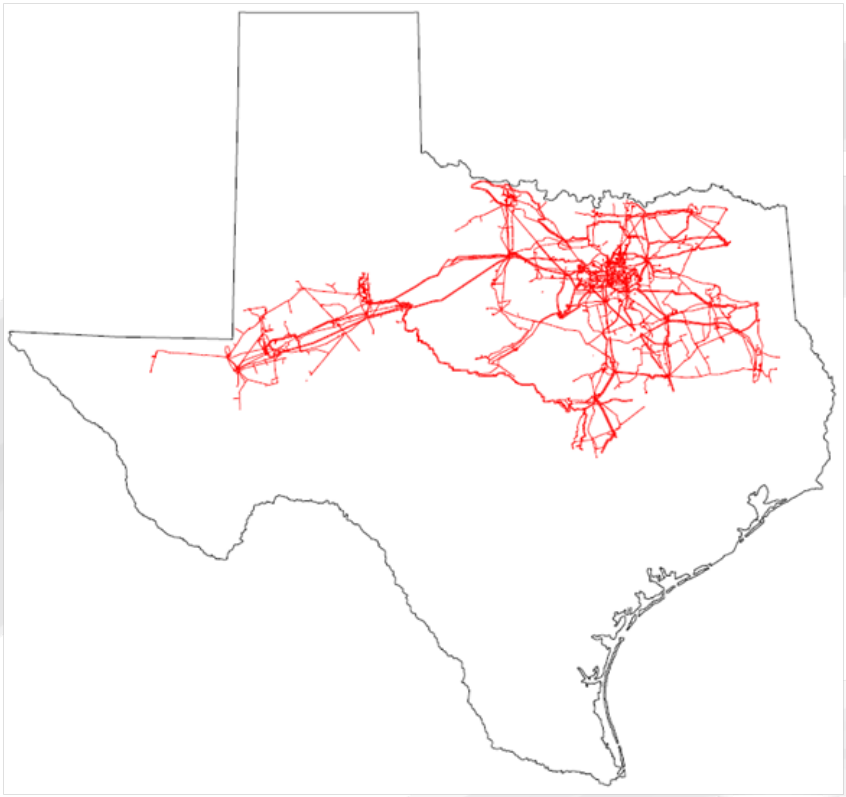
VALUE OF A VAR
SYSTEM PLANNER PERSPECTIVE

DOE Electricity Advisory Committee Meeting
NRECA Conference Center
Arlington, VA



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WE DELIVER.

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PLANNING CONCEPTS

Customer Expectations/Interest/Communications Increasing

Compliance and Oversight Increasing

Generation is Locating Away from Load Centers

Increasing Renewable, Distributed Generation and Demand Response

Lower System Inertia (large units, frequency control)

System Strength Weaker (fault duty, short circuit ratio)

Dynamic and Transient Stability Limiting Transfer Capability More Than Static Limits

Oscillations and Control Interactions Increasing Concern

Load and Peak Demand Projections Highly Variable Based Upon Many Factors

System Operational Control and Coordination Very Complex

System Security and Flexibility Needed for Events Changing Conditions

HILF Events, CIP and Physical Security Concerns

Outages, Clearances and System Restoration Considered

Changing Load Types (Lighting - Incandescent to CFL to LED)

Models to Support Good Decisions

Power Electronics Enabling Transmission Control/Redispatch

- Voltage Source Converter Increasing Utilization of Existing System

Dynamic* Power System Analysis

Absolutely essential to the understanding of power system stability

- **Physical power system never truly in "steady state"**
- **At any instant, numerous small "disturbances" taking place**
  - **Changes in load, generation, ambient temperature etc.**
  - **All result in time – dependent adjustments in system operation**
- **Strong – System can easily absorb these changes**
  - **Under these circumstances, steady – state approx. sufficient**

* "Dynamic" refers to "change with respect to time". The term should be applied with caution when describing subcategories of time – based stability analysis

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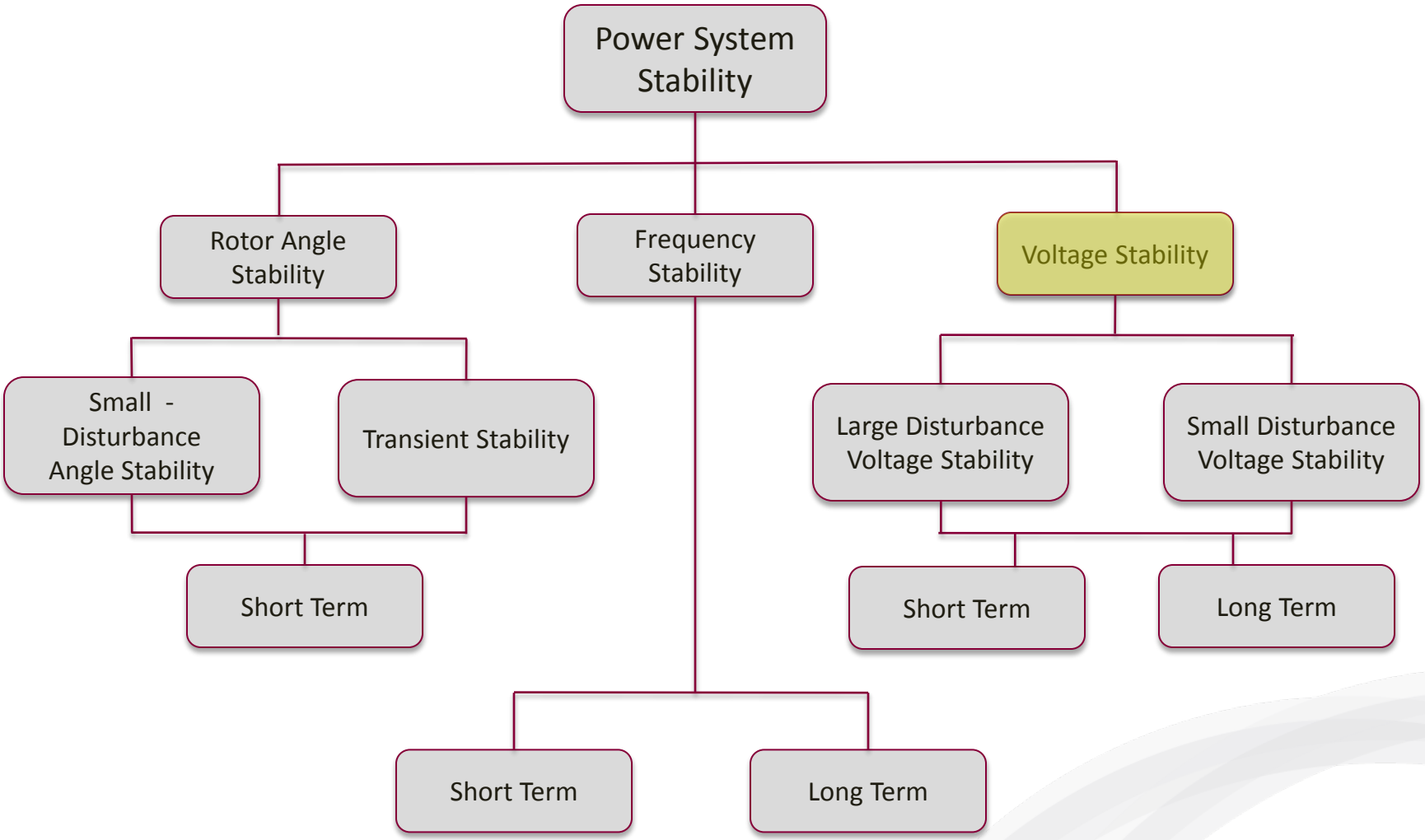
The Stability Problem



Voltage Stability

The ability of the power system to maintain stable bus voltages following disturbance or deviation from initial operating condition

- **Desired equilibrium between load demand and load (power) supply**

- **Instability may cause progressive rise/fall on bus voltages, possibly resulting in:**
  - **Transmission circuit tripping (lines, capacitors, etc.)**
  - **Local or system wide load loss**
  - **Loss of machine synchronism → rotor angle instability**
    - **Usually prevented by protective relaying**

- **Voltage collapse:**
  - **Severe voltage instability**
  - **Low voltages beyond transformer tap capabilities**
  - **Demand of voltage sensitive load not met.**

- **Several factors can contribute, but load typically the driving factor**
- **Two main categories**
  - **Small – Disturbance**
    - **How system voltages respond to small system disturbances**
  - **Large – Disturbance**
    - **How system voltages respond to large system disturbances**
- **Time frames of concern**
  - **Short term: seconds to tens of seconds; induction motors, electronic controls, HVDC converters etc.**
  - **Long term: tens of seconds to minutes; thermally controlled loads, tap – changers, machine current limiters etc.**

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PERMANENT SOLUTIONS

Voltage

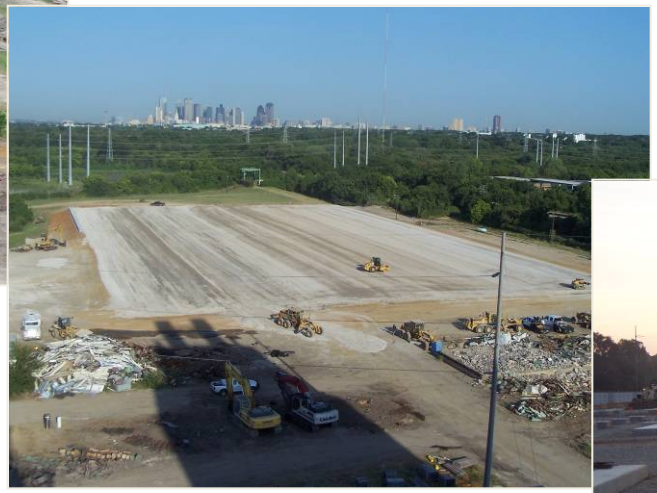
- **Increase reactive power support in areas of depressed voltage**
  - Improve load power factor
  - Add distribution feeder capacitors
  - Add substation (distribution or transmission) capacitors
  - Add generation with dynamic reactive capability
  - Add synchronous condenser
  - Add dynamic reactive device (STATCOM, FACTS device)
- **Decrease reactive power losses in the network**
  - Add series capacitors to lines
  - Add Static Synchronous Series Compensator (SSSC, FACTS device) to lines
  - Add Superconducting Magnetic Energy Storage (SMES) device

Questions?

Brown SVC

Parkdale SVC

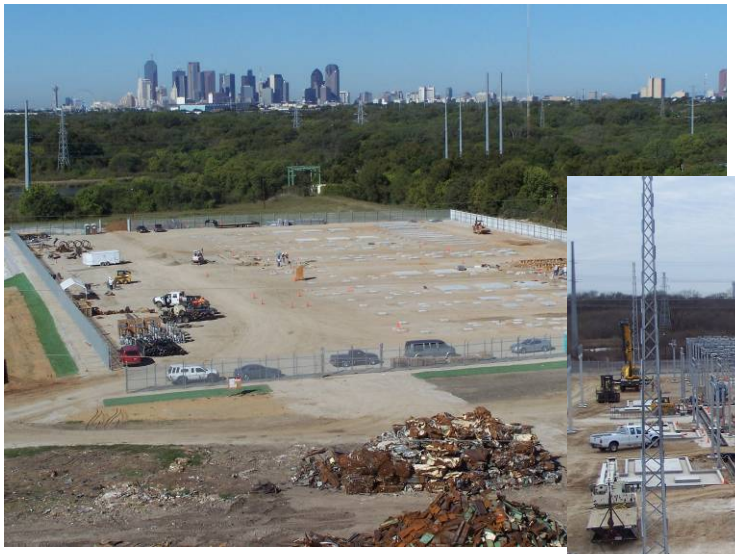
June 2008



August 2008

September 2008

Parkdale SVC

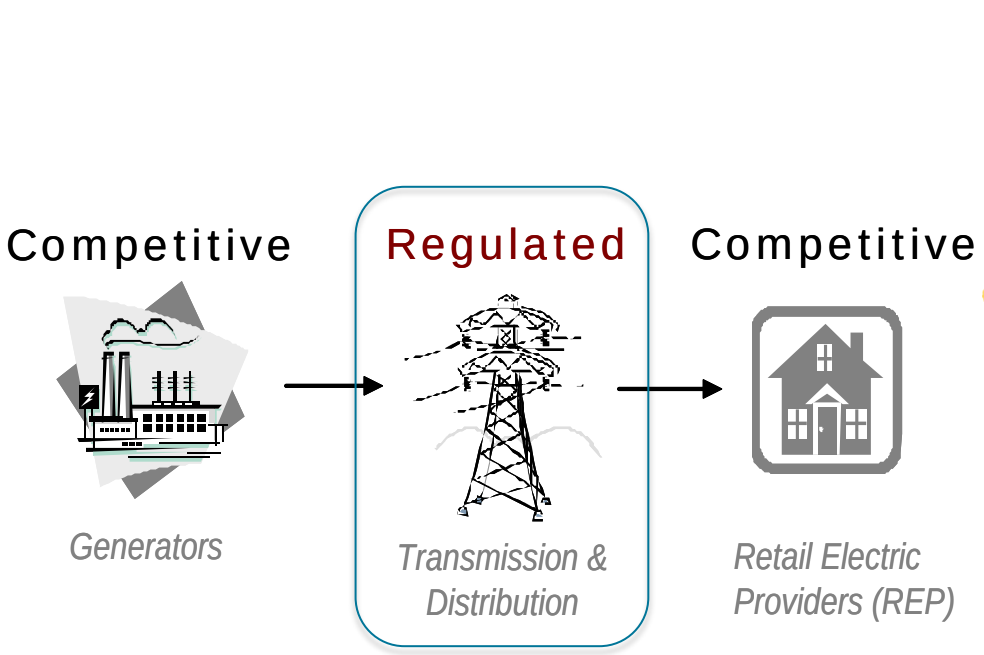


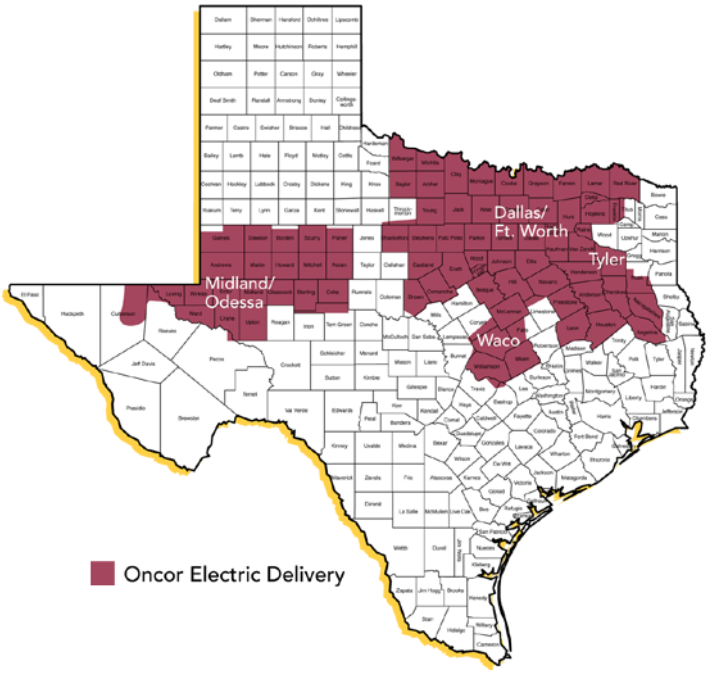
October 2008

December 2008

February 2009

ONCOR ROLE IN THE MARKET





- **Texas' largest regulated transmission and distribution utility**
  - 6th largest in the U.S.
- **More than 15,000 miles of transmission lines**
- **Competitive ERCOT wholesale and retail electric energy market since 2002 for investor-owned players**
- **Regulated delivery utilities – do not generate, own, or sell electricity**

Reliable delivery through the application of technology