

Improve System Stability & Reduce Manual Operations from Dynamic Resources

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Implement an Automatic Voltage Controller

The Challenge:

Reduce Xcel Energy system operators' burden by automating the control of 1,400 MW of highly variable wind farms and a STATCOM radially connected along 150-miles of 345 kV transmission line with multiple wind farm owners.

The Solution:

An **Automatic Voltage Setpoint Optimizer (AVSO)** control system was developed to assist real-time operators in managing the resources.

The Results:

- 83% drop in switching operations from tighter voltage control
- Eliminates manual voltage adjustments from load fluctuations
- Optimizes system performance to stabilize wind farm operations
- Success driving expansion plans to accommodate another wind farm

Project Features:

- 5 wind farms = 1,400 MW total generation
- 150-mile-long, radial 345 kV transmission circuit
- 7 345 kV lines, 2 switchyards, 1 STATCOM
- Dedicated and redundant fiber communications ring
- Operation and functional documentation to support current and future implementation
- Modular controller design for future system expansion
- Automated system control with remote and local operator interface and override capabilities

Helping Xcel Energy Provide Clean Energy to its Customers:

- **Automatic and redundant:** Seamless automated system controller allow operators to manage various potential device failures, including the AVSO controller itself, with redundant systems.
- **Operational focus:** Automation and redundancy provides system operators more time to focus on other operational tasks.
- **Tested and proved:** AVSO controller tested in a real time digital simulator (RTDS) environment using hardware-in-the-loop to show it performed as expected.
- **Criteria refined:** Xcel Energy received a refined system controller and criteria through coordination of multiple contractors performing studies on the wind transmission circuit.
- **Performance validated:** A PSCAD model of the AVSO controller validated its performance response in the 1,400 MW system model.



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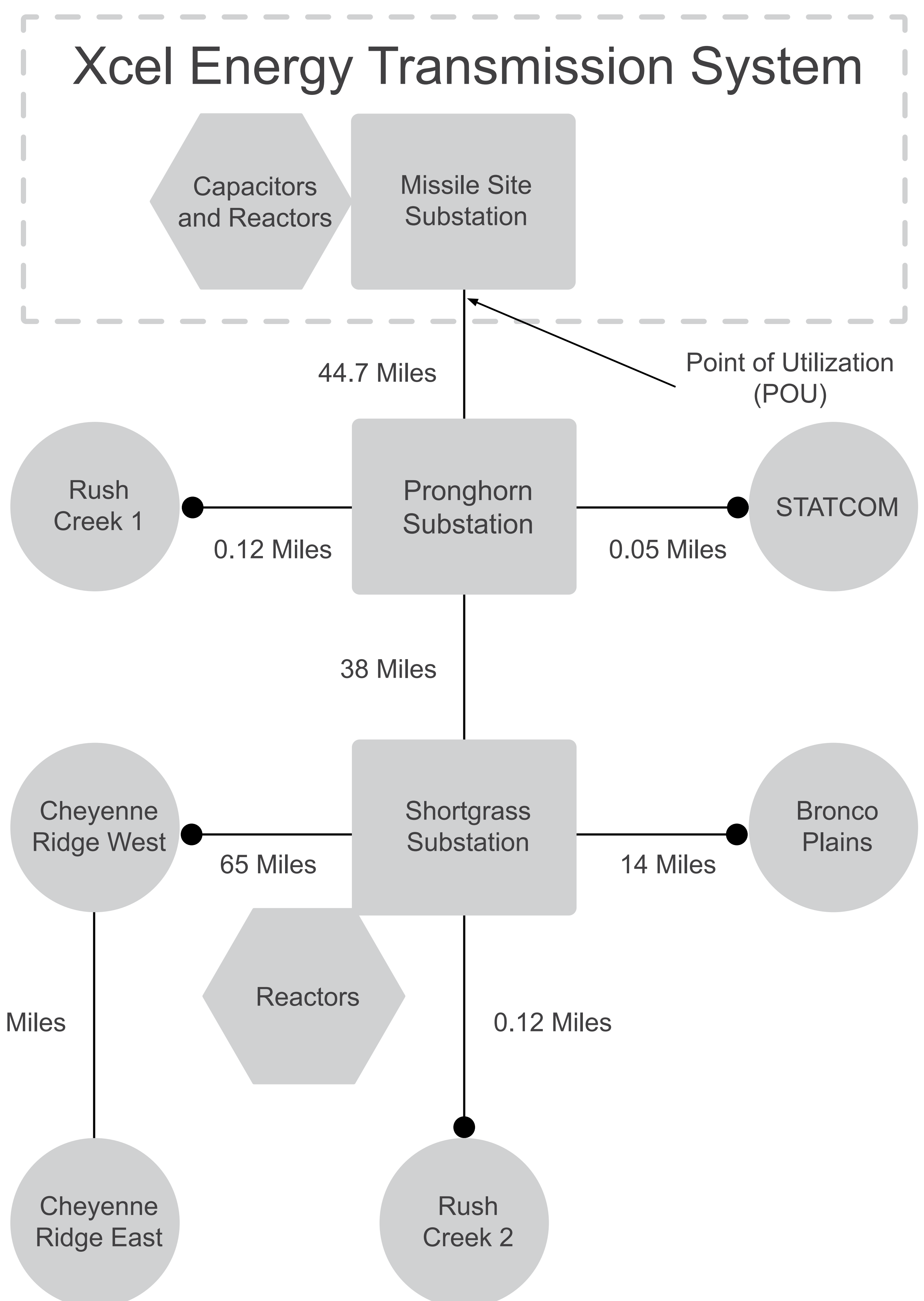
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[Integration of Inverter-based Resources into a Weak Grid](#)



Legend:

