Active Markets and Reactive Policies: Requirements, Rules, Incentives and Business Models for Reactive Power

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Sources of Reactive Power

- Transmission
  - Capacitors - static
  - Transmission Lines (line charging) - static
  - Static Var Systems – dynamic
  - STATCON - dynamic
- Generators - dynamic
- Synchronous Condensers - dynamic
Uses of Reactive Power

- Transmission
  - Inductors - static
  - Transmission Lines (inductance) - static
  - Static Var Systems - dynamic
- Generators - dynamic
- Motors and other load - static
Reactive Power Does Not Travel Well

- Real Power Losses = $I^2R$
- Reactive Power Losses = $I^2X$
- $X$ is 10-20 times $R$ on a transmission system
Reactive Planning

- Want a mix of static and dynamic resources (no reason to have all dynamic)
- Need to locate reactive resources where needed on the system
- Need both inductive and capacitive control (need to balance at all loads)
Reactive Planning

- Generators, Synchronous Condensers – location not flexible, dynamic, best performance at low voltage, cost depends on allocation mechanism
- Static Var System – location more flexible, dynamic, low forced outage rates, relatively high costs
- Switched Capacitors – flexible location, static, low forced outage rates, relatively low costs
What if Reactive Power is Not Available When Needed?

- Low Voltage – may have time to act – manual load shedding
- Voltage Collapse – may not have time to act – undervoltage load shedding
- Not necessarily time for ‘TLRs’
General Principles

- Comparability – no difference based on ownership
- Performance Based Payments – generators paid for services provided
- Fair to load – load should not pay for more reactive power than needed to meet reliability needs
Generator Equipment

- Generator (Rotor, Stator)
- Exciter
- Transformer
- Balance of Plant (cooling system, lubrication system)
Payment for Generator Reactive Capability

Default Compensation

- All generators receive cost-based compensation for a 0.95 power factor (subject to actual performance)
- If a non-independent transmission provider compensates its own generation or the generation of an affiliate at a power factor different than 0.95, all generators would be eligible for compensation up to that power factor (subject to actual performance)
- If a generator has an interconnection agreement for a different power factor, the generator receives cost-based compensation at the power factor stated in the interconnection agreement (subject to actual performance)
- Compensation for new generation may be limited to competitive least-cost alternative
Payment for Generator Reactive Capability

- Additional Compensation
  - If independent transmission provider determines that a generator is required to provide reactive power in excess of the requirements of the interconnection agreement (or the minimum of 0.95 power factor), the generator would receive cost-based compensation at that greater level
    - Payments may be capped at alternatives such as SVS
  - Adjustments can be made on a seasonal basis – such as if a generator agrees to operate with higher cooling capability (e.g., higher hydrogen pressure) for a season providing additional reactive capability
  - Need rules for non-independent transmission provider
  - Transmission Provider can determine greater requirement:
    - In advance through planning studies
    - Through actual operation
Performance Standards

- RTOs should promulgate reasonable performance standards together with adjustments to generators revenue requirements for not meeting such standards
- Factors should consider whether generators provide expected reactive power when demanded, generator availability, availability of voltage regulators, results of reactive testing
- Adjustments should not be punitive but should reflect a relationship between payments and service provided