

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

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# Sources of Reactive Power

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- **Transmission**
  - **Capacitors - static**
  - **Transmission Lines (line charging) - static**
  - **Static Var Systems – dynamic**
  - **STATCON - dynamic**
- **Generators - dynamic**
- **Synchronous Condensers - dynamic**

# Uses of Reactive Power

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- **Transmission**
  - **Inductors - static**
  - **Transmission Lines (inductance) - static**
  - **Static Var Systems - dynamic**
- **Generators - dynamic**
- **Motors and other load - static**

# Reactive Power Does Not Travel Well

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

# Reactive Planning

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- **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

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- **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?

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- **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

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- **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

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- **Generator (Rotor, Stator)**
- **Exciter**
- **Transformer**
- **Balance of Plant (cooling system, lubrication system)**

# Payment for Generator Reactive Capability

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## ➤ 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

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- **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

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- **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**