Electric Energy Challenges of the Future:
Integrating Transmission and Distribution Engineering Eventualities

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Research objectives

This task is an integrative research task, intended to bring together research and analysis of several energy transmission and distribution eventualities. The eventualities include engineering and scientific breakthroughs as well as significant advances that are more hardware oriented. The objective is to examine 'what if' a given eventuality is implemented in the power system.

Importance for the future grid

The importance of this effort for the future grid is the acceptance of those technologies that are appropriate to solve such problems of transmission right of way, bulk transmission, new technologies in power electronics, and corresponding advances that are useful for distribution engineering.

Research deliverables

The deliverable in the first year shall be a report on sub-task 1. This is an in depth report on breakthroughs in transmission technologies including test cases from the US transmission grid. Integrated into that report shall be a summary of breakthrough analyses for the technologies studied.

Research approach

Subtask #1.1 Integrating Transmission and Distribution Engineering Eventualities

The research approach is the examination of several recent technologies in transmission and distribution engineering, and an assessment of the values of these technologies. Examples include:

- Access transmission experts to identify advanced transmission technologies
- Study of sample systems with networked DC
- Stability studies of large scale networks that are successively split along coherent regions
- Utilization of new electronic controls including hybrid controls in test bed environments
- Development of multiobjective control test cases
- Research on new ideas of distribution system controls – including signals from the transmission system

Example

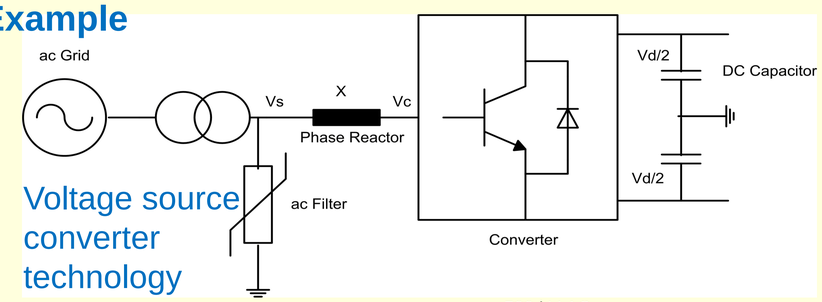
A study will be done on the impact of reconductoring certain circuits of the interconnected grid, with **HTLS** conductors. The increased ampacity and potentially lower positive sequence reactance shall be studied. Limitations of power exchange before and after reconductoring shall include

- Long term thermal limits
- Security limits
- Voltage limits
- Limitations imposed by the loading of adjacent circuits

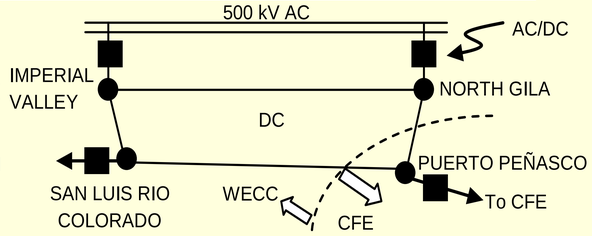
Research approach

As an example of the research approach, a three terminal HVDC system was augmented to the Pacific DC Intertie, (PDCI) and (separately) a four bus HVDC network was augmented to the transmission system in Southern California and Arizona. Voltage source converter technology was used. Some results are shown below.

Example



Voltage source converter technology



An example of a four terminal HVDC network – joining the asynchronous Mexican CFE system to WECC

Case considered	Location of increased loading	Permissible increase in base case loading MW *
1 Base case with existing PDCI in place. Three terminal HVDC system.	Sylmar	**3648**
2 Same as Case 1 but Sylmar – Palo Verde HVDC added	Sylmar	**4790**
3 WECC system base case with no added HVDC.	Imperial Valley + San Luis Rio Colorado	**992**
4 Same as Case 3 with added meshed HVDC. Four terminal HVDC network.	Imperial Valley+San Luis Rio Colorado	**3350**

Potential uses of this research

This research is intended to highlight and identify the most useful of recently proposed and developed transmission and distribution technologies. The concept is to integrate the benefits of these technologies in an assessment of the cost / benefit analysis.