SuperGrid 2 Workshop

University of Illinois at Urbana-Champaign
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System Integration Issues

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Preliminary calculation of power required to create 10GW of electricity through HTSC HVDC line (not verified yet)

- Assume 50KWhr to make 1 Kgm of liquid H2

- Assume 1 Kgm of liquid H2 is 14 liters

- Assume two 45cm diameter pipes (.159 m2)

- Assume 4 m/sec flow rate

- 2*(50 KWhr/Kgm H2)*(1 Kgm H2/14 liters)*(1 liter/1 cubic decimeter)*(.159 m2)*(4m/sec)*(3600 sec/hr)*(1 cubic decm/.001 cubic meters)

- = 16.4 GW

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Our view of the objectives of the SuperGrid project

- Reduce dependence on carbon fuels

- Reduce greenhouse gases

- Provide a modern electricity infrastructure (move electricity and provide mechanism for storage)

- Bottom line: The project must reduce the use of gasoline (i.e. make hydrogen).

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Broad research topics

- Need to create a master plan (i.e. radial or point-to-point vs rings etc.)
- End game scenarios
- Need to do feasibility studies
- Studying the benefits of tying together the Eastern, WECC and ERCOT systems
- Use of H2 for storage - how do we use it?
- Need to create prototypes

Specific research needs

- High current dc sensors (like pt and ct)
- New CBs for high dc currents
- What level of load following is needed?
- Maintenance/outage planning
- Need to dispatch electricity and H2
- Adequacy of supply in case of super contingencies

Specific research needs

- H2 and electric substations

- Super markets - super hedging

- Generation siting

- How do we optimize a mixed superconductor/traditional system

- Need better methods for solving large systems - loss of generation can cause power flow divergence

Specific research needs

- Representing the dynamics between the supergrid and the traditional grids. Similar to BPA issues with Pacific Intertie, but bigger.

- Interaction with fuel cell, slower dynamics

- Need contingency analysis tools that can model systems with lots of dc.

Specific research needs

- Studying the architecture of the supergrid and its function for improving reliability and operating characteristics.

- How does the supergrid interact with other generation sources?

- Time-scale dynamics

- L di/dt dynamics of the superconductors severely limits their dynamic response

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Specific research needs

- Need coordination of supergrid between the various control areas

- What is the requirement for inertia on the ac system?

- Need to develop better tools in general to handle the Supergrid

- Need planning/operation models

- Need to evaluate locational reserves

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