FERC Technical Conference on Principles for Efficient and Reliable Reactive Power
Supply and Consumption, March 8, 2005.

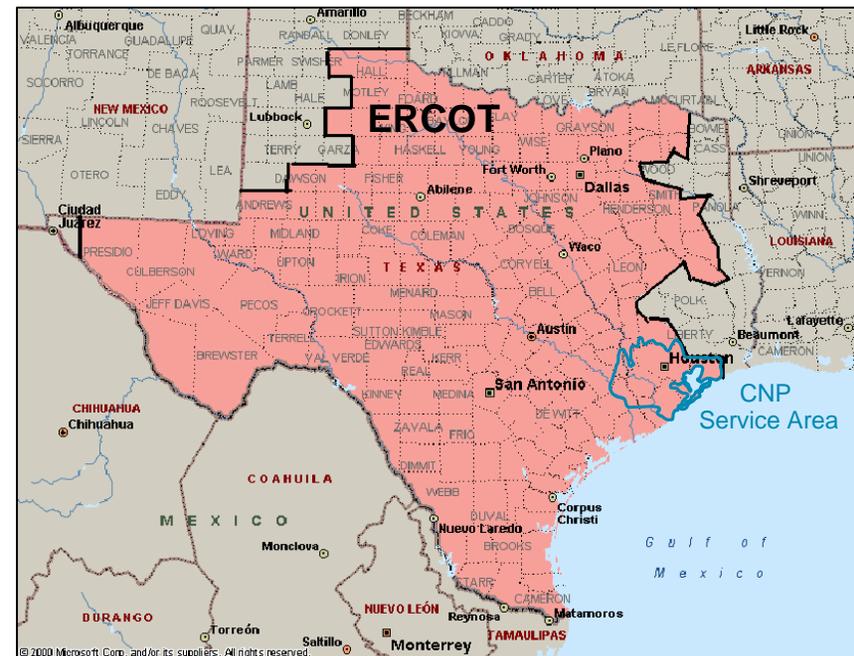
CenterPoint Energy Electric Transmission and Distribution



- Unbundled “Wires” company that delivers power to over 1.8 million metered customers.
- Highly industrialized, 5000 sq. Mile service area, including Houston and 102 surrounding communities.
 - Approximately 40,000 miles of distribution lines.
 - Approximately 3,600 miles of transmission lines.
 - Approximately 16,000 MW peak demand.
 - About 1/4 of the ERCOT load with less than 10% of ERCOT transmission circuit-miles.

CenterPoint Energy Electric Transmission and Distribution

- Wholesale deregulation has encouraged retirement of local generation.
- Now import 25% or more of load requirement from North and South ERCOT.
- As load is increasingly served by remote generation the **local dynamic reactive supply has declined.**
- Now vulnerable to tie line contingencies that might cause voltage collapse.



CenterPoint Energy Electric Transmission and Distribution



- Installed undervoltage load shedding (a NERC recommendation subsequent to 2003 northeast blackout).
- Increased installation of static reactive resources (capacitor banks) connected at transmission voltage.
- Participated in efforts that led to adoption of regional static reactive requirements for distribution loads, transmission systems, and generators.
- Increased monitoring of voltage and reactive performance.

Characteristics of Dynamic Reactive Capability



- Continuously variable output vs. Fixed output for static reactive capability.
- Synchronous generators are primary supplier of dynamic reactive, and can produce several multiples of their normal rating for short periods.
- FACTS devices are more limited but can be designed with dynamic reactive characteristics.

The Need For Clear Dynamic Reactive Reliability Standards



- Cost of dynamic reactive equipment is significantly higher than static reactive equipment.
- The need for dynamic reactive additions must be demonstrated in contested rate proceedings to recover those costs.
- Existing standards for transmission system dynamic voltage performance are vague.

Desired Content of Dynamic Reactive Reliability Standards



- Clear definition of generator low voltage ride-through requirement applicable to ALL generators.
- Clear definition of transmission system dynamic voltage performance criteria.
- Clear definition of generator dynamic reactive responsibility.

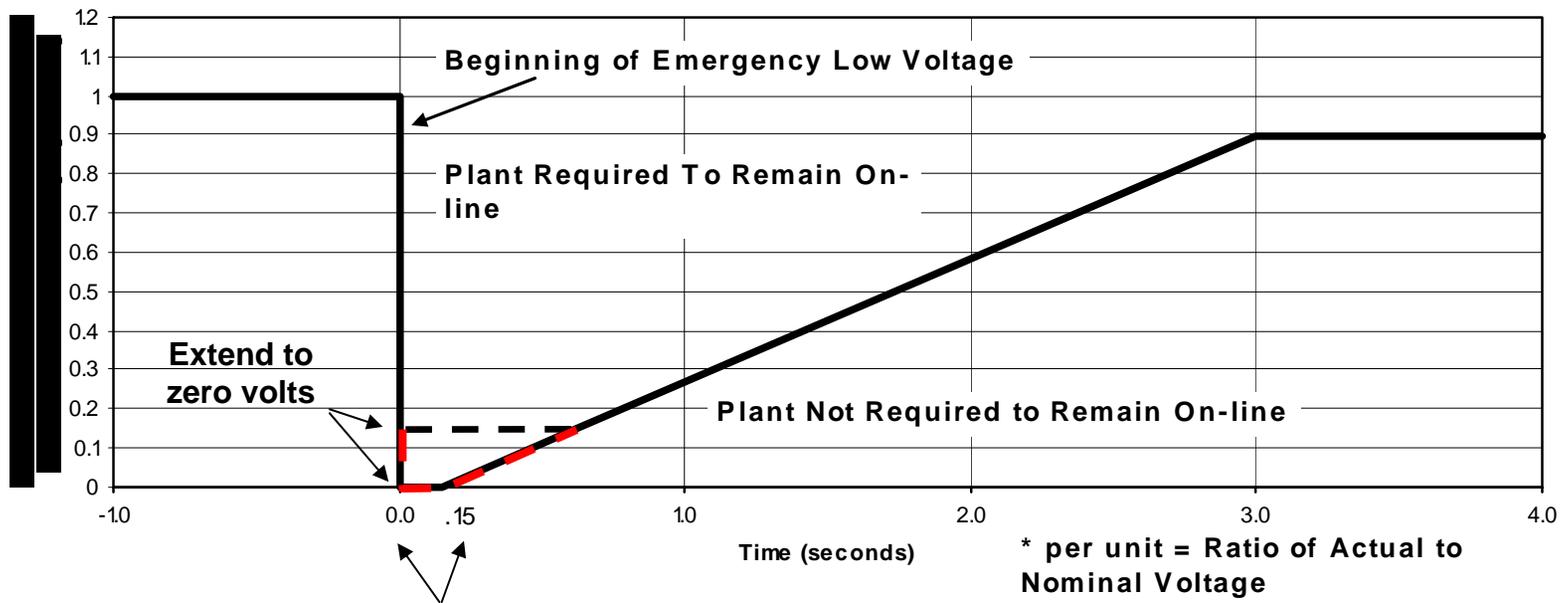
Generator Low Voltage Ride-through



- Proposed for wind and alternative energy generators in docket RM05-4-0000 NOPR.
- We recommend applying the requirement to conventional generators as well as wind and alternative energy.
 - In addition the generator must ride through fault clearing.
- Low voltage ride-through capability for conventional generators is limited by generator protection settings or susceptible auxiliary equipment.

Generator Low Voltage Ride-through. Apply to All Generators

Minimum Required Generator Plant Response to Emergency Low Voltage

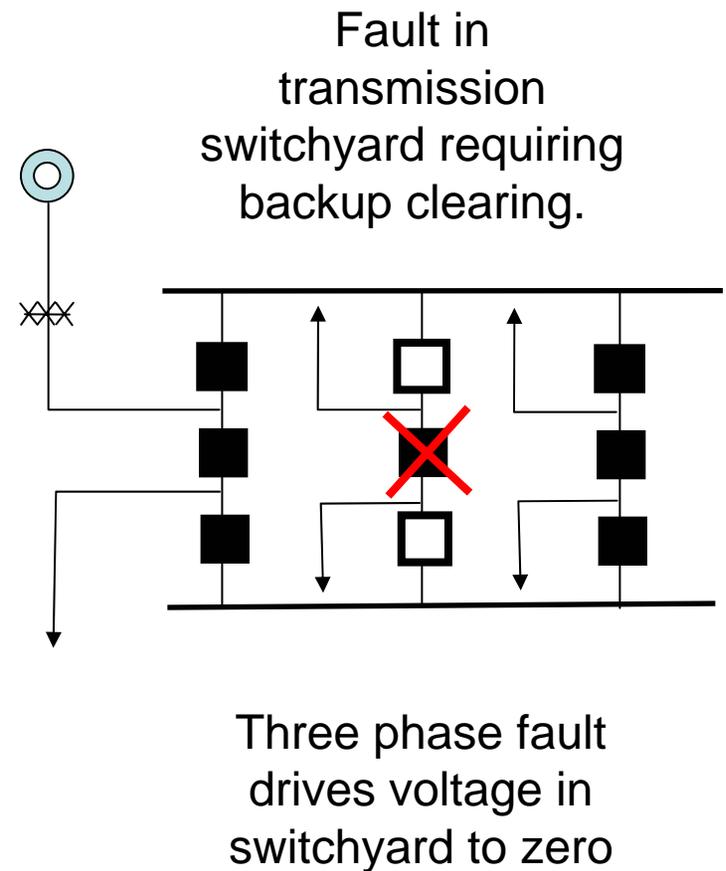


Fault clearing time

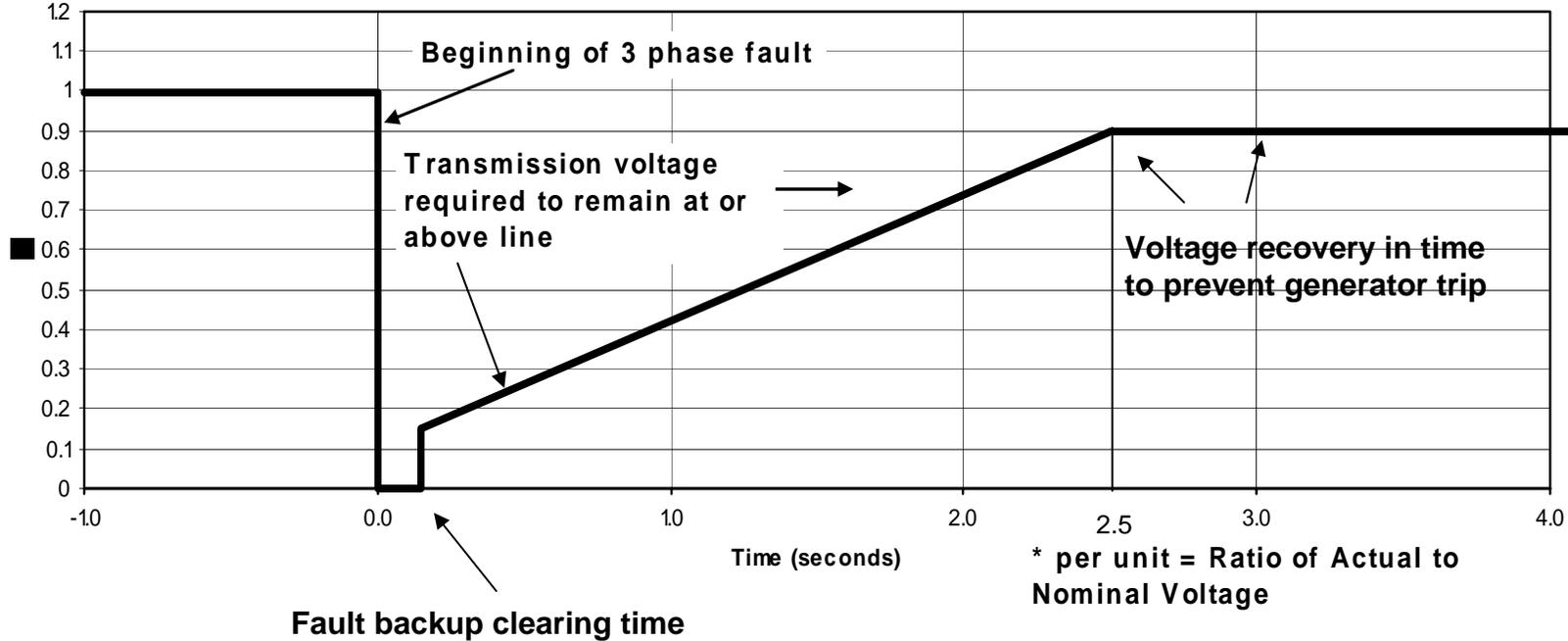
Modified From Docket No. RM05-4-000 Wind NOPR

Criteria for Transmission System Dynamic Voltage Recovery

- Without a corresponding transmission performance standard, the ride-through requirement for generators is of questionable value.
- Transmission systems should meet a dynamic voltage recovery criteria for a three phase fault event with backup clearing time.
- Criteria should be applied at transmission stations serving power plants .

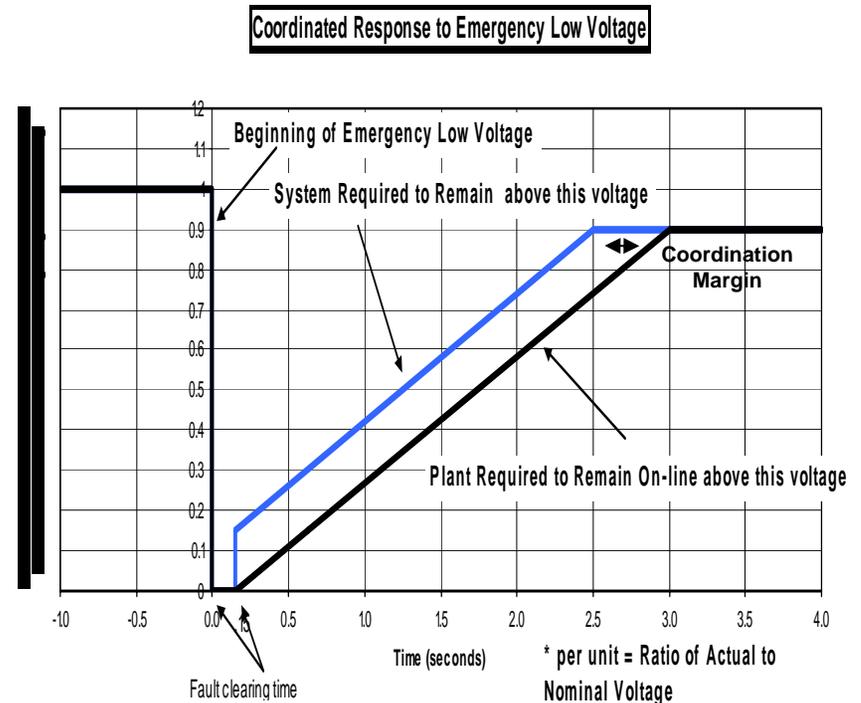


Strawman Criteria for Transmission Dynamic Voltage Recovery



Transmission Dynamic Voltage Performance

- If transmission dynamic voltage recovery is slow, it indicates weakness and danger of voltage collapse
- Transmission system performance should coordinate with generator low voltage ride-through to avoid tripping of generators and cascading voltage collapse.
- If necessary, the system can be strengthened via improved generator dynamic response or addition of a transmission dynamic var device.



Standards/Incentives for Generator Dynamic Reactive Performance



- Requirements based on power factor apply to steady state (static), not dynamic performance.
- Generator dynamic reactive performance affects transmission system dynamic voltage performance.
- All generators (even synchronous machines) do not provide equivalent dynamic reactive performance.
 - Difference in exciter capabilities, (static vs. Rotating exciter, etc.).

Standards/Incentives for Dynamic Reactive Capability



- Develop minimum dynamic reactive performance requirements for generators to participate in energy markets and/or establish incentives for high performance dynamic reactive response under depressed voltage conditions.
- Incentives should be awarded only for capability demonstrated via test or or actual response to low voltage events.