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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.
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

- **Beginning of Emergency Low Voltage**
- **Plant Required To Remain On-line**
- **Plant Not Required to Remain On-line**
- **Extend to zero volts**
- **Fault clearing time**

* per unit = Ratio of Actual to Nominal Voltage

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.

Fault in transmission switchyard requiring backup clearing.

Three phase fault drives voltage in switchyard to zero.
Strawman Criteria for Transmission Dynamic Voltage Recovery

- **Beginning of 3 phase fault**
- **Transmission voltage required to remain at or above line**
- **Fault backup clearing time**
- **Voltage recovery in time to prevent generator trip**

* per unit = Ratio of Actual to Nominal Voltage
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 actual response to low voltage events.