Increased Transmission Capacity

Program Overview

Program Description

For 2010, EPRI is offering three strategic collections of research projects or programs in “virtual programs.” These virtual programs have been designed to provide focus for solutions of key issues the industry is facing.

Utilities are being challenged to create additional power capacity without making large capital investments and often within short periods of time. The Increased Transmission Capacity virtual program provides options to utilities that can be acted upon faster than new construction and that significantly reduce new capital expenditures for both transmission and substation equipment by optimizing the use of their existing assets. The program consists of ten projects sets to help provide solutions to designers, planners and operators.

Planning and Operations

Project Set Description

Research to help system operators improve monitoring and visualization capabilities, improve real-time analyzing capabilities, improve control capabilities, deal with supply and load uncertainties, understand standard planning characteristics of non-traditional resources and resource capacities, improve modeling and simulation capabilities of more complex operating conditions, and understand the impact of reliability standards.

Project Number	Project Title	Description
P39.008	Guidelines for Implementing Dynamic Thermal Circuit Rating (DTCR) in EMS	The research project will develop practical guidelines for integrating DTCR into EMS.
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.

P39.008 Guidelines for Implementing Dynamic Thermal Circuit Rating (DTCR) in EMS (069245)

Key Research Question

The ratings of power equipment via DTCR (Dynamic Thermal Circuit Rating) are typically 5% to 15% higher than conventional static ratings. Application of dynamic ratings may enhance economical operation by enabling less constrained operation and timely mitigation action to avoid dangerous system insecurity conditions by tracking the thermal state of equipment. There are a number of practical implementation issues to consider, including SCADA/EMS flexibility and capability, communication links, instrument reliability, and engineering acceptance regarding dynamic rating and its variability. Due to these issues, dynamic ratings are still not widely integrated into power system operations.

Dynamic thermal ratings must be integrated into power system operations if they are to be useful. This project will develop and document practical guidelines whereby dynamic ratings and monitoring data can be useful in system operations, both as displayed values to operators in EMS and as input for many other EMS applications.

Approach

This project plans to focus on the following activities:

- Identify practical issues hindering the wide integration of DTCR into power system operations and seek to understand operators' perspectives on DTCR through surveys and workshops. These implementation issues may include flexibility and capability of current EMS and its applications in incorporating dynamic ratings, reliability and functionality of measurement devices, availability and reliability of communication links to SCADA/EMS, practical methods for utilizing varying weather and loading conditions to calculate or predict dynamic ratings, and representing and storing continuously changing ratings in EMS. The survey and workshop should help achieve wider engineering acceptance for integrating DTCR into EMS, and learn what system operators need from DTCR and its EMS applications.
- Develop functional specifications for implementing DTCR into EMS, and practical guidelines to resolve the aforementioned issues in incorporating DTCR into the EMS based on thorough engineering and market efficiency studies as well as an investigation of utility practices in using DTCR.
- Future year efforts may include demonstrating the beneficial impact of integrating DTCR into EMS in terms of improved system reliability and efficiency. The specific scope may depend on the number of participants, but could include deploying instruments at appropriate locations, communicating monitoring data with SCADA/EMS, and interpreting and utilizing the dynamic ratings from DTCR in EMS applications based on the technical guidelines developed.

Impact

Successful completion of this project could:

- Help operators take advantage of increased power equipment utilization
- Improve operators' situational awareness of potentially dangerous or damaging situations, and help them act appropriately to reduce loading due to DTCR implemented into EMS
- Improve system reliability
- Help system operators avoid false congestion and security alarms by providing sound operating limits through real-time ratings of system equipment
- Provide sound engineering judgments in applying dynamic ratings to operational decisionmaking.

How to Apply Results

- Operators can better understand the value and issues of using dynamic ratings in system operations through practical guidelines developed through this project.
- ISOs or RTOs may integrate DTCR into their EMS applications based on the guidelines, and pursue improved system and market efficiency.
- Transmission owners may achieve benefits in terms of increased equipment utilization and reliability, and avoid damaging critical components.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Guidelines for Implementing Dynamic Thermal Circuit Rating (DTCR) in EMS: This technical report will summarize research efforts in 2010. Results are expected to include an examination of practical issues and guidelines for implementing DTCR into EMS.	12/31/10	Technical Report

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

PS35G Increased Overhead Transmission Capacity (069258)

Project Set Description

This project set develops and delivers reference materials, training, software tools, and methodologies to increase or optimize the power capacity of overhead lines without the capital costs of major new construction and permitting. A Transmission Circuit Ratings Workstation will help engineers, operators, and planners to optimize the power transfer capabilities of transmission lines and entire circuits safely, reliably, and in a scientifically justified manner that meets the requirements of the Federal Energy Regulatory Commission (FERC) and other regulatory bodies. The effects of high operating conductor temperature and reduction in conductor ground clearance, loss in conductor strength, and damage to connectors and other overhead line components will be studied, along with mitigation techniques. New conductors with higher current carrying capacity also will be studied. A state-of-the-science guidebook, along with workshops and conferences, are used for educating power industry engineers about the general concepts and how best to apply them.

Project Number	Project Title	Description
P35.013	Increased Power Flow Guidebook and Ratings for Overhead Lines	This project provides state-of-the-science reference and training materials for optimizing and increasing power flow through transmission lines. It will help companies optimize the power transfer capabilities of transmission circuits safely, reliably, and in a scientifically justified manner that meets the requirements of FERC and other regulatory bodies.
P35.014	Impact of High Temperature Operations on Conductor Systems and Thermal and Corona Models	This project will collect all available information on high-temperature operations, conduct laboratory tests to address knowledge gaps, and prepare software to facilitate the risk evaluation of high-temperature operations.

Project Number	Project Title	Description
P35.015	Advanced Conductors	The project will investigate the long-term performance of advanced HTLS conductors to complement the field demonstration project that provided information on handling and stringing of these conductors. Maintenance procedures for this new type of conductor will also be established.

P35.013 Increased Power Flow Guidebook and Ratings for Overhead Lines (069259)

Key Research Question

The demand for electric power over transmission circuits is increasing at a faster rate than the construction of new transmission facilities. This trend has pushed the capacity of most existing transmission circuits to their design limits. In addition, much of the grid has already aged beyond its original design specifications, resulting in an increasing number of bottlenecks, brownouts, and other severe reliability issues. With the proper technology, and with the proper training and guidance, greater power capacities can be reliably and safely realized without making large capital investments, and can be used to meet mandated regulatory requirements on the establishment of transmission circuit ratings.

Approach

This project develops and delivers an industry guidebook, training, software tools, and methodologies for the purpose of increasing or optimizing the power capacity of transmission circuits without the capital costs of major new construction and permitting. The ***Increased Power Flow Guidebook*** documents state-of-the-science technical options for increased power flow (IPF) on transmission and substation equipment. The guidebook, along with its ***IPF Wizard*** and training materials, provides a means to guide engineers, operators, designers, and planners in applying increased power flow strategies for transmission lines, and it provides learning materials for the next generation of power industry personnel. In 2008, the *IPF Guidebook* was published with a “platinum” color and became part of EPRI’s color book series. In 2010 EPRI will publish a new edition of the IPF *Guidebook.* The new edition will feature case studies related to design, engineering, system planning, and operations. Also, the existing material will be updated to incorporate the latest developments, and the presentation of visual materials will be improved. Information on improved thermal models and developments of new instruments and other hardware also will be included. The IPF Wizard and training materials also will be revised to include the most recent information.

In addition, this project will continue to develop software and methodologies for increasing and optimizing the power transfer capabilities of transmission lines. The software products being developed can be used for: real-time ratings; rating studies to help meet the FERC requirements regarding setting reliable and safe line ratings; and forecasting circuit ratings hours or days into the future to facilitate bulk power transfer planning. They also can be used to help operators get through emergency situations safely.

The real-time capability is particularly useful in riding out emergency situations and for optimizing daily power flows. The software being developed includes:

- Dynamic Thermal Circuit Rating (DTCR)
- Data Analysis Program (DAP)

The DTCR and DAP programs will be significantly improved to make them more accurate, robust, user friendly, and acceptable to a conservative company culture, and new features will be added. Ultimately, they will be combined into a single workstation environment in order to make their features more widely applicable. The project also develops methodologies for establishing transmission circuit ratings to optimize power capacity within the practical constraints of the company's operating philosophy, while fulfilling FERC, and other, requirements.

This project focuses on overhead lines, and is executed in coordination with corresponding projects for underground cables (project P36.004) and for substation equipment (P37.012).

Impact

- This project may have the following impacts: Provide guidance and training to new and experienced technical personnel
- Increase and optimize power flow through entire transmission circuits, particularly overhead lines
- Defer capital expenditures
- Improve transmission circuit reliability and safety
- Meet new mandatory FERC requirements for circuit ratings
- Optimize power transfer planning
- Optimize energy transactions through rating forecasts
- Ride out emergency situations safely and reliably
- Avoid unnecessary system outages

How to Apply Results

Companies can use the *IPF Guidebook* as a reference source for implementing IPF strategies and to train their engineers in IPF technology. The *IPF Guidebook* compares the economic benefits of each available IPF technology, enabling EPRI members to make informed decisions when choosing IPF options for their applications. The IPF Transmission Circuit Rating Wizard software will also help engineers decide on options.

Transmission operators, planners, researchers, IT personnel, and engineers will use the computer programs and methodologies to optimize the ratings of their circuits. The software products can be applied for the various reasons discussed above, and the methodologies on how best to apply all results can be obtained through EPRI reports, training materials, and workshops held regularly.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Increased Power Flow Conference: As part of its technical transfer activities, EPRI sponsors a biennial conference on the topic of Increased Transmission Capacity. Project P35.013 will cosponsor the activity in 2010 and will present sessions on the recent developments and applications of the technology.	11/30/10	Workshop, Training, or Conference
IPF Guidebook (Platinum Book), Third Edition : A technical report will be published as the next version of the *IPF Guidebook* (also known as "Platinum Book") as part of the EPRI color book series.	12/31/10	Technical Report
IPF Transmission Circuit Rating Wizard , 2.0: The IPF Wizard will be updated to reflect the latest IPF developments discussed in the *IPF Guidebook.*	12/31/10	Software
DTCR 5.1: The DTCR will continue to be developed and enhanced in 2010 to make it more accurate, robust, and user friendly to a conservative company culture. Several significant features will be added.	12/31/10	Software
DAP 2.0: A software product designed to work in conjunction with other programs, particularly DTCR, for the purpose of pre-processing and post-processing data, performing data analysis, and providing data plots and graphical user interfaces for ease of application. It is particularly useful for performing statistical data analyses of rating data for the purpose of optimizing approach to static ratings that meets the scientifically rigorous requirements of regulatory bodies. The product also provides tools to help ride out emergency situations.	12/31/10	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Transmission Circuit Ratings Workstation 1.0: Following the development of updated versions of the DTCR and DAP software, they will be integrated into a comprehensive workstation.	12/31/11	Software
Transmission Circuit Ratings Workshop: A workshop will be provided covering the Transmission Circuit Rating Workstation, including presentation of the underlying concepts and hands-on software exercises.	12/31/11	Workshop, Training, or Conference
Increased Power Flow Guidebook, Technical Update: New material on the latest IPF technologies will be produced as a Technical Update.	12/31/12	Technical Update
Transmission Circuit Ratings Workstation 2.0: The Transmission Circuit Ratings Workstation will go through its first revision following a year of experience with it. It will be improved using feedback from EPRI member engineers, operators, designers, and planners.	12/31/12	Software
Increased Power Flow Conference: This project will cosponsor and participate in an open technical transfer activity, such as an IPF Conference.	12/31/13	Workshop, Training, or Conference
Increased Power Flow Guidebook, Fourth Edition: Following four years of application and new developments, an updated version of the *IPF Guidebook* will be planned for release in 2014.	12/31/14	Technical Report

P35.014 Impact of High Temperature Operations on Conductor Systems and Thermal and Corona Models (069260)

Key Research Question

Electric power companies can increase the power transfer capacity of transmission lines by raising the conductor operating temperature. The effects of high operating conductor temperature are reduction in conductor ground clearance, loss in conductor strength, and damage to connectors and other overhead line components. Research is needed to investigate premature failures of conductor and conductor accessories from thermal cycling of these components due to high temperature operations. Conductor accessories include conductor splices and dead-ends, dampers, spacer dampers, and all hardware attached to the conductor of an overhead line. With accurate data, electric power companies are able to assess the risks of high temperature operations. They can then establish a temperature limit below which overhead lines can operate reliably. Appropriate mitigation measures can also be taken to raise the limit.

In addition, it is necessary to update research on the mechanical performance of an overhead line at high temperatures because the corona and thermal models used in evaluating the electrical and heat-transfer performance of an overhead line were based on a conductor at ambient temperature. Although the assumption was valid when an overhead line typically operated at 49^0C (120^0F), these models must be revised for conductor temperatures that are now well above 100^0C.

Approach

This project evaluates the mechanical, electrical, and thermal performance of overhead lines operating at high temperatures. Solutions are developed and models enhanced to allow power companies to raise transmission line capacities safely, reliably, and with confidence.

Performance of common compression fittings in an electric power system is studied at various conductor temperatures above 100°C. Because fittings at the connection point are the weakest links in a transmission system, the project first focuses on establishing temperature and duration limits for these fittings beyond which they may encounter thermal or mechanical failure. It then investigates and tests different mitigation methods to alleviate the impact of high temperatures on the fittings to allow an overhead line to operate reliably at high temperatures. The knowledge gaps of other critical conductor accessories for high-temperature operations will also be addressed. The project summarizes all research results conducted both by EPRI and other organizations on the performance of conductors and conductor accessories operating beyond the conductor annealing temperature of 93°C. The information is updated each year in the form of a progress report and an applet software. The matrix in the applet identifies line components that may fail when an overhead line is operated at a given temperature. Detailed information can be accessed by drilling down into the matrix. In addition, calculators for conductor annealing, current capacity at various temperatures and methodologies to evaluate component life, when available, are included in the applet.

The project will also assess the accuracy of existing thermal and corona models at elevated operating temperatures. Required tests will be identified and performed. In addition, the empirical models will be updated to account for the new data, and algorithms will be provided to update prediction software products.

Impact

This project may have the following impacts:

- Raise confidence in operating overhead lines at high temperatures
- Avoid damage to overhead line components and subsequent line failures
- Adopt mitigations to achieve increased power flows
- Provide accurate prediction of electrical and thermal conductor performance

How to Apply Results

Transmission engineers can use information from the project to evaluate the risks of raising a conductor to a given temperature. Mitigation methods developed in the project can be adopted to increase the operating temperature of an overhead line. By using this information and the methods, the electrical and thermal performance of these overhead lines can be evaluated more accurately. A company can then establish internal guidelines for high-temperature operation of overhead lines.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Guide for Operating Overhead Lines at High-Temperatures - 2010 Update: Based on data and research results from previous years, a guide will be developed to help the electric power industry raise the current capacity of an overhead line to an acceptable level. For the benefit of less-experienced staff, the guide will also include the fundamental and basic information behind high temperature operations. The guide will first be developed in draft form in 2010, and in final form in the following year.	12/31/10	Technical Update
HTC (High-Temperature Conductor) Matrix: Version 3.0: The HTC Conductor Knowledgeable Matrix applet will be revamped completely in 2010 to be consistent with other EPRI software in input and output formats. New information will be added and data and research results will be updated. A calculator will be included to evaluate the life expectancy of single-stage splices, based on the methodology developed under another EPRI research project. In addition, the features of the Matrix will be further enhanced.	12/31/10	Software
Impact of High Conductor Temperature on Corona and Thermal Models	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Guide for Operating Overhead Lines at High-Temperatures: The draft guide will be reviewed critically by members for its ease of use and practical applications. Comments and suggestions will be incorporated into the final version. The final guide will be useful not only to experienced staff but also for junior staff who would like to gain sufficient knowledge to become an expert in this area.	12/31/11	Technical Update
HTC (High-Temperature Conductor) Matrix: Version 3.1: The HTC Conductor Knowledgeable Matrix applet will be updated with new information, data, and research results from the previous year. New calculators for predicting component lives, when available, will be added to the Matrix. Information on the basics of high-temperature operation will be included.	12/31/11	Software
Increased Transmission Capacity Options and Impact: The workshop will provide the fundamentals of increased transmission capacity options and the impact of each option on the existing power system. It will present the "how to" of different options and discuss the advantages and disadvantages of these options.	12/31/11	Workshop, Training, or Conference
Prediction of End-of-Life of Transmission Line Components Operated at High-Temperatures	12/31/12	Technical Update
HTC (High-Temperature Conductor) Matrix: Version 3.2	12/31/12	Software

P35.015 Advanced Conductors (065550)

Key Research Question

A field demonstration on the application of advanced conductors (also known as high-temperature low-sag or HTLS conductors) was successfully conducted under a supplemental project with 20 participating utilities. While positive, the field trial raised a number of issues such as the long-term performance of some of these conductors as well as the maintenance method for the conductors. These issues must be addressed before utilities will accept these conductors and take advantage of the benefits they offer. Further, a new aluminum conductor steel supported (ACSS) “advanced” conductor with a high-strength steel core has since been developed. This ACSS conductor should be evaluated and compared with the other HTLS conductors for its performance.

Approach

This project addresses the outstanding issues identified in the HTLS conductor field demonstration project: long-term performance of some of these HTLS conductors and maintenance of lines using HTLS conductors. The cores of these HTLS conductors are different than conventional aluminum conductor, steel reinforced (ACSR) conductors, and some must be handled differently. The operating temperature of these advanced conductors will be much higher than that of conventional conductors. The tool requirements and maintenance procedures will be different.

This project will first investigate the longevity of carbon fiber composite core HTLS conductors. It will establish a test protocol for design engineers to qualify this type of conductor. It will then conduct an accelerated aging test for all commercially available HTLS conductors, including a conductor splice and dead-end. The project will also evaluate and establish methods that are suitable for maintaining overhead lines using HTLS conductors. A field trial of the high-strength ACSS conductor may also be carried out under a supplemental project.

Impact

The project may have the following impacts:

- Provide engineers with a tool to evaluate the long-term performance of different HTLS conductors
- Ensure the safety of utility personnel and reliability of transmission lines with proper maintenance procedures

How to Apply Results

The test protocol developed under this project provides design engineers with a tool to qualify and compare different carbon fiber composite core HTLS conductors. The accelerated aging test provides useful information on the long-term performance of these advanced conductors that members can use to compare and select proper HTLS conductors for their application. Maintenance methods and procedures developed for HTLS conductors can be incorporated in a member's maintenance manuals.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Methods and Tools for Maintenance of HTLS conductors: Preliminary procedures developed for maintenance of HTLS conductors in the previous year will be demonstrated and refined in the laboratory or in the field in 2010 to produce a practical and useful guide for maintenance of HTLS conductors in 2011.	12/31/10	Technical Update
Performance of HTLS Conductors under an Accelerated Aging Test - Progress Report: In 2010, the behavior of HTLS conductors under six months of accelerated aging test will be observed, and initial test results will be available. To simulate conductor aging in actual applications, the test will be extended to the following year for additional aging. Subsequent forensic and diagnostic tests will also be performed to provide insights into the long-term performance of these conductors.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Guide for Maintenance of HTLS conductors: A guide for maintenance of different HTLS conductors will be developed. The guide provides will provide guidelines on methods and tools that are suitable for maintaining HTLS conductors.	12/31/11	Technical Update
Methodology for Aging Evaluation of Metallic Fiber Composite Core Conductors: In 2011, a test protocol is developed to qualify metallic fiber composite core HTLS conductors. Detail specifications for the test will be provided. Test protocols for other HTLS conductors will be developed in the future.	12/31/11	Technical Update
Procedure for Maintenance of HTLS conductors: Procedures, including details on the method and tool for the application, will be finalized and documented for the maintenance of HTLS conductors.	12/31/12	Technical Report

Product Title & Description	Planned Completion Date	Product Type
Performance of HTLS Conductors under an Accelerated Aging Test - Final Report: Results from thermal cycling of advanced HTLS conductor-connector systems provide valuable information in determining the expected life of these conductors. A model based on the thermal cycling results and studies of connector materials and designs will be developed to provide engineers with a valuable tool to determine the life expectancy of these conductors.	12/31/12	Technical Report

PS36B Cable Dynamic Rating and Increased Power Flow Guidebook (069262)

Project Set Description

This Project Set develops and delivers reference materials, training, software tools, and methodologies to increase or optimize the power capacity of underground transmission circuits without the capital costs of major new construction and permitting. Dynamic thermal circuit rating tools will help engineers, operators, and planners optimize the power transfer capabilities of transmission cables safely, reliably, and in a scientifically justified manner that helps to meet the requirements of regulatory bodies such as FERC. A state-of-the-science guidebook, along with workshops and conferences, educate power industry engineers about the concepts in general and how best to apply them.

Project Number	Project Title	Description
P36.004	Cable Dynamic Rating and Increased Power Flow Guidebook	Provide state-of-the-science reference and training materials for optimizing and increasing power flow through transmission circuits. Provide tools to optimize the power transfer capabilities of transmission cables safely, reliably, and in a scientifically justified manner that helps to meet the requirements of regulatory bodies such as FERC.

P36.004 Cable Dynamic Rating and Increased Power Flow Guidebook (069263)

Key Research Question

The demand for electric power over transmission circuits is increasing at a faster rate than the construction of new transmission facilities. This trend has pushed the capacity of many existing transmission circuits to their design limits. In addition, much of the grid has already aged beyond its original design specifications, resulting in an increasing number of bottlenecks, brownouts, and other severe reliability issues. With the proper technology, training and guidance, greater power capacities can be reliably and safely realized without making large capital investments, and can be used to meet mandated FERC (and other regulatory bodies') requirements for establishing transmission circuit ratings.

Approach

This project develops and delivers an industry guidebook, training, software tools, and methodologies for increasing the power capacity of transmission circuits without the capital costs of major new construction and permitting. The *Increased Power Flow Guidebook* (the "Platinum Book") documents state-of-the-science technical options for increasing power flow on transmission and substation equipment. The guidebook, along with its *IPF Wizard* and training materials, can guide engineers, operators, designers, and planners in applying increased power flow strategies for transmission circuits, and provides learning materials for the next generation of power industry personnel. In 2010, EPRI will publish an updated edition of the *IPF Guidebook*,

which will add case studies related to design, engineering, system planning, and operations. In addition, existing material will be updated with the latest developments for underground cables, and the presentation of visual materials will be improved. Information on improvements in applications or design of thermal models as well as development of new instruments and other hardware will be included. The *IPF Wizard* and training materials will also be updated with the latest information.

This project will also continue to develop dynamic thermal rating software and methodologies for increasing and optimizing the power transfer capabilities of underground cables. The software products being developed can be used for real-time ratings, for rating studies to help meet FERC requirements regarding setting reliable and safe line ratings, and for forecasting circuit ratings hours or days into the future to facilitate bulk power transfer planning. The software allows users to perform statistical data analyses of rating data for the purpose of optimizing approaches to static ratings. The ability to quickly simulate rating scenarios is particularly useful in responding to emergency situations as well as for optimizing power flows daily. The software being developed includes:

- Dynamic Thermal Circuit Rating (DTCR)
- Data Analysis Program (DAP)

The DTCR and DAP programs will be significantly improved to make them more accurate, robust, user friendly, and acceptable to a conservative utility culture, and many new features will be added. Ultimately, they will be combined into an integrated computational environment to make their features more widely applicable. The project also develops methodologies for establishing thermal circuit ratings to optimize transmission capacity within the practical constraints of a member's operating philosophy, while helping to fulfill FERC and other requirements.

This project focuses on underground cables, and is executed in coordination with corresponding projects for transmission lines (Project P35.013) and for substation equipment (P37.012).

Impact

This program may have the following impacts:

- Provide guidance and training to new and experienced technical personnel
- Increase and optimize power flow through entire transmission circuits
- Defer capital expenditures
- Improve transmission circuit reliability and safety
- Help to meet mandatory FERC requirements for circuit ratings
- Optimize power transfer planning
- Optimize energy transactions through rating forecasts
- Ride out emergency situations safely and reliably
- Avoid unnecessary system outages

How to Apply Results

Utilities can use the *IPF Guidebook* as a reference source for implementing IPF strategies and training their engineers in IPF technologies. The *IPF Guidebook* compares the economic benefits of each available IPF technology, enabling EPRI members to make informed decisions when choosing IPF options for their applications. IPF Transmission Circuit Rating Wizard software will also help utility engineers decide on options. Transmission operators, planners, researchers, IT personnel, and engineers will use the computer programs and methodologies to optimize the ratings of their circuits. Software products can be applied for the various reasons described, and the methodologies on how best to apply all results can be obtained through EPRI reports, training materials, and regular workshops.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Increased Power Flow Conference: As part of its technology transfer activities, EPRI sponsors a biennial conference on the topic of Increased Transmission Capacity. This project will cosponsor the conference in 2010, and will present sessions on recent developments and applications of the technology.	11/30/10	Workshop, Training, or Conference
IPF Guidebook (Platinum Book), Third Edition: A technical report will be published as an updated version of the *IPF Guidebook* (also known as "Platinum Book") as part of the EPRI color book series.	12/31/10	Technical Report
IPF Trans Circuit Rating Wizard, 2.0: The IPF Wizard will be updated to reflect the latest IPF developments discussed in the *IPF Guidebook*.	12/31/10	Software
DTCR 5.1: The DTCR will continue to be developed and enhanced in 2010 to make it more accurate, robust, and user-friendly to a conservative utility culture. Several significant features will be added.	12/31/10	Software
DAP 2.0: A software product designed to work in conjunction with other programs, particularly DTCR, for the accommodating different data formats, performing statistical data analyses, and providing data plots and graphical user interfaces for ease of application, including rapid simulation of contingency rating scenarios.	12/31/10	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Transmission Circuit Ratings Workshop: A workshop covering the Transmission Circuit Rating Workstation, including presentation of the underlying concepts and hands-on software exercises.	11/30/11	Workshop, Training, or Conference
Integrated DTCR/DAP: Updated versions of the DTCR and DAP software will be combined into an integrated computational environment that will include underground cables. Feedback from EPRI member engineers, operators, designers, and planners will be sought to determine the future implementations of this software, whether it is to be a stand alone engineering workstation or integrated into utility EMS systems for use by operators, or both.	12/31/11	Software
Increased Power Flow Guidebook, Technical Update: New material on the latest IPF technologies will be produced as a Technical Update.	12/31/12	Technical Update
Increased Power Flow Conference: This project will cosponsor and participate in an open technical transfer activity, such as an IPF Conference.	11/30/13	Workshop, Training, or Conference
Increased Power Flow Guidebook, Fourth Edition: Following four years of application and new developments, an updated version of the *IPF Guidebook* will be planned for release in 2014.	12/31/14	Technical Report

PS37I Fault Current Management and Substation Equipment Rating (069264)

Project Set Description

Fault current levels are increasing in substations, and there is a growing need to increase the power flow through existing assets. This situation exerts greater stresses on substation equipment and poses new challenges for utilities. This project set provides resources and develops tools and technologies to address these issues. The “Fault Current Management Guidebook” (Maroon Book) is updated annually to provide utility engineers with a central resource to address pertinent issues and to raise awareness of the most recent approaches and techniques. The Ground Grid Evaluation project assists members in the design, evaluation, and refurbishment of substation ground grids (which have an increasingly important role in protecting workers within the substation and the public outside the substation fence) and proper operation of substation equipment. Solid state current limiters are being developed and, when commercially available, they will provide additional tools to manage increasing fault currents. Guides and tools will also be developed to help utility engineers address both static and dynamic ratings of substation components.

Project Number	Project Title	Description
P37.010	Solid-State Fault Current Limiter Development	This research project focuses on developing solid-state fault current limiters for transmission and distribution applications. It will start with prototype developments and then move into field demonstrations by deploying the fault current limiters at utility sites. Finally the operating experience of the fault current limiters will be documented.
P37.014	Fault Current Management Issues	This project addresses fault current management in a systematic way by investigating issues such as the impacts of fault currents on protection and metering, as well as identifying new techniques to mitigate fault currents.
P37.015	Ground Grid Evaluation, Maintenance, and Refurbishment	This project conducts research and develops guidelines and tools for design and performance evaluation of substation grounding grids.
P37.018	Increased Power Flow Guidebook and Ratings of Substation Equipment	Provide state-of-the-science reference and training materials for optimizing and increasing power flow through transformers and other substation equipment, and entire transmission circuits. Optimize the power transfer capabilities of transmission circuits safely, reliably, and in a scientifically justified manner that meets the requirements of FERC and other regulatory bodies.

P37.010 Solid-State Fault Current Limiter Development (102105)

Key Research Question

Continuing developments in solid-state power electronic switching devices are enabling enormous efficiency improvements in the electrical energy utilization sector. Increasingly, multi-megawatt solid-state power control systems are being implemented in critical industrial electrical installations. In the electric utility sector, pilot field demonstration projects operating Flexible AC Transmission Systems (FACTS) and Custom Power have established their effectiveness in improving the power delivery infrastructure, although their deployments have been modest. While FACTS devices are devoted to the improvement of the transmission system, Custom Power devices focus on distribution systems. As more renewable generation such as wind and solar are added to the existing transmission and distribution systems, the fault current levels are increasing, and these need to be limited to protect the existing infrastructure. Deployment of power electronics-based solid-state current limiters at strategic transmission and distribution (T&D) locations is one way of limiting these fault currents to acceptable levels. In the near future there will be a need for transmission and distribution class

solid-state fault current limiters (SSFCLs). This need can be met only by conducting research and building prototypes, followed by production-grade fault current limiters.

Approach

This project is investigating opportunities for improving functionality within power substations through the implementation of power electronics, with a focus on future challenges and solutions. It will develop a technical roadmap for the widespread adoption of solid-state power electronic switching technology as an opportunity to meet the challenges of future power delivery systems.

In 2006, a technical update was delivered on the status of power electronics controllers and their application in solving the most significant issues facing substations of the future. In 2007, a technical report was prepared on the application of an advanced power electronic controller for solving a selected substation issue. The 2008 and 2009 work included an implementation plan for deploying advanced power electronics controllers in substations, based on previous research and on detailed consultations with utility and vendor industry experts. A preliminary cost-benefit study estimates the economic and financial benefits of the implementation plan. Depending on the cost-benefit study, the status of technology advancement, and participant commitment, multiple developmental projects, especially in the area of fault current limiters, will be initiated in 2010 and beyond.

EPRI is already collaborating with the U.S. Department of Energy (DOE) to develop a 69 kilovolt (kV) transmission class solid-state current limiter prototype. Additional efforts are underway to develop a 15 kV distribution class solid-state current limiter, collaborating with California Energy Commission. In addition EPRI is collaborating with the U.S. Navy and DOE to develop fault current limiters using Super Gate Turn Off devices (S-GTOs) with advanced materials such as silicon carbide (SiC) and gallium nitride (GaN). The lessons learned from these collaborative projects will be useful to continue the fault current limiter development in 2010 and beyond. EPRI will continue to seek further collaborations with utilities, government agencies, and vendors to enhance and develop cost-effective solid-state fault current limiters.

Impact

- Reduce environmental impacts by better utilization of existing power delivery infrastructure and by enabling easier integration of environmentally benign distributed generation.
- Promote economic growth through generation of new jobs and improved productivity across various sectors by advancing broad application of power electronics technology in the electric power industry.
- Relieve system congestion via enhanced use of existing resources.
- Reduce energy losses at transmission, substation, and distribution levels via improved controllability.
- Improve reliability and power quality through the use of various power electronics technologies at substations, mitigating events such as momentary outages, voltage sags/surges, and harmonics.
- Improve physical and cyber-security.
- Reduce fault currents using fault current limiters and thus save millions of dollars by avoiding equipment failures due to high fault currents.

How to Apply Results

Project funders use project findings and deliverables in their system planning efforts to evaluate potential applications of advanced power electronics controllers in substations for a variety of issues (e.g., managing load growth, life extension of existing facilities, reduced maintenance of reactive power support devices, mitigation of voltage fluctuation produced by nonlinear loads and varying generation sources, improving distributed generation [DG] interfaces, and fault current handling).

2010 Products

Product Title & Description	Planned Completion Date	Product Type
SSFCL Design and Test Document	12/31/10	Technical Update
SSFCL Prototype Development: Develop prototypes of solid state current limiters for transmission and distribution applications.	12/31/10	Hardware

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
SSFCL Design and Test Document	12/31/11	Technical Report
SSFCL Prototype Development: Develop solid-state fault current limiter prototypes.	12/31/11	Hardware
SSFCL Field Demonstration: Demonstrate solid-state fault current limiter at utility sites.	12/31/12	Technical Update
SSFCL Field Demonstration: Demonstration of solid-state fault current limiters at utility sites.	12/31/12	Hardware
SSFCL Field Demonstration: Demonstration of solid-state fault current limiters at utility sites.	12/31/13	Technical Report
SSFCL Field Demonstration	12/31/13	Hardware
SSFCL Operating Experience: Document the operating experience of the solid-state fault current limiters at utility sites.	12/31/14	Technical Update

P37.014 Fault Current Management Issues (065594)

Key Research Question

Utilities worldwide are experiencing increased fault current levels due to increased distributed energy sources as well as systems being operated at higher power levels than previously. The issues related to increased fault currents include equipment failures and system outages.

Approach

This project addresses fault current management in a systematic way by investigating issues such as the impacts of fault currents on protection and metering, as well as identifying new techniques to mitigate fault currents. This project is divided into several tasks:

Fault Current Management Guidebook

Due to increased load demands and reduced incentives to build new transmission, energy companies are increasing power flows on existing transmission assets, which in turn increases fault current levels throughout the power system. In addition, unplanned generation sources on the transmission and distribution network increase the power flows and fault current levels in the system. Under increased power flow conditions, limiting fault currents is important to avoid equipment malfunctioning and damage. This comprehensive guidebook documents the state of the science for limiting fault currents in transmission and distribution assets. It describes possible schemes for limiting fault currents and reports on studies conducted at a few member sites to examine the impact of these schemes and document economic comparisons of each

technology. The guidebook draws from a combination of information on other EPRI technology, industry experts, documented case studies, and associated engineering and safety guidelines. A course will be developed to directly support the guidebook.

Impact of Fault Currents on Protection and Metering

Existing protection systems (such as relays and breakers) and metering systems (such as current transformers [CTs] and potential transformers [PTs]) may not be able to function properly at increased fault current levels. This project studies the impact of different fault current levels on protection coordination, as well as on metering equipment. It will include lab and field testing with varying levels of fault currents and monitoring of protection and metering equipment performance. In addition, the task develops simulation models based on the testing results and uses these models to study the impacts at sufficiently large (abnormal) fault current levels. The project documents all field test and simulation results and provides recommendations regarding the impacts and the percentage of increased fault current levels at which abnormal functions occur.

Study of Mechanical Forces in the Primary Equipment at Increased Fault Currents

Increased fault currents may develop higher mechanical forces in primary equipment, such as transformers, cables, and other substation modules. Additional weight on substation structures due to increased bus work to limit fault currents may also increase mechanical forces in the equipment. This task conducts lab and field tests to explore mechanical force levels at different levels of increased fault currents, and develops mathematical models based on these results. It also investigates the impact of mechanical forces on equipment failure, and provides recommendations regarding the level of mechanical forces that may cause equipment failures and their corresponding fault current levels.

Application of Advanced Technologies to manage Fault Currents

EPRI has been developing solid-state and superconducting current limiters to address the issue of limiting fault currents This project investigates other possible technologies to limit fault currents. The project develops concepts of new technologies for fault current limitation, develops prototypes, and then conducts field demonstrations.

Impact

- Avoid equipment replacement costs by reducing or eliminating equipment damage due to high fault currents.
- Avoid costs due to system outages.
- Realize more revenue by increasing power flows using existing assets.
- Contribute to improved grid reliability by avoiding equipment damages and subsequent outages.
- Increase safety in substations and on transmission corridors by avoiding equipment explosions.
- Reduce overall costs of transmitting power over the grid.
- Improve customer satisfaction with reduced interruptions and energy rates.

How to Apply Results

Project funders can use project results to make informed decisions when choosing options for limiting fault currents. By implementing one or more of the options, funders can obtain increased power flows without damaging equipment due to high fault currents. Project funders will also be able to understand whether their existing protection and metering systems are adequate at increased fault currents or whether the protection equipment needs replacement.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Updated Fault Current Management Guidebook (Maroon Book): The Fault Current Management Guidebook will be updated with the latest developments in fault current limiters, as well as with the results of the other research and development (R&D) projects in this area.	12/31/10	Technical Update
New Technologies for Fault Current Limiting: New technologies for fault current limiting will be developed for practical application by the utilities.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Lab / Field Demonstration of New Technologies for Fault Current Limiting: Promising new technologies will be demonstrated in a laboratory environment and at utility sites.	12/31/11	Technical Update
Updated Fault Current Management Guidebook (Maroon Book): Fault Current Management Guidebook will be updated with the latest information.	12/31/11	Technical Report

P37.015 Ground Grid Evaluation, Maintenance, and Refurbishment (058564)

Key Research Question

A substation ground grid is an essential component for at least three reasons: 1) it serves as a safety feature for any personnel who may be in the substation during a fault; 2) it minimizes hazards to the public, such as step and touch voltages near the substation; and 3) it provides adequate ground for substation equipment, especially control room electronics. The ground grid must be carefully designed to ensure that even the worst available faults will not damage equipment or harm staff. Today substation ground grids are receiving more attention because of increasing fault current levels. Facilities that were designed and installed 40 or more years ago were often based on a calculated fault current from the generation sources and interconnections of that time. Although the common practice then was to base needs on a conservative calculation of available fault levels, over the years additional generation and introduction of increased power flow measures have resulted in increased fault levels. At the same time, there are sites at which enough corrosion has occurred over the decades to measurably decrease the effectiveness of the ground grid.

Approach

In the early 1980s, EPRI developed software for the design of substation grounding grids, and, in the early 1990s, EPRI developed the Smart Ground Multimeter (SGM), an instrument for measuring substation ground grid impedance without requiring an outage. In 2006, EPRI completed the enhancements to the third-generation Smart Ground Multimeter. Building on these accomplishments, this project conducts a study of ground grid designs with the view to enhancing their fault current ratings and refurbishing deteriorated grids. This activity includes full-scale experiments to verify the studies and their recommendations. The project deliverable is a guide to the design and construction of new ground grids with increased current ratings, ground grids to which an incremental area is being added, and ground grids that must be augmented to increase their fault current rating. The guide will provide advice on when to consider the possibility of corrosion of the ground grid, what choices can minimize the degradation of corrosion, and how deteriorated grids can be refurbished in the most economical manner.

Impact

- Improve ease and accuracy of evaluating adequacy of installed grounding systems.
- Provide effective methods to install new grids, bolster grids that have deteriorated, or improve grids that need upgrading because of higher fault current levels.
- Increase substation worker safety as well as public safety in areas adjacent to the substation via design of high-quality substation ground grids.

How to Apply Results

Ground grid design, maintenance, and refurbishment guides developed by this project can be used by utilities for planning new grids and enhancements to existing grids; evaluation of the condition and degree of deterioration of existing grids, to ensure worker and public safety; and grid repair based on sound economic principles.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Training materials for Smart Ground Multimeter (final report or DVD): EPRI funded the development of the Ground Grid Evaluator (commercially known as "Smart Ground Multimeter") instrument for assessment of substation ground grids, step and touch voltages, soil resistivity, and related substation grid parameters. Operation of the instrument is rather simple; however, interpretation of results in the field during the measurement session can be quite involved. This project will develop training materials to help technicians performing grid assessment interpret measurements and resolve difficulties that can occur in the field.	12/31/10	Workshop, Training, or Conference
Step and Touch Voltage Measurements on Field Installed Ground Grid and Concrete Slabs: Concrete is used as building material in substations (within the substation fence) and around substations (outside the fence) for driveways, foundations, walkways, oil containment, sidewalks, walls, and more. This project will evaluate the effects of various types (reinforces, non-reinforced) and conditions (dry, wet) of concrete structures on step, touch and transfer-touch voltages in and around substations.	12/31/10	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Training materials for Smart Ground Multimeter (final report or DVD): EPRI funded the development of the Ground Grid Evaluator (commercially known as "Smart Ground Multimeter") instrument for assessment of substation ground grids, step-touch voltages, soil resistivity, and related substation grid parameters. Operation of the instrument is rather simple; however, interpretation of results in the field during measurement session can be quite involved. This project will develop training materials to help technicians performing grid assessment interpret measurements and resolve difficulties that can occur in the field.	12/31/11	Workshop, Training, or Conference
Develop cost-effective approaches to augmenting or repairing grounding grids: This report will provide guidelines for augmenting grids to handle increased faults currents and to repair defective grids (grids that have been corroded over the years, inadvertently damaged by in-station construction activities or compromised by copper theft, and grids that have been improperly installed in the construction phase).	12/31/11	Technical Update

Product Title & Description	Planned Completion Date	Product Type
"Blind study" - three audits ("as is", "damaged", "repaired"): Conduct a three-stage "blind" study using the Smart Ground Multimeter: • Assessment of the "as-is" condition of an aging (possibly damaged) ground grid • Assessment of the condition of the grid in the same substation after unknown modifications (additional damages) are performed by the utility, without informing the researchers of the details of the modifications • Assessment of the condition of the grid in the same substation after repairs are performed by the utility, without informing the researchers of the details of the repairs	12/31/12	Technical Report

P37.018 Increased Power Flow Guidebook and Ratings of Substation Equipment (069265)

Key Research Question

The demand for electric power over transmission circuits is increasing at a faster rate than the construction of new transmission facilities. This trend has pushed the capacity of most existing transmission circuits to their design limits. In addition, much of the grid has already aged beyond its original design specifications, resulting in an increasing number of bottlenecks, brownouts, and other severe reliability issues. With the proper technology, and with the proper training and guidance, greater power capacities can be reliably and safely realized without making large capital investments, and can be used to meet mandated Federal Energy Regulatory Commission (FERC) requirements (and those of other regulatory bodies) on the establishment of transmission circuit ratings.

Approach

This project develops and delivers an industry guidebook, training, software tools, and methodologies for the purpose of increasing the power capacity of transmission circuits (including transformers and other substation equipment) without the capital costs of major new equipment purchases. The *Increased Power Flow Guidebook* (the IPF Guidebook) documents state-of-the-science technical options for increasing power flow on transmission and substation equipment. The guidebook, along with its *IPF Wizard* and training materials, provides a means to guide engineers, operators, designers, and planners in applying increased power flow strategies for transformers and other substation equipment. It also provides learning materials for the next generation of power industry personnel. In 2008, the IPF Guidebook was published with a "platinum" color and became part of EPRI's color book series. In 2010 EPRI will publish a new edition of the IPF Guidebook.

The new edition will add case studies related to design, engineering, system planning, and operations. Also, the existing material will be updated with the latest developments, and the presentation of visual materials will be improved. Information on improved thermal models of substation equipment will be included, as will developments of new instruments and other hardware. The IPF Wizard and training materials will also be updated with the latest information.

This project will also continue with the development of software and methodologies for increasing and optimizing the power transfer capabilities of transmission lines. The software products being developed can be used:

- for real-time ratings,
- to help operators get through emergency situations safely,
- for rating studies to help meet the FERC requirements regarding setting reliable and safe substation equipment ratings, and
- for forecasting circuit ratings hours or days into the future to facilitate bulk power transfer planning, and
- for optimizing daily power flows.

The products being developed include:

- Dynamic Thermal Circuit Rating (DTCR)
- Data Analysis Program (DAP)

The DTCR and DAP programs will be significantly improved to make them more accurate, robust, user friendly, and acceptable to a conservative utility culture. Ultimately, they will be combined into a single workstation environment in order to make their features more widely applicable. The project also develops methodologies for establishing transmission circuit ratings to optimize power capacity within the practical constraints of the utility's operating philosophy, while fulfilling FERC, and other requirements. This project focuses on transformers and other substation equipment, and it is executed in coordination with corresponding projects for underground cables (project P36.004) and for overhead lines (P35.013).

Impact

- Provide guidance and training to new and experienced technical personnel
- Increase and optimize power flow through entire transmission circuits, including transformers and other substation equipment
- Defer capital expenditures
- Improve transmission circuit reliability and safety
- Meet new mandatory FERC requirements for circuit ratings
- Optimize power transfer planning
- Optimize energy transactions through rating forecasts
- Ride out emergency situations safely and reliably
- Avoid unnecessary system outages

How to Apply Results

Utilities can use the IPF Guidebook as a reference source for implementing IPF strategies, and to train their engineers in IPF technology. The IPF Guidebook compares the economic benefits of each available IPF technology, enabling EPRI members to make informed decisions when choosing IPF options for their applications. The IPF Transmission Circuit Rating Wizard software will also help utility engineers decide on options.

Transmission operators, planners, researchers, IT personnel, and engineers will use the computer programs and methodologies to optimize the ratings of their circuits, including transformers and other substation equipment. The software products can be applied for the various reasons discussed above, and the methodologies on how best to apply all results can be obtained through EPRI reports, through EPRI training materials, and through regular EPRI workshops.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Increased Power Flow Conference: As part of its technical transfer activities, EPRI sponsors a biennial conference on the topic of Increased Transmission Capacity. Project P37.018 will cosponsor the activity in 2010 and will present sessions on the recent developments and applications of the technology.	11/30/10	Workshop, Training, or Conference
IPF Guidebook (Platinum Book), Third Edition : A technical report will be published as the next version of the *Increased Power Flow Guidebook* (also known as the “Platinum Book”), as part of the EPRI color book series.	12/31/10	Technical Report

Product Title & Description	Planned Completion Date	Product Type
IPF Trans Circuit Rating Wizard, 2.0: The IPF Wizard will be updated to reflect the latest IPF developments discussed in the IPF Guidebook.	12/31/10	Software
DTCR 5.1: The Dynamic Thermal Circuit Rating program will continue to be developed and enhanced in 2010 to make it more accurate, robust, and user friendly to a conservative utility culture. Several significant features will be added.	12/31/10	Software
DAP 2.0: The Data Analysis Program (DAP) is a software product designed to work in conjunction with other programs, particularly DTCR, for the purpose of pre-processing and post-processing data, performing data analysis, and providing data plots and graphical user interfaces for ease of application. It is particularly useful for performing statistical data analyses of rating data for optimizing an approach to static ratings that meets the scientifically rigorous requirements of regulatory bodies. In addition, the product provides tools to help ride out emergency situations.	12/31/10	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Transmission Circuit Ratings Workstation 1.0: Following the development of updated versions of the DTCR and DAP software, they will be integrated into a comprehensive workstation.	12/31/11	Software
Transmission Circuit Ratings Workshop: A workshop will be conducted to cover the Transmission Circuit Rating Workstation. It will include presentation of the underlying concepts and hands-on software exercises.	12/31/11	Workshop, Training, or Conference
Increased Power Flow Guidebook, Technical Update: New material on the latest IPF technologies will be produced as a Technical Update.	12/31/12	Technical Update
Transmission Circuit Ratings Workstation 2.0: The Transmission Circuit Ratings Workstation will go through its first revision following a year of experience. It will be improved using feedback from EPRI member engineers, operators, designers, and planners.	12/31/12	Software
Increased Power Flow Conference: This project will cosponsor and participate in an open technical transfer activity, such as an IPF Conference.	12/31/13	Workshop, Training, or Conference
Increased Power Flow Guidebook, Fourth Edition : Following four years of application and new developments, an updated version of the IPF Guidebook will be planned for release in 2014.	12/13/14	Technical Report