SESSION no. 2

OF POWER ELECTRONICS

UTILITY APPLICATIONS

ECE 529
Transmission Problem Areas

- Bulk power transfer over long distances
- Transmission Limitations/Bottlenecks have one or more of the following:
  » Steady-state stability limits
  » Transient stability limits
  » Power system oscillation limits
  » Inadvertent flows
  » Short circuit current limits
  » Thermal limits

Deregulated Structure Combined with Renewables

- Results in:
  » Increased variability in network condition
  » Uncontrolled variable generation output
- Needs
  » Better utilization of existing infrastructure
  » Robust, resilient solutions
Distribution Problem Areas

- Usually fall under power (voltage) quality:
  » Voltage sags due to faults, motor starting
  » Voltage flicker
  » Interruptions
  » Harmonics

Traditional Solutions

- Reactive compensation (distribution)
  » Shunt capacitors/reactors
  » Synchronous condensers
  » Passive harmonic filters

- Reactive compensation (transmission)
  » Shunt compensation (capacitors, synchronous condensers)
  » Series capacitors (SSR issues in some cases)

Phase shifting transformers
Out of phase with P.
Traditional Solutions

- Transmission system fixes
  - Automatic Generation Control
  - Excitation control/Power System Stabilizers
- Phase shifting transformers
- Faster protection (trip/reclose)
- Operational limits
- Reconductor lines
- Increase voltage levels
- Build more lines
- Special stability controls

Power Electronic Applications?

- Specialized applications where traditional technologies inadequate
- Apply where power converters matter
  - Fast, dynamic compensation is needed
  - Avoid steady-state AC compensation
  - Conversion ac/dc or between frequencies
    - For transmission
    - Due to nature of generation or energy storage
Power Electronics to Change (Improve) Performance

- Classes of devices
  - Variable impedance ac compensators
  - Switching converter based compensators
    - Effectively controlled voltage source
    - Or controlled current source
  - HVDC: ac/dc conversion and power transfer

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Power Electronics to Change (Improve) Performance

- Concerns:
  - Cost
  - Losses
  - Complexity
  - Reliability
  - Maintainability