VALUE OF A VAR SYSTEM PLANNER PERSPECTIVE

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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
HI LF 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.
The Stability Problem

Power System Stability

- Rotor Angle Stability
  - Small Disturbance Angle Stability
    - Short Term
  - Transient Stability

- Frequency Stability

- Voltage Stability
  - Large Disturbance Voltage Stability
    - Short Term
    - Long Term
  - Small Disturbance Voltage Stability
    - Long Term
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.
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
• 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