EPRI

AT A GLANCE

Transmission Planning

Program 40

RESEARCH AND MEMBER VALUE

- Develops innovative methods and tools used by system planners for reliable, resilient, and economic integration of new energy resources, transmission technologies, and end-use loads.
- Engages stakeholder community, including regulatory agencies and external industry standard groups, to advance the state-of-the-art transmission planning to benefit public at large and reduce risk for grid operators.
- Applies research insights, analysis, and tools to transmission planning to save time, mitigate risks, and reduce costs while maintaining reliability.
- Allows members to collaborate with other transmission planners, expert researchers, and technology specialists to solve near-term issues, as well as identify and prioritize research for long-term benefits.

Traditional power system planning methods and tools are being increasingly challenged as utilities embark on low-carbon pathways to mitigate and adapt for climate change related impacts. Transmission owners and operators need to plan for future demand growth, increasingly uncertain generation portfolios, and at the same time provide transmission services for scenarios with vast amount of distributed and bulk-connected variable generation (VG) technologies that are often remote from load centers with significantly different characteristics from synchronous generation. The challenge of meeting reliability requirements with the changing landscape and increasing levels of uncertainty may necessitate augmenting existing transmission paradigms and adoption of new tools, methods and models for transmission planners.

EPRI's Transmission Planning program is designed to support a modern transmission grid that is reliable, resilient, safe, and economical to operate. Research areas include:

1. Generic and publicly available vendor-accepted models for generation technologies, power electronics-based transmission technologies, and end-use loads for stability assessments
2. Wide-area protection coordination, identification of protection mis-operations, validation of short-circuit models, and better consideration of protection in planning studies to ensure safe, reliable and stable protection operation
3. Advanced transmission planning methods for long-term investment decisions. The methods focus on risk-based framework for transmission reliability and resilience assessments as well as coordinated expansion approaches for future investments.
4. Integration of off-shore wind, remotely connected renewables, energy storage, and new loads due to electrification
5. Assessment of transmission technologies including HVDC and Grid Enhancing Technologies (GET) as part of the overall planning portfolio
6. Transmission power quality, sub-synchronous oscillations as well as analysis of extreme events such as Geo Magnetic Disturbance (GMD)

Efficient technology transfer is ensured by developing practical and easy to use tools, guidelines, reports, media, and leveraging EPRI's collaborative model via active engagement with commercial vendors, reliability entities, standard making bodies and other research entities.

Key Activities for 2023

RESEARCH PORTFOLIO

P40A: Model Development, Validation, and Management. This project set addresses the need to develop generic, publicly available, vendor accepted and well documented models that accurately capture the aggregated dynamic response of loads, power electronic-based transmission technologies (FACTS, HVDC), synchronous power plant components, Distributed Energy Resources (DER) for stability studies. The research is performed in close collaboration with industry stakeholders – WECC, NERC, software vendors, and equipment vendors in addition to transmission planners.

P40B: Protection Methods, Tools, and Guides. Protection systems have grown in complexity, speed, and reliability, and modern relays can provide reliable and selective fault detection and isolation. However, optimal application of these capabilities may be challenging with significant changes in supply mix and new transmission infrastructure to support the changes. The focus of this research is to develop tools, methods, and guidelines for planners and protection engineers to check protection settings for changing system conditions, tools for proactively identifying protection mis-operations and near-misses from a large data repository, validating short-circuit models based on event data, and insights to explicitly model protection systems in planning studies.

P40C: Risk-Based Analysis in Planning Process. This project set focuses on new, risk-based analysis and tools that can be integrated with existing deterministic planning processes to explicitly consider uncertainties due to changes in resource mix, change in end-use load behavior, and need for system reinforcement to support the changes occurring. The research focuses on assessing long-term system reliability as well as grid resiliency against extreme events to make judicious investment decisions. The project also focuses on coordinated long-term expansion planning methods across generation and transmission for optimum decisions. Lastly, this project set supports EPRI's Integrated Strategic System Planning (ISSP) framework from transmission assessment perspective.

P40D: Special Assessments for Transition Planning. This research space addresses specific issues in the planning process beyond power flow and stability analyses to address challenges posed by ascendance of inverter-based resources, more power electronics-based transmission technologies, and increased vulnerabilities due to extreme events. The project set provides a repository of topics that include geomagnetic disturbance analysis, harmonic modeling and analysis, electromagnetic transient modeling and studies, and modeling and analysis for sub-synchronous oscillations required for transmission systems.

P40E: Analytics for Emerging Planning Needs. As power systems change, transmission planners are looking at different technologies to improve existing reliability while ensuring economic operation. This research focuses on developing new analytics using state-of-the-art approaches and data analytics to help planners save time and resources to make planning decisions. The topics include integration of Grid Enhancing Technologies (GET) in transmission, integration of HVDC technologies specially in the context of off-shore wind and remotely connected renewables, and tools for automated contingency generation and screening of a large number of contingencies for system reliability assessments.

SUPPLEMENTAL PROJECTS

Opportunities beyond the annual research portfolio include:

- Geomagnetically Induced Current (GIC) Harmonic Analysis
- Geomagnetically Induced Current (GIC) Model Validation
- Protection System Evaluation Tool (PSET) User's Group
- Modeling and Model Validation Tools User's Group
- Transmission System Resilience Analysis
- FERC Order 2222 Phase 1: Collaborative Forum, Gap Assessment, and Implementation Roadmap
- Benchmarking of Generic Dynamic Models Across Software Platforms
- Expediting Adoption of Generic PV Models in Transmission Planning
- Pandemic-Resilient and Sustainable Transmission and Distribution (T&D) Systems
- Exploring Climate Impacts in Utility Operations and Planning Interest Group
- Technology Transfer to Expedite PV-MOD Results Adoption for Transmitting Planning
- Assessing Transmission Resilience to Future Climate Risks and Extreme Events
- Inverter Based Distributed Energy Resources (DER) Dynamic Response Characterization for Protection, Planning, and Power Quality
- Synchronous Condensers Cost and Performance Study (joint with P178)
- Service Territory Energy Storage Analysis (joint with P94)

For more information, contact: Anish Gaikwad, Program Manager, 865.218.8066, agaikwad@epri.com.

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EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 • USA • 800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com