



ELECTRIC GRID RESEARCH PROGRAM

Project Summary

California Transmission Infrastructure Research Project

Context

A host of transmission issues – namely, capacity inadequacies, dynamic instabilities, economic inefficiencies, and threats to reliability – in California, and the larger interconnected Western power grid, are potential threats to the attainment of California’s policy goals and the welfare of its citizens and the economy. For example, access to and integration with an adequate and reliable transmission grid is often cited as the major barrier to meeting California’s Renewable Portfolio Standard (RPS) goals. Growing threats to reliability increase the chances for outages, which, based on history, can cost Californians hundreds of millions to billions of dollars per year, not to mention the inconveniences and threats to human safety. Power capacity limitations and dynamic instabilities in the power grid have led to high congestion costs of hundreds of millions of dollars annually in the wholesale power market in California, and reduced the amount of renewable and lower-cost power that can be imported from outside California.

California must modernize its transmission system in order to keep the lights on, maintain electricity affordability, and protect the environment. Advancements in technology, fostered by research and development, will support the development of new tools for transmission owners, planners, operators and regulators.

Project Goals

The goal of this project was to identify new or expanded transmission infrastructure research activities that:

1. Increase the transmission of electricity from renewable resources,
2. Increase the efficiency of the transmission system, and
3. Reduce the emissions of greenhouse gases (GHG) that are associated with the transmission system

The project created a plan defining the R&D activities to be taken to achieve the project goal.

Description

The project consisted of various activities aimed at defining important research activities in the following areas:

- Equipment and devices to provide improvements to the operational performance of the transmission system for the integration of renewables.
- SmartGrid technologies that can increase the transmission of electricity from renewable resources.
- Equipment and devices that can improve the efficiency of the transmission infrastructure and reductions in the emission of greenhouse gases associated with transmission infrastructure.

The project extensively engaged stakeholders in the form of meetings with grid operators and researchers, attendance at conferences and workshops, and meetings of a Technical Advisory Committee.

Key Results/Conclusions

The project identified promising research in the following infrastructure areas:

- High-Temperature, Low-Sag (HTLS) Conductors: investigations into the long-term aging characteristics of the conductors, splices, connectors and other associated hardware.
- Fault Current Controller (FCC) Technology Evaluation: further technical development and field testing in actual utility environments.
- Smart Distribution Transformer: development of specifications for intelligent monitoring and control systems in response to increasing installation of residential PV and chargers for electric vehicles.
- Electric Energy Storage Systems: evaluation of the capabilities of emerging storage technologies and their economic rationale.
- Impacts of High Penetration of photovoltaics (PV) on T&D Infrastructure: assessment of the potential impacts of high levels of distributed (PV) systems on distribution feeders.
- Underground Cable Aging and Diagnostics: development of in-situ diagnostic tools and validation of their performance in field testing.
- Real-Time Rating (RTR) Systems: identification of high value applications of RTR in the California transmission system and the barriers to implementation. Recommendations for cost-effective applications.

Why It Matters

California has adopted aggressive energy policy goals to significantly reduce greenhouse gases, improve energy



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efficiencies and increase penetration of renewable energy generation. The electric transmission and distribution (T&D) system in California is a factor in being able to meet each of these goals, but currently faces many challenges in performing its roles in achieving them. Meeting these challenges will require new or expanded capabilities for the grid, and new transmission technologies offer the prospect of providing a substantial portion of the new or expanded capabilities to supplement traditional solutions.

This project will help assure that the transmission system continues to meet the critical requirements for adequacy, reliability, affordability, security, safety, and environmental protection while performing its role in meeting the California policy goals of renewable generation deployment, GHG reduction and energy efficiency improvements.

Participating Organizations

Principal Investigator:

California Institute for Energy and Environment.

Research Advisors/Consultants:

California Independent System Operator
Pacific Gas & Electric Co.
San Diego Gas & Electric Co.
Southern California Edison
Bonneville Power Administration

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Project End Date: November 30, 2011

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Reports

Report: *Future Transmission Grid Infrastructure Research Report* ([Link](#))

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