Fact Sheet

Vision

- A nation-wide transmission grid that is fully monitored and dynamically controlled for high efficiency, high reliability, low cost, better accommodation of renewable sources, full utilization of storage, and responsive load.
- A new generation of electric power and energy systems engineering leaders with a global perspective coming from diverse backgrounds.

Why CURENT is Needed

- Energy sustainability is one of the most fundamental societal challenges.
- Reliance on fossil fuels creates significant environmental and national security issues.
- Solutions are being pursued which focus mostly on source and load.

CURENT System

In order to achieve our vision, CURENT will develop a system that can showcase wide-area control and monitoring technologies with large penetration of renewables.

<table>
<thead>
<tr>
<th>Years 1-3</th>
<th>Years 4-6</th>
<th>Years 7-10</th>
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<tbody>
<tr>
<td><strong>Generation 1</strong></td>
<td><strong>Generation 2</strong></td>
<td><strong>Generation 3</strong></td>
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<tr>
<td>- Regional grids with &gt;20% renewables and balance of other clean energy sources</td>
<td>- Reduced interconnected EI, WECC and ERCOT system, with &gt;50% renewable and balance of other clean energy sources</td>
<td>- Fully integrated North American system, with &gt;50% renewable and balance of other clean energy sources</td>
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<td>- Sufficient monitoring to provide measurements for full network and parameter observability.</td>
<td>- Full PMU monitoring at transmission level with some monitoring of loads</td>
<td>- Fully monitored at transmission level and extensive monitoring of loads in distribution systems</td>
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<td>- Closed-loop non-local frequency and voltage control using PMUs</td>
<td>- Fully integrated PMU based closed-loop secondary voltage control system under normal and emergency conditions.</td>
<td>- Closed loop control using wide area monitoring across all time scales and demonstrating full use of transmission capacity</td>
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<td>- Grid architecture including UHV DC and multi-terminal DC</td>
<td>- PMU based control for improved damping of inter-area modes</td>
<td>- Future load composition and selective energy storage</td>
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Engineered Platforms

**Large Scale**

- Develop a large scale simulation platform to demonstrate CURENT Technology.
- Demonstrate to stakeholders how CURENT technology can improve the existing system.

**Hardware**

- Emulate electric grid system with interconnected clusters of scaled-down sources and loads.
- Use modular, reconfigurable converters for sources, loads, flexible network and scenario emulation.
**Generation 1 System Level Projects**

**HVDC & FACTS**
- Develop technologies needed for the future hybrid AC-DC transmission network, including:
  - Advanced HVDC converter technologies
  - Meshed and multi-terminal HVDC control & protection
  - Architecture scheme for better utilization of transfer capability
  - PMU based remedial action scheme for hybrid AC-DC systems

**Measurement Based On-Line Grid Condition Assessment Toolbox**
- Utilize fast, wide-area monitoring to facilitate improved protection and control functions
- Develop better visualization and support tools for system operators

**Frequency Regulation and Control with Large Renewable Penetration and Inverter Control**
- Develop methodology and provide characterization on using wind and PV solar energy for dynamic grid frequency and voltage support over wide areas.
- Explore the effects of inverter-connected sources and loads on electromechanical system stability.
- Quantify contributions of distributed, local control policies to system-wide robust stabilization.

**Measurement Based Wide-Area Voltage Security**
- Use real-time measurements for voltage security assessment (VSA)
- Develop a hybrid VSA scheme integrating model based and measurement based approaches, in particular, for load areas supplied by multiple interface lines.

**Resilient Multi-Level Wide-Area Dynamic State Estimator and Cyber Security**
- Develop a dynamic state estimator:
  - Tracking the dynamic system state based on available measurements
  - Remaining robust and accurate against measurement delays, losses or errors
  - Estimating network parameters
- Establish cyber security methods:
  - Detect attacks made on measurements and communication systems
  - Share and/or store data securely

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