

Grid Planning - Program 40

Program Overview

Program Description

Utilities, transmission companies, and ISOs/RTOs need to plan for future demand growth and provide transmission services for changing generation portfolios. The challenge of meeting reliability requirements with the addition of variable generation and allowing demand response as a capacity resource may necessitate transmission planning to reassess the planning objectives. Planning for peak load scenarios may not be sufficient. Evaluation of additional scenarios such as low load and shoulder load, as well as intermittent availability of variable resources may also be required. Variable resources have two other characteristics that need to be addressed in planning: uncertainty, and a regional nature beyond the traditional utility boundaries. Strategic issues that grid planners need to resolve include:

- Increasing uncertainty of future generation and load
- Higher utilization of transmission assets and right-of-waysHigher reliability standards and greater regional planning.

A second focus of this program is to identify and develop solutions and decision support tools for planners to deal with specific technology gaps to improve overall planning activities.

Research Value

Participation in EPRI's Grid Planning program could produce:

- A framework of adjusted planning objectives to deal with supply and load uncertainties
- Standard planning characteristics of non-traditional resources and resource capacities
- Improved modeling and simulation capabilities of more complex operating conditions
- Understanding of the impact of reliability standards
- Robust transmission systems.

Approach

The Grid Planning program will facilitate an industry forum in which stakeholders define the objectives for a planning framework that can meet these challenges. Implementing this framework may lead to the creation of a robust transmission grid capable of meeting the variability of renewable resources, regional availability of those resources, and higher utilization of transmission assets. In addition, the program will continue to focus on assessing, developing, and demonstrating new algorithms and methodologies to improve modeling and simulation capabilities, facilitate smoother cooperation between utilities connected to the same grid for model exchange and model reduction technologies, and reliability assessment.

Accomplishments

The Grid Planning program has delivered valuable information that has helped its members and the industry in numerous ways. Some examples include:

- Probabilistic Risk Assessment (PRA) Version 4.1—The PRA software reads load flow text files as well as probabilistic information, then computes and displays reliability indices through a Graphical User Interface. When applied to power delivery systems, this methodology provides the ability to determine the probability or likelihood of an undesirable event on the transmission system and a measure of its severity. PRA combines a probabilistic measure of the likelihood of undesirable events with a measure of the consequence of the events into a single reliability index, the Probabilistic Reliability Index (PRI).
- Utility Application Experiences of Probabilistic Risk Assessment Method—This technical report summarizes recent utility experiences applying EPRI's PRA methodology, which offers greater accuracy

than traditional deterministic approaches for assessing grid reliability. PRA methodology has already been used by many utilities since 2001, and sufficient data are now available for the power industry to move toward widespread implementation. These studies enable system planners to receive complementary information in addition to traditional deterministic contingency analysis results. Displaying deterministic and probabilistic risk assessment results on charts, tables, and maps enables the visualization of complex reliability information effectively.

- Comprehensive Load Modeling for System Planning Studies - This technical report presents valuable information related to both measurement-based and component-based load modeling. It also presents a clear, step-by-step current best-practice approach to comprehensive load modeling for planning studies. Detailed data on laboratory tests of key load components—such as air conditioners, compact fluorescent lighting, and high-definition televisions—are presented. Results on many measurement-based load model parameter derivation attempts and what was learned from these exercises are also presented.

Current Year Activities

In 2010, this program expects to accomplish these objectives:

- Facilitate a review and adjustment, if necessary, of an overall planning framework and objectives
- Evaluate the economics of options to increase transmission system capacity
- Produce assessments and case studies on applications using synchro-phasors
- Facilitate effective inter-utility model exchange and network reduction
- Assess the possibility of deriving model information from mining metering data contained in data stores
- Expand reliability assessment methodologies to include historical availability information.

Estimated 2010 Program Funding

\$2.0M

Program Manager

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Summary of Projects

PS40D Strategic Planning (069250)

Project Set Description

The Strategic Planning Project Set focuses on the strategic and economic aspects of transmission planning. Before performing detailed studies, planners need to evaluate strategic options for adding transmission capacity. Such options are addressed in this research.

Project Number	Project Title	Description
P40.008	Development of New Planning Framework	The project will focus on developing a consensus for a new planning framework to address variability, uncertain characteristics of load response as a resource, and regional planning.
P40.009	Economic Assessment of Technology Options for Increasing Transmission Capacity	This project develops the understanding and tools to effectively include incremental and major line and systems upgrades into planning, including prioritization of specific improvements to achieve the optimum system improvement.
P40.010	Application Surveillance and Success Stories of Synchro Phasors	The objective of this project is to gather and document successful applications of synchro-phasor devices, helping members realize their full value in improving electric power system reliability and efficiency.
P40.011	Portfolio Planning Under Uncertainty	This research project will develop methods to model uncertainties and their implications for transmission planning with an emphasis on utilizing a portfolio approach for addressing risk.

P40.008 Development of New Planning Framework (069251)

Key Research Question

Various stakeholders—including state regulators, utilities, environmental advocates, transmission owners, grid operators, and energy developers—expect the integration of renewable resources into the grid. Variability and regional concentrations of renewable resources may change overall planning objectives. While in the past it was sufficient for utility planners to focus on a limited number of peak scenarios, it will now be necessary to plan for many different scenarios, including low loads with high availability of variable resources affecting regions beyond the traditional planning boundaries.

This means that traditional integrated planning exercises will likely be supplanted by integrated planning conducted by multiple entities. In addition, variables such as load and supply forecasts, the location and characteristics of new generation, and the timing of new transmission facilities are now less certain than in the past. Furthermore, system operations may have to accommodate load following supply to dispose of available unscheduled energy through storage or the charging of plug-in hybrid electric vehicles (PHEVs). The characteristics of supply and demand become less distinct and may require different considerations when planning for the overall system due to the trend to accept demand response as part of overall capacity planning. While common planning goals remain, identifying regional least-cost options for generation and transmission investment are needed to address the objectives and include these trends.

Approach

This research project will facilitate a consensus-building industry forum, inviting stakeholders to help define the objectives for a planning framework that can meet the challenges of creating a robust transmission grid. This grid should be adapted to deal with the variability and regional availability of renewable resources as well as other changing operational requirements of the grid.

The framework for this new transmission planning process recognizes the reality of current organizational structures within the electric power industry and the changing needs of energy consumers. The industry forum will be tasked with identifying the existing structures and changing needs, and then envisioning a new overarching structure that can build on current practice and move toward satisfying new planning requirements such as:

- Handling increasing uncertainties of future generation and load
- Meeting higher reliability standards and broader regional planning needs.

Impact

- Enable planners to identify optimal and feasible states in various time scales, with integrated analyses of economics, security, and adequacy.
- Enable greater utilization of current generation resources and increase potential for greater efficiencies.
- Optimize the use of existing assets.
- Provide predictable and foreseeable bounded results instead of "zero-to-perfect" one-time exercises.
- Enhance understanding among neighboring entities, thus promoting regional cooperation.

How to Apply Results

A series of webcasts and a workshop will be held to gather input regarding existing practices and to present the integrated planning framework. These products will provide information for members to start applying the methodology and concepts in their own planning process.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Workshop on Methodology and Planning Framework: A workshop will be organized to train members on the research results on the methodology and planning framework, as will be documented in a technical update report.	12/15/10	Workshop, Training, or Conference
Report on New Planning Framework: This report will document research results in 2010. It will describe the planning methodology and planning framework, define holistic objectives in terms of metrics, develop holistic methodology and approach that will meet the new TPL standards, and define multiple base cases and sensitivity cases.	12/31/10	Technical Update

P40.009 Economic Assessment of Technology Options for Increasing Transmission Capacity (069252)

Key Research Question

With new transmission construction difficult to pursue, incremental upgrades may be considered first, followed by major upgrades. Such measures could include a voltage upgrade, implementing FACTS (Flexible AC Transmission System), and adding advanced high-temperature low-sag conductors to the existing system as demand increases. The opportunity to increase transmission capability through upgrades is large, and they need to be considered in system planning decisions. Understanding the impact of incremental and major upgrades in system planning will help planners make economic decisions while considering the costs and limitations of such upgrades.

In addition, planners understand that while capacity improvements on selected lines may increase capacity, they may only have limited impact on overall system capacity. Prioritization of possible improvements is necessary to get the most system value from specific capacity improvements.

Increased power flows on transmission circuits can be achieved by controlling circuit parameters such as current, voltage, phase angle, or timing of current flow. Often, upgrade of a single parameter, such as current or voltage, provides increased power flows. However, controlling more than one parameter, while typically more expensive than a single-parameter upgrade, offers distinct benefits. This option not only allows a utility to increase the capacity of an overhead line, but also enhances the power flow performance of the entire transmission system.

Approach

This project will address planning issues related to incremental upgrades, such as dynamic ratings and major upgrades including voltage, FACTS, and advanced high-temperature low-sag conductors. It addresses power flow upgrades achieved by controlling more than one of the system's parameters. The project selects different advanced technologies at various stages of maturity for evaluation in power flow management applications. It also examines the economics of applying such technologies to develop a tool for making the financial decisions associated with implementing such technologies. The project will further explore systematic methodologies of prioritizing capacity upgrades to get the most economical capacity improvements for the overall transmission system.

The tasks addressed in this project include:

- Develop planning methodologies to integrate incremental and major power flow upgrades. Existing transmission planning tools focus on new equipment additions and new line construction. It is important to review existing planning methodologies (both deterministic and probabilistic methods) and propose new ways of considering incremental and major power flow upgrades.
- Investigate the feasibility of applying incremental upgrades and major power flow upgrades when adding new generation, including wind and solar.
- Document the technical and economic benefits of each upgrade option, and providing engineering requirements.
- Develop study methodologies to prioritize possible line upgrades.

Impact

This project may help system planners and operators communicate and realize the economic benefits of advanced transmission technologies in these ways:

- Perform cost-benefit analysis to evaluate planning options
- Communicate operational benefits and translate them into reliability and economic benefits suitable for planning analyses
- Provide an economic basis for strengthening grids and deferring investment in new transmission
- Improve robustness of the transmission grid through the application of advanced technologies
- Provide a method to forecast reduced risks and costs of major outages
- Demonstrate how advanced technology can relieve transmission bottlenecks and increase operating efficiency
- Help quantify higher quality maintenance, protection, and operation information for increased robustness and integrity of transmission grids.

How to Apply Results

The materials developed will deal with incorporating incremental and major improvements, including advanced transmission technologies, as planning options for enhancing the transmission grid. By understanding how to apply the technology options, system planners can enhance the robustness and flexibility of their plans for a very reliable and high-capacity system.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Methodologies for Economically Assessing Technology Options for Increased Transmission Capacity	12/31/10	Technical Update
Economic Case Studies of Technology Options for Increased Transmission Capacity	12/31/10	Technical Update

P40.010 Application Surveillance and Success Stories of Synchro Phasors (069253)

Key Research Question

Power systems continue to be stressed as they are operated in many instances at or near full capacity. Wide Area Measurement Systems (WAMS) are technologies that may bring major advances in power system operation, protection, and maintenance. Key building blocks of WAMS are synchro-phasors, widely known as phasor measurement units (PMUs).

Time-synchronized phasor measurements of bus voltages and line currents are becoming available via PMUs and other system components. These measurements are highly accurate and provide phase angle information previously missing from conventional measurements on which most EMS functions rely. A large number of PMUs have been installed, or are planned to be installed, in systems such as the Eastern Interconnection (EI), Western System Coordination Council, and ERCOT in Texas.

This technology is expected to improve state estimate, oscillation detection and control, voltage stability monitoring and control, load model validation, and system restoration, and event analysis that may lead to power systems being routinely operated close to full capacity. However, only a few applications and successes have been realized using this technology.

Approach

The objective of this project is to find, assess, and document successful applications of synchro-phasors by surveying the industry for potential and successful uses of this technology. The project will document possible value derived from the technology as well as experiences and plans, and will create a list of new and existing applications that can derive enhanced value from detailed synchro-phasor technology.

The approach is to include the following activities:

- Conduct a survey of planners and operators on the uses of synchro-phasor data. The team will also outline a qualitative framework for assessing efforts required to obtain the expected value.
- Conduct an international workshop to gather industry experts who have developed or propose applications of synchro-phasor data. Participants will present their applications and case studies that convert raw synchro-phasor data into information leading to actionable decisions.
- Perform a technical gap analysis, and publish a summary of research needs. The results of this workshop will be published as technical proceedings available to workshop participants and project members, with the intent of communicating openly the benefits of increased application and use of synchro-phasors.

Impact

This project helps document and communicate the full value of synchro-phasors. With successful applications of synchro-phasors, members should realize the following benefits:

- Communication and lessons learned on the value of synchro-phasors
- Improved performance and functionality of existing monitoring and control applications
- Improved situational awareness through better monitoring and visualization capabilities

- Maximum utilization of existing transmission assets and extended equipment life
- Better assessments of transmission system adequacy
- Verified load models, through dynamic analysis of measurement data
- Cost-benefit analyses that evaluate planning options for installing synchro-phasor systems
- Enhanced system reliability and efficiency
- Promising new benefits from integrating synchro-phasors into system operations, maintenance, and planning.

How to Apply Results

The goal of this project is to identify features and functions of synchro-phasor devices that support and enhance system operations, maintenance, and planning. Members can use the qualitative ranking framework, workshop, and report to communicate internally the prospects of installing synchro-phasor systems and utilizing this data across system operations, maintenance, and planning departments.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Application Success Stories of Synchro-Phasors	12/31/10	Technical Update

P40.011 Portfolio Planning Under Uncertainty (069254)

Key Research Question

Transmission planners face a complex future. They need decision-support methods that assess future business uncertainties, and the interactions and impacts of those uncertainties, to optimize investments with respect to expense, revenue, timing, risk and reliability.

New technical developments such as stochastic generation (wind and solar), energy storage, and the smart grid, as well as uncertainties in emission regulations, load growth, power and fuel market pricing, and siting permissions, contribute to the difficulty of transmission planning. Long lead times for permits and construction as well as large capital expenditures exacerbate exposure to risks.

At the same time, energy companies are increasingly adopting "enterprise risk management" practices. Top executives expect transmission planners to contribute a well-thought-out understanding of the potential impact of their function on overall corporate risk exposure.

Approach

This research project will develop methods to model uncertainties and their implications for transmission planning. Because exposures in different portions of the asset mix may collectively reduce or exacerbate particular risks, emphasis is placed on utilizing a portfolio approach for handling risk.

Research will consist of enumerating the types of uncertainties, creating mathematical descriptions of their nature and mutual influence, and using analytic methods to explore impacts on candidate asset portfolios and alternative future courses of action. There may be a need to develop new risk metrics and measures. Some of the analytic approaches to be explored in this project may be based on methods that have been successfully applied for analyzing the behavior and impact of power markets, fuel markets, and loads. Particular care will be taken to reflect the potential impact of rare but highly impactful "tail events" ("black swans") on the portfolio of assets and obligations.

Impact

The methods developed through this project are intended to help transmission planners assess the behavior, interaction and impact of the most important risk exposures their transmission investments will face. Such tools would enable them to make investment decisions more quickly and with greater confidence, as they will be able to ascertain and include a wider range of potential future outcomes. These methods would also help planners provide management with better information to use in corporate assessments of enterprise risk.

How to Apply Results

Participating members should expect to receive new methodologies and education via reports, webcasts and seminars. Spreadsheet implementations may be developed and distributed, to the extent they are warranted and funded, for algorithm testing. A limited number of opportunities will exist for members to serve as a study case in developing the needs and methodologies, or a study case in applying the methodologies.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Transmission Portfolio Planning Under Uncertainty	12/31/10	Technical Update

PS40A Modeling and Standardization (067425)

Project Set Description

The Modeling and Standardization Project Set is designed to help system planners improve modeling and data preparation capabilities.

Project Number	Project Title	Description
P40.012	Determination of Load Composition using Smart Meter Data	This research project develops novel methodologies for determining dynamically changing load classes and compositions using smart meters.
P40.013	Development of Standard Models for Dynamic Components	This new EPRI research project develops base support to reinforce existing industry efforts, as needed, to progress toward standard, international CIM models. The project will also organize workshops to educate members in the proper utilization of these models.
P40.014	Transmission System Model Management	This project expects to develop an efficient transmission network management tool, facilitating and expediting the processes of building and managing electric power network models for system planners.

P40.012 Determination of Load Composition using Smart Meter Data (069246)

Key Research Question

Component-based load modeling for power flow and stability studies is a common approach used by planners to represent various load characteristics. It is a bottom-up process that utilizes load surveys and understanding of the behavior of typical devices to assign the percentage compositions of the components of a chosen load model structure, representing the total load at a specific bus of a bulk power system.

This project explores an alternative approach to deriving model parameter information by mining the metering data retrieved by automated meter infrastructures and stored in data stores. This approach may lead to more up-to-date and accurate models due to the fact that it is based on measurements.

Approach

This multi-year research project may focus on the following tasks:

- Investigating techniques and methods for mining, analyzing, and deriving load model parameters from the extensive load data retrieved from widely deployed smart meters
- Expanding the existing component-based load model structures and parameters to store load information derived from the metered data
- Examining load characteristics and compositions by customer type—including residential, industrial, and commercial—and comparing them with existing load modeling approaches to determine a simplified load representation in existing load models.
- Capturing seasonal or annual statistics of regional load classes and compositions, and developing methods to predict changes of bus loads for adequate representation in planning base cases.

For this multi-year project, the EPRI project team may focus on the tasks outlined. Future research directions may explore the possibilities of adjusting load models more rapidly.

Impact

- Help planning and operations engineers accurately determine load composition using smart meters, which may result in accurate operating limits.
- Enable operations engineers to capture dynamically changing load compositions and provide foundations for dependable on-line dynamic security assessment.
- Help system operators avoid false congestion and security alarms by providing sound operating limits through accurate load models.
- Help system planners improve modeling and standardization capabilities.

How to Apply Results

- Planning engineers may utilize the seasonal load class and composition values statistically determined through the proposed schemes to validate and revise models on an on-going basis to satisfy NERC model validation requirements.
- Operations engineers may utilize the proposed methodologies to obtain updated load compositions.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Determination of Load Composition using Smart Meter Data: This report will document research results in 2010. Topics may include methodologies for determining dynamically changing load classes and compositions using smart meters, as well as functional requirements to implement these methodologies.	12/31/10	Technical Report

P40.013 Development of Standard Models for Dynamic Components (069247)

Key Research Question

Power system planners rely on proper power system modeling to simulate system dynamic performance when assessing the need for transmission system reinforcements and additions.

Planning and modeling tools have lagged behind recent developments in generation and transmission technologies. Some examples are the proliferation of wind generation technologies and the recent large numbers of thyristor-based and voltage-source converter-based static VAR systems, which have additional control features such as coordinated switching of existing shunt devices. Modeling issues related to renewable technologies are addressed in EPRI program 173. This program focuses on modeling issues related to conventional generation technologies and power electronic transmission devices such as FACTS.

Research must be performed to meet the growing demand for modeling capabilities as more and more power electronic devices are installed across the system. Research is needed to assess the current status of dynamic models and tools, and to develop a plan to build upon existing efforts ensuring a sustainable development of generic, non-proprietary dynamic models for planning studies related to modern devices such as FACTS.

Approach

This project aims to develop an open library of generic models appropriate for the dynamic analysis of transmission and generation equipment. In addition, a key focus is providing workshops on model usage and application. With the objective to provide power engineers with generic non-proprietary models, this project has the following activities:

- Survey existing models and modeling efforts, and assess the status of these efforts in terms of the ability of the models to represent a variety of device configurations. With this assessment, the team will develop a plan for enhancing these models as a collaborative effort to produce newly needed generic models.
- Develop a generic model library, coordinated with efforts such as the WECC Modeling and Validation Working Group. This activity will engage a team of industry and vendor support, and comprises the majority of the project. It will proceed for several years, with a series of status reports in webcast form, presentations at WECC MVWG meetings (which are public meetings), and periodic workshops to report results and future plans.
- Coordinate efforts with the international standards effort of the CIM for Dynamics Working Group, with the goal of promoting model and data standardization of the generic model library.
- Develop tutorials and webcast materials to communicate not only what the power electronics library models are, but how they can be used in practice. These tutorials will, as much as possible, be developed through case study examples and lessons learned from practice.

For this multi-year project, EPRI will focus on the surveying existing models and develop the generic planning models. Coordination efforts with the CIM for Dynamics Working Group will take place in parallel, and become more concentrated in later years as new models are tested, verified, and documented.

Impact

Power system operators and planners will have new capabilities to more accurately study modern and existing devices for various solutions to system dynamic performance issues, including voltage stability, transient stability, and more. Utilization of generic models with standardized data formats will reduce study preparation and enhance the ability to exchange data among different power engineers on a consistent basis. Development of these models is intended to take place within the context of existing power system simulation tools and promote their further development for new and enhanced applications. All model development is intended to be open source to facilitate their easy implementation by existing software vendors and maximize benefit to EPRI members and the industry.

In summary, this project provides value to its members through:

- Improved modeling and standardization capability
- Better study of system dynamic performance and interactions
- Enhanced data preparation and data exchange efforts
- Promoting existing tool enhancements to allow members to utilize the full capabilities of the new dynamic models.

How to Apply Results

EPRI offers project status updates, training webcasts, and reporting exercises that cover the strengths of these generic models and how to apply them for system studies that investigate new and different solutions to operations and planning challenges. Members will develop the capabilities to utilize the new generic model library and enhancements in standard simulation tools to improve planning accuracy and handle new advanced transmission technologies in their planning studies.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Workshop on Modeling Modern Static Var Systems: This workshop will contain presentations of component models and how they can best be applied in practice. Case studies and lessons learned will communicate the use and value of the modeling library.	12/31/10	Workshop, Training, or Conference
Generic Modeling of Transmission and Synchronous Generation Technologies: This report will document components of the modeling library and the presentation materials on how they can best be applied in practice. Case studies and lessons learned will communicate the value of the modeling library.	12/31/10	Technical Update

P40.014 Transmission System Model Management (069248)

Key Research Question

Utilities, ISO/RTOs, and Regional Reliability Coordinators develop many power flow models, such as seasonal on-peak or off-peak base cases, based on expert knowledge in power system analysis as well as past experience. This model building should be conducted annually. However, it also requires laborious and time-consuming collaborative efforts among a group of transmission system planning engineers to collect, check, and merge extensive amounts of network model data from diverse data sources.

Utilities can easily access the model data or the status of their own system or network components from their own database and build the network model. However, building equivalent models for neighboring utilities is still challenging because there are no systematic guidelines for representing the level of detail for external networks. This often results in inadequate models, which may be a significant source of errors in network security analyses.

It is not uncommon for planning engineers to spend extra hours and effort to run unsolved cases due to erroneous data simply because no systematic engineering tool has been developed for these routine but important tasks. Therefore, it is highly desired to investigate methods for adequately representing external electric networks, develop techniques for merging network models from diverse sources, and develop an efficient transmission system model management tool.

Approach

The objective of this project is to develop transmission system model management techniques and tools that will facilitate and expedite conventional model building and management practices of system planning engineers. The project may focus on the following tasks:

- Identify existing problems attributable to lack of adequate models of external networks
- Develop a comprehensive set of guidelines for modeling external networks, and investigate techniques to represent them adequately
- Investigate methods for translating and merging diverse network models into to a common network model
- Develop functional requirements for a model management tool, including model reduction for neighboring networks for most common applications
- Identify tools, methods, and techniques to identify model inconsistencies.

Impact

This research project should improve transmission planning engineers' work efficiency by saving time and effort for routine collection, verification, and merging of data models:

- Improve modeling and standardization capabilities
- Expedite the time-consuming model building process
- Manage extensive model data from diverse sources
- Avoid human errors and build more accurate and credible base cases on time
- Provide a platform for planners to share and communicate their ideas and expertise.

How to Apply Results

The network model management tool can be incorporated into utilities' standard processes and facilitate the model building process. System planners may exploit the useful functionalities of the tool to:

- Manipulate network model data residing in the core database
- Identify errors in the model parameters, visualize the network model, merge cases, and convert the network model to be compatible with specific analytical tools.
- Import, export, view, and manipulate data, as well as run embedded auxiliary application tools
- Avoid erroneous model data, because the software will automatically identify and tag data anomalies
- Audit the entire modeling building process.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Transmission System Model Management: This engineering tool will facilitate and expedite the processes of building and managing electric power network models for system planning engineers.	12/31/10	Software
Transmission System Model Management: A technical report on the functional requirements and processes of building and managing electric power network models for system planning engineers.	12/31/10	Technical Report

PS40B Reliability Assessment (067426)

Project Set Description

The Reliability Assessment and Standards Project Set is designed to help system planners assess the reliability of future transmission networks, taking into account the uncertainties of generation, load, and market. Projects also help members comply with ERO standards.

Project Number	Project Title	Description
P40.003	Application of Transmission Availability Statistics for Reliability Assessment	This project will catalog transmission availability data (TAD) according to event likelihood, use the TAD to build a probabilistic measure of likelihood for various categories of contingencies, and then make a forward-looking estimate of risk level using the PRA-compatible assessment of a constant risk level (in which Risk = Likelihood x Consequence).
P40.015	Balancing Economics and Reliability to Evaluate Planning Options in a Competitive Environment	This project is expected to develop a multi-objective model to consider both reliability and economics for transmission expansion planning, and then develop decision support tools to prioritize plan options. Case studies will be performed to evaluate different scenarios to demonstrate the proposed model and tools.

P40.003 Application of Transmission Availability Statistics for Reliability Assessment (062079)

Key Research Question

New tools and transmission reliability assessment and planning methods are needed to help transmission planners conduct studies that comply with whatever reliability criteria are adopted. The direction of these emerging reliability standards is toward more comprehensive assessment of single and multiple contingencies with or without cascading effects, with ranges of consequences in terms of overloads, voltage violations, and load curtailments to prevent voltage collapse.

Approach

- Categorize and develop a probabilistic measure of likelihood for various categories of contingencies. It seems possible for the various contingency events in the current Tables 1 and 2 to be re-categorized into five or six groups based on "order of magnitude of likelihood." Each order of magnitude of likelihood is ten times less likely than the preceding order.
- Develop a forward-looking estimate of component outages using historical off-line measurements to estimate component outages. This approach would be consistent with Probabilistic Risk Assessment when the industry has collected enough transmission outage data to enable it to be applied to obtain rapid learning and the resulting benefits in the context of risk-based transmission reliability.
- Investigate the relationship between risk level and deterministic criteria. A number of utilities are already performing PRA studies for their transmission planning. The advantages of using PRA have been demonstrated in the nuclear power industry. It would be desirable to have a pathway for the power industry to transition from the current deterministic planning criteria in TPL-001 to probabilistic planning criteria, without waiting for another major revision to the TPL standard.

Impact

- Quantify the degree of robustness of a transmission grid
- Enable more comprehensive reliability assessment of transmission plans
- Meet and exceed existing reliability standards

How to Apply Results

The advanced reliability assessment method can be used by utilities, ISOs, and RTOs to evaluate the robustness of transmission plans and the extent to which they satisfy existing NERC reliability standards. EPRI will offer supplemental project opportunities to apply the methods and tools developed through this project to help members perform expansion planning studies and design economical, efficient, reliable, and robust transmission systems.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Probabilistic Measure of Likelihood for Various Categories of Contingencies: This report will categorize and develop a probabilistic measure of likelihood for various categories of contingencies.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Tools for Advanced Transmission Reliability Assessment and Planning: The software will provide tools to apply the methodology for advanced transmission reliability assessment and planning, with example case studies for illustration.	12/31/11	Software

P40.015 Balancing Economics and Reliability to Evaluate Planning Options in a Competitive Environment (069249)

Key Research Question

After the electric industry was restructured in the 1990s to provide open transmission access and introduce competition into wholesale electricity markets, the reliability of the transmission grid became dependent on a combination of assets provided by independent commercial developers and regulated electric utility companies with a statutory obligation to deliver safe and adequate service to retail customers.

In a competitive environment, increasing network flexibility is desirable. One challenge is that the construction time of transmission projects is much longer than that of generation projects. Typically, new transmission projects require five to 10 years to design and build. In order to maintain the system's long-term reliability, new transmission projects must be available now or in development to meet future needs. A key question to consider is who should pay for transmission expansion. In nodal or zonal electricity markets, transmission investments are usually market driven activities. It is generally agreed that basing transmission expansion decisions on market drivers is in an incomplete strategy.

Approach

A sustainable transmission expansion plan should be able to meet future transmission capacity requirements, provide return on investment, and ensure a level of reliability and quality expected by customers. This program uses the concept of integrating financial and engineering analyses. New methods and tools can evaluate uncertainties and alternatives, then compare investments for reliability and economics. These methods or tools should have this functionality:

- Economic evaluation of a proposed transmission planning project is necessary for minimizing financial risk and ensuring optimal benefits from the investment plan. Reliability evaluation of a proposed transmission planning project is necessary to improve reliability and ensure the satisfaction of customers.

Based on these two objectives, a multi-objective model will be built to consider these two factors simultaneously.

- The objective of transmission expansion is to relieve current congestion and potential transmission bottlenecks. In principle, prioritizing transmission expansion options should be based on assessing reliability level against the following formula: (Cost of Expansion - Expected Annualized Cost Savings x Duration Years).
- To identify future transmission bottlenecks, detailed analysis of market conditions to forecast power transfer requirements related to generation expansion and load growth is necessary, and scenario analysis will provide information for this purpose.

Impact

- Quantify the degree of robustness of a transmission grid and build consensus on transmission enhancements
- Enable more comprehensive reliability assessments of transmission plans by evaluating economics and reliability
- Meet existing reliability standards and pursue maximum economic benefits

How to Apply Results

The project concepts and tools can be used by utilities, ISOs, and RTOs to evaluate the robustness of their transmission plans and the extent to which they satisfy existing NERC reliability standards. EPRI will offer supplemental project opportunities to apply the methods and tools developed through this project to help members perform expansion planning studies and design economical, efficient, reliable, and robust transmission systems.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Balancing Economics and Reliability to Evaluate Planning Options under Competitive Environment: This report will document the proposed multi-objective model to consider both reliability and economics. Economic evaluation of a proposed transmission planning project is necessary to minimize financial risk and ensure the optimal benefits from the investment plan. Reliability evaluation of a proposed transmission planning project is necessary to improve transmission reliability and ensure customer satisfaction. Based on these two objectives, a multi-objective model will be built to consider these two factors simultaneously.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Decision support tools to prioritizing plan options: The objective of transmission expansion is to relieve current congestion and potential transmission bottlenecks. In principle, prioritizing transmission expansion options can be accomplished by comparing reliability level against the formula (Cost of Expansion - Expected Annualized Cost Savings x Duration Years).	12/30/11	Software