

# Underground Distribution Systems - Program 30

## Program Overview

### Program Description

Utility distribution systems are challenged by an aging infrastructure, conventional designs, and increased demands for power. Electricity distribution companies are under pressure to improve reliability and system performance while dealing with the ongoing challenges of this aging infrastructure and increasing customer demands for higher reliability and power quality. Budget and investment constraints require electric utilities to manage their distribution systems more efficiently. EPRI's Underground Distribution Systems research program addresses these challenges by providing guidance to utilities on managing underground distribution assets, reducing O&M costs, and improving reliability and system performance. In close collaboration with its members, EPRI has developed a strategic plan to articulate its research objectives and ensure that its research focus is aligned with those objectives.

### Research Value

With the knowledge acquired through this research program, members will have access to information that can provide:

- Improved understanding of cable diagnostic systems and technologies
- Improved management of aging underground distribution system components
- Improved assessment tools and techniques
- Reference tools for everyday use
- Shared best practices.

### Approach

EPRI research in underground distribution will yield a variety of data and knowledge beneficial to members of the program. This information will be available in a number of forms and is expected to include:

- Publishing an update on the Underground Distribution Reference: the "Bronze Book"
- Understanding cable fleet management methods and use of advanced cable diagnostics
- Applying sensor technologies, and conducting laboratory testing and field demonstrations
- Advancing nano-dielectric technology for use on medium-voltage cables
- Sharing industry best practices and technically rich workshops.

### Accomplishments

The underground distribution systems research program delivers valuable information that has helped its members and the industry in numerous ways. Some examples include:

- An EPRI "Industry Summit" technical workshop, attended by more than 35 utilities and focused on diagnostic techniques that help members effectively manage their distribution cable fleets. The workshop is designed to help members better understand the capabilities and limitations of currently available cable diagnostic tools.
- Recognizing the potential of nanotechnology in power distribution, EPRI continues to accelerate the commercial possibilities of using the technology to enhance the properties of medium-voltage cable dielectrics. This research has resulted in encouraging findings, particularly for a formulation based on functionalized silicon dioxide nanoparticles in a cross-linked polyethylene (XLPE) polymer.
- EPRI continues to build a repository of industry best practices in the underground distribution area.
- A comprehensive "Distribution Research" strategic plan has been published that outlines the future objectives of the underground distribution systems research program.

## Current Year Activities

In the coming year, this research program expects to accomplish these objectives:

- Publish an update on the Underground Distribution Reference: the “Bronze Book”
- Understand advanced diagnostics techniques, modeling, and methods
- Apply sensor technologies and conduct laboratory testing and field demonstrations
- Advance nano-dielectric technology for use on medium-voltage cables
- Share urban network best practices and conduct workshops.

## Estimated 2010 Program Funding

\$2.0M

## Program Manager

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## Summary of Projects

### PS30A Managing Underground Systems (63275)

#### Project Set Description

The electricity delivery infrastructure has been in service for nearly, and in some cases beyond, its design life. Many companies face substantial future costs to replace aging underground distribution cables. Yet today, utility decisions are made under stringent expense controls, limited capital, and increased public concern about reliability. These factors combine to make well-informed decisionmaking more crucial and yet more elusive than ever. Developing and justifying a replacement management strategy for populations, and the rational basis for it, is increasingly important.

This Project Set focuses on the underground cables and cable systems associated with underground distribution systems. Participating utilities can benefit from reduced costs through improved component selection and appropriate application when designing new or refurbished facilities.

Currently available diagnostic techniques have not proven to be accurate, effective, and reliable. Utilities are faced with issues of cost justification, accuracy, and false positive results, and thus require research that will support a strategy to move forward. Recently completed EPRI research of both off-line and on-line nondestructive diagnostic test methods reveals the potential of several new non-destructive methods.

Effective cable management programs have been the subject of utility investigation for many years, and various methodologies have been employed to establish programs. Nonetheless, there is no industry-wide accepted practice. In large part, this is due to the wide variation in utility purchasing, operating and maintenance practices, and business, regulatory and operating environments. Consequently, new approaches continue to be developed.

| Project Number | Project Title  | Description   |
|----------------|--|---|
| P30.001        | Advanced Diagnostics for Underground Cable and Cable Systems | <ul style="list-style-type: none"> <li>This project expands on earlier EPRI work to correlate the results of common condition-assessment techniques for distribution cables with actual and accelerated aging of XLPE insulated cables.</li> <li>Recently completed EPRI research of both off-line and on-line nondestructive diagnostic test methods reveals the potential of several new methods. Techniques such as off-line polarization and depolarization as well as isothermal return current and return voltage, when combined with conventional partial discharge dissipation-factor diagnostic techniques, could enhance the prediction of future performance and service life of XLPE cable.</li> <li>EPRI intends to expand the scope of this project and build on its collaborative effort with the help and partnership of other industry expertise such as NEETRAC and the CDFI.</li> </ul>  |
| P30.009        | Distribution Cable Fleet Management                          | <p>EPRI proposes to develop, adapt, and enhance component-focused and risk-based research to help identify optimal fleet management strategies for installation, replacement, rejuvenation, and maintenance of underground cable and cable systems.</p> <p>Essential steps in this development include a survey of industry utility practices and perceived needs, identification of important fleet management business case scenarios of interest to utility decisionmakers, assessment of the quality and availability of data relevant to these types of problems through detailed work with a host utility, and preliminary formulation and application of the fleet methodology concepts to provide a quantitative and rigorous basis for selected types of business case studies.</p> <p>Supplemental projects will pursue ongoing development through field trials at various members' facilities to ensure that different operating environments are taken into account. Lessons learned will be catalogued and shared with the collaborative membership in the form of a best practices fleet-management reference guide.</p> |

## P30.001 Advanced Diagnostics for Underground Cable and Cable Systems (063276)

### Key Research Question

North America has a significant underground electric distribution system that is nearing the end of its design and service life. Global replacement of aging underground facilities is not an option, and utilities require better diagnostic methods, technologies, and tools to assess the condition of installed systems so they can develop and prioritize cost-effective strategies to address aging facilities.

Knowledge of cable condition provides utilities with a basis for implementing a staged rejuvenation or replacement program over a number of years and helps them avoid unpredictable peaks and unexpected rises in costs associated with increasing failure rates.

The utility industry has focused on cable diagnostics for many years, but is still facing uncertainty and confusion regarding the effectiveness and accuracy of cable diagnostic testing techniques and methods. Currently available diagnostic techniques have not proven to be accurate, effective, and reliable. As a result, utilities are faced with issues of cost justification and accuracy. To develop a workable replacement strategy, research must be done to help develop effective diagnostic techniques. Moreover, research is needed to understand how to interpret diagnostic information and apply it to replacement and rejuvenation strategies.

## Approach

- This project expands on earlier EPRI work to correlate the results of common condition-assessment techniques for distribution cables with actual and accelerated aging of XLPE insulated cables.
- Recently completed EPRI research of both off-line and on-line nondestructive diagnostic test methods reveals the potential of several new nondestructive methods. Techniques such as off-line polarization and depolarization as well as isothermal return current and return voltage, when combined with conventional partial discharge dissipation-factor diagnostic techniques, could enhance the prediction of future performance and service life of XLPE cable.
- EPRI intends to expand the scope of this project and build on its collaborative effort with the help and partnership of other industry experts such as the National Electric Energy Testing, Research and Applications Center (NEETRAC) and the Cable Diagnostic Focused Initiative (CDFI).

## Impact

- Delivers technology and case study reviews
- Provides methods to establish the condition state of aged extruded distribution cables
- Enables prioritization of cable replacement, minimizing the present value cost of cable replacement programs
- Fosters improved reliability through enhanced knowledge of the condition states of installed underground assets and active replacement of those with the least remaining life

## How to Apply Results

Utility engineers will be able to apply information from the planned Industry Summit Workshop on Advanced Diagnostics. They will be able to apply degradation models for each diagnostic method and correlate this information with the life model developed from the accelerated cable life test to determine which diagnostic methods best serve their needs.

## 2010 Products

| Product Title & Description                                  | Planned Completion Date | Product Type     |
|--|-------------------------|------------------|
| Advanced Diagnostics for Underground Cable and Cable Systems | 12/31/10                | Technical Update |

## P30.009 Distribution Cable Fleet Management (069233)

### Key Research Question

The electricity delivery infrastructure has been in service for nearly, and in some cases beyond, its design life. Many companies face substantial future costs to replace aging underground distribution cables. Yet today, utility decisions are made under stringent expense controls, limited capital, and increased public concern about reliability. These factors combine to make well-informed decisionmaking more crucial and yet more elusive than ever.

Developing and justifying a replacement management strategy for populations, and the rational basis for it, is increasingly important. As a result, EPRI has launched initiatives to help managers deal with the problem of aged equipment populations by formulating innovative methodologies to justify practical, justifiable investment strategies.

Effective cable management programs have been the subject of utility investigation for many years and various methodologies have been employed to establish programs. Nonetheless, there is no industry-wide accepted practice. In large part, this is due to the wide variation in utility purchasing, operating and

maintenance practices, and business, regulatory and operating environments. Consequently, new approaches continue to be developed.

### Approach

EPRI proposes to develop, adapt, and enhance component-focused and risk-based research to help identify optimal fleet management strategies for installation, replacement, rejuvenation, and maintenance of underground cable and cable systems.

Essential steps in this development include a survey of industry utility practices and perceived needs, identification of important fleet management business case scenarios of interest to utility decisionmakers, assessment of the quality and availability of data relevant to these types of problems through detailed work with a host utility, and preliminary formulation and application of the fleet methodology concepts to provide a quantitative and rigorous basis for selected types of business case studies.

Supplemental projects will pursue ongoing development through field trials at various members' facilities to ensure that different operating environments are taken into account. Lessons learned will be catalogued and shared with the collaborative membership in the form of a best practices fleet-management reference guide.

### Impact

The project is intended to supplement project justification and existing capital allocation processes. Many utilities have established corporate procedures to assess economic value added or some other investment return measure, and it would be duplicative to attempt to incorporate any such measures in this methodology. Strategy development in this project will be based on existing data, learning from EPRI members, benchmarking with industry-wide metrics, and use of expert input to bridge data gaps.

### How to Apply Results

Underground cable fleet managers can use the results of this project to better understand and implement a cable replacement, rejuvenation and maintenance strategy. They may be able to better assess the quality of availability of data for selecting specific scenarios and business cases.

### 2010 Products

| Product Title & Description  | Planned Completion Date | Product Type     |
|--|-------------------------|------------------|
| <b>Distribution Cable Fleet Management: Catalogue and Assessment of Industry Maintenance Practices</b> | 12/31/10                | Technical Update |

## PS30D Advanced Underground Technologies (069234)

### Project Set Description

New sensor technologies are being developed and evaluated. EPRI research will help members apply these technologies, based on field experience, technology assessments, and test results. EPRI recently developed a new dielectric system based on nano-composite dielectrics that demonstrates improved defect tolerance and electric endurance, which will lead to a thinner wall cable and possibly an increased operating temperature. The dielectric strength of the new nano-filled polymer is more than twice that of existing insulations, while the voltage endurance is close to two orders of magnitude better in laboratory tests.

| Project Number | Project Title   | Description   |
|----------------|---|---|
| P30.002        | Sensors for Underground Systems                               | <p>This project seeks to integrate advanced sensor technology that monitors underground distribution assets with asset planning processes for developing optimum asset investment plans. The project will address the industry need to develop new ways to manage and invest in underground distribution assets by taking advantage of asset condition information conveyed through advanced sensors. This use of sensors will enable members to move from traditional cyclical inspection, maintenance, and replacement approaches to more cost-effective targeted approaches enabled by asset condition information.</p> <p>EPRI will produce a set of guidelines developed through an industry survey, laboratory test results, and use case research. Members will be able to use these guidelines to develop and implement asset planning process steps that consider asset condition information.</p>   |
| P30.004        | Nano Dielectrics for UG Distribution cables and cable systems | <p>EPRI recognized the potential of nanotechnology in power distribution, and began exploring the possibilities of using nanotechnology to enhance the properties of distribution-class voltage cables and cable systems.</p> <p>This project will support scale-up efforts to commercialize the technology for the utility industry.</p> <p>EPRI has developed a new dielectric system based on nano-composite dielectrics. It demonstrates improved defect tolerance and electric endurance, which will lead to smaller diameter cable and possibly allow an increased operating temperature.</p> <p>In 2008, work focused on evaluating sample materials using established long-term wet electrical test protocols. On the basis of initial results of both dry and wet electrical tests, research will proceed to demonstrate the new polymer on model cables and begin practical applications and commercialization. In 2009, a model cable at 15 kV was produced, and testing has started to evaluate key performance characteristics. This work will continue in 2010.</p> |

## P30.002 Sensors for Underground Systems (060491)

### Key Research Question

As members implement and refine their processes for developing optimum investment plans for their distribution assets (that is, implement asset planning processes), they must decide how to use information collected via remote sensing technology to help inform investment decisions.

Many utilities record distribution asset performance information. The types of data collected and the application of this data can vary greatly among utility companies. Data can range from information about asset type (such as rated voltage, vintage, and manufacturer) to records of asset performance and condition (such as number of operations, number of failures, inspection findings, and diagnostic measures such as voltage or temperature). This information is collected in a variety of ways, from personal inspections to the use of advanced sensors and communication systems that gather information remotely and transmit it electronically.

Utilities are increasingly using remote sensor technology to collect such data. Collection of substation data has increased substantially, and more and more utilities are using low-cost sensors to understand distribution asset condition outside the substation. As utilities increase their use of advanced sensors to monitor and understand distribution asset performance, they will build an information database that can be factored into asset investment decisionmaking.

### Approach

This project seeks to integrate advanced sensor technology that monitors underground distribution assets with asset planning processes for developing optimum asset investment plans. The project will address the industry need to develop new ways to manage and invest in underground distribution assets by taking advantage of asset condition information conveyed through advanced sensors. This use of sensors will enable members to move from traditional cyclical inspection, maintenance, and replacement approaches to more cost-effective targeted approaches enabled by asset condition information.

EPRI will produce a set of guidelines developed through an industry survey, laboratory test results, and use case research. Members will be able to use these guidelines to develop and implement asset planning process steps that consider asset condition information.

### Impact

- Members will be better able to achieve their financial, customer service, and reliability goals through more effective investment and maintenance strategies.
- Members will be able to increase system reliability, ultimately improving regulatory and customer relations.
- Members will be able to improve safety and health of the general public and utility personnel by gaining knowledge of potentially dangerous components on the verge of failure.

### How to Apply Results

Members can apply the results of this project by:

- Participating in expanded trials of advanced sensor technology to monitor distribution asset condition
- Applying learned methods for tying in monitored information with other asset information to create an overall picture of asset condition
- Learning how the industry is utilizing information monitored via advanced sensors along with other asset information to ascertain asset health
- Applying methods for using this information to perform risk analysis and quantification
- Understanding methods for incorporating this information into the process of making investment decisions and optimizing maintenance approaches (Asset Management Processes)
- Employing tools that capitalize on monitored information to help members decide on optimum investment plans

### 2010 Products

| Product Title & Description             | Planned Completion Date | Product Type     |
|---|-------------------------|------------------|
| <b>Sensors for Distribution Systems</b> | 12/31/10                | Technical Update |

## P30.004 Nano Dielectrics for UG Distribution cables and cable systems (063277)

### Key Research Question

As demands on the power delivery system increase, advanced materials are needed to extend the capabilities of the system. A new high-stress dielectric material would enable utilities to utilize underground distribution circuits in new ways, with smaller cables, fewer manholes, fewer joints, smaller duct sizes, and easier handling.

### Approach

EPRI recognized the potential of nanotechnology in power distribution, and began exploring the possibilities of using nanotechnology to enhance the properties of distribution-class voltage cables and cable systems. This project will support scale-up efforts to commercialize the technology for the utility industry.

EPRI has developed a new dielectric system based on nano-composite dielectrics. It demonstrates improved defect tolerance and electric endurance, which will lead to smaller diameter cable and possibly allow an increased operating temperature.

In 2008, work focused on evaluating sample materials using established long-term wet electrical test protocols. On the basis of initial results of both dry and wet electrical tests, research will proceed to demonstrate the new polymer on model cables and begin practical applications and commercialization. In 2009, a model cable at 15 kV was produced, and testing has started to evaluate key performance characteristics. This work will continue in 2010.

### Impact

- Reduce the costs of underground distribution, enabling greater response to societal demands for undergrounding of distribution systems.
- Increase the operating capacity of underground distribution systems utilizing existing infrastructure.
- Reduce the life-cycle cost of underground cables via longer-life dielectrics.

### How to Apply Results

Distribution designers will use the results to modify economic models and plans for underground system implementation. Members will provide direct input to the ongoing development of the cable design to maximize the benefit for future distribution system designs.

### 2010 Products

| Product Title & Description                                | Planned Completion Date | Product Type     |
|--|-------------------------|------------------|
| Nano Dielectrics for distribution cables and cable systems | 12/31/10                | Technical Update |

## PS30B Urban Underground Systems (063278)

### Project Set Description

This Project Set focuses on urban underground network systems, with the intent of capturing and documenting best practices for the key functional areas. It also focuses on delivering practice and reference guides, best-in-class field guides, job aids and, where possible, commissioning field demonstration pilots to address application issues. Participating members can expect to improve safety, improve reliability, and reduce costs associated with planning, designing, engineering, constructing, and operating their urban network systems.

| Project Number | Project Title                   | Description   |
|----------------|---------------------------------|---|
| P30.005        | Urban Network Systems Practices | <p>This project focuses on urban underground network systems. This project produces guidelines and helps members reduce the time, cost, and uncertainty of dealing with network systems. Tasks include:</p> <ul style="list-style-type: none"> <li>• Providing members with relevant practice information, guidelines, technologies, and training to manage aging network system assets</li> <li>• Providing an industry-leading handbook on best practices for underground network systems</li> <li>• Developing information to aid in the selection and application of components</li> <li>• Ensuring safe operation of the network system</li> <li>• Developing tools and techniques to identify high-risk components</li> <li>• Assessing populations of components to determine whether to refurbish or replace them</li> <li>• Addressing the loss of institutional knowledge by providing educational tools for both engineering and field personnel</li> <li>• Increasing understanding of component aging and life expectancy, resulting in better application and more durable products.</li> </ul> |
| P30.006        | Urban Network Simulation Tools  | <p>EPRI will research commercially available tools for modeling network systems (primary and secondary) and performing network circuit analyses. EPRI will work with network utilities to develop a desired features list, including attributes such as graphical displays, ability to perform primary feeder fault analysis, ability to perform networked secondary load flows, ability to perform PQ analyses, and interfaces with mapping systems, GIS data, AMI data, CIS data, and SCADA/remotely monitored data to create accurate network models. EPRI will produce a matrix of vendor product offerings with available features that support network planning, design, and operations.</p>  |

### P30.005 Urban Network Systems Practices (063279)

#### Key Research Question

Urban underground network systems are a crucial part of the industry and deliver high levels of reliability and customer service. Underground networks also present challenges, such as high costs for construction and maintenance. Moreover, the loss of experienced engineering staff to mergers and attrition has left many utilities with a gap in the expertise needed for optimal planning, design and engineering, construction, and operation and maintenance of underground network systems.

#### Approach

This project focuses on urban underground network systems. This project produces guidelines and helps members reduce the time, cost, and uncertainty of dealing with network systems. Tasks include:

- Providing members with relevant practice information, guidelines, technologies, and training to manage aging network system assets
- Providing an industry-leading handbook on best practices for underground network systems
- Developing information to aid in the selection and application of components
- Identifying safe operation of the network system
- Developing tools and techniques to identify high-risk components
- Assessing populations of components to determine whether to refurbish or replace them

- Addressing the loss of institutional knowledge by providing educational tools for both engineering and field personnel
- Increasing understanding of component aging and life expectancy, resulting in better application and more durable products.

### Impact

- Improve reliability of urban underground distribution networks.
- Improve the safety of utility activities involving construction and operation of underground systems.
- Reduce costs associated with planning, designing, engineering, constructing, and operating urban network systems.

### How to Apply Results

Members can use practice and reference guides, best-in-class field guides, job aids, and information gathered from field demonstrations to manage their aging network assets. With results of this project in hand, members can enhance safety, improve liability, and lower costs.

### 2010 Products

| Product Title & Description     | Planned Completion Date | Product Type     |
|---------------------------------|-------------------------|------------------|
| Urban Network Systems Practices | 12/31/10                | Technical Update |

## P30.006 Urban Network Simulation Tools (067435)

### Key Research Question

Utilities that serve customers using networked secondary systems require technologies to model the system and perform load flow and other circuit analyses on both the primary and networked secondary. Utilities may utilize commercially available load flow products to model their radial systems, but many older products are unable to accurately model and perform analyses on meshed secondary network systems sourced from multiple primary feeders. Consequently, many utilities are using legacy systems to perform network analysis—systems that may lack ties to GIS systems, graphical display ability, ability to easily analyze “what if” scenarios, ability to reflect real-time system condition changes, and other features of newer, vendor-developed products.

Members can benefit from assistance in understanding which vendor products are currently available to model and perform analyses on network systems and what features those products contain.

### Approach

EPRI will research commercially available tools for modeling network systems (primary and secondary) and performing network circuit analyses. EPRI will work with network utilities to develop a desired features list, including attributes such as graphical displays, ability to perform primary feeder fault analysis, ability to perform networked secondary load flows, ability to perform PQ analyses, and interfaces with mapping systems, GIS data, AMI data, CIS data, and SCADA/remotely monitored data to create accurate network models. EPRI will produce a matrix of vendor product offerings with available features that support network planning, design, and operations.

## Impact

- Research will summarize features that are important to members.
- The research will enable members to understand what functionality is available in the marketplace and ascertain whether the features of commercially available products will meet their needs, including secondary modeling and analysis.
- Analysis will result in a matrix that summarizes features of commercially available products, which will help members evaluate vendors and select products.

## How to Apply Results

Utility engineers and network system operators will be able to compare the functionality of commercially available products to their specific network analysis and modeling needs. This comparison will help members develop a practical technology implementation strategy and prepare a justification for investing in vendor modeling and analysis software implementation and integration. Ultimately, the implementation of network modeling and analysis software will help engineers develop optimum system reinforcement plans to meet capacity and reliability expectations. It will also aid operators in optimally configuring the system based on real-time conditions.

## 2010 Products

| Product Title & Description    | Planned Completion Date | Product Type     |
|--------------------------------|-------------------------|------------------|
| Urban Network Simulation Tools | 12/31/10                | Technical Update |

## PS30C Underground Distribution Technology Transfer and Knowledge Development (067419)

### Project Set Description

The EPRI Underground Distribution Technology Transfer and Knowledge Development Project Set is new in 2009. Its goal is to utilize high-impact resources in covering a range of topics relevant to underground distribution systems planners, designers, and operators.

This Project Set includes development of the "Bronze Book," continuing the tradition of providing distribution engineers and planners with a reference on underground cable design and construction theory as well as practical application knowledge. This multiyear project provides new information in a comprehensive reference book that covers all aspects of an underground distribution system, from the substation to the service box.

| Project Number | Project Title  | Description  |
|----------------|--|--|
| P30.007        | Underground Distribution Reference Guidebook - The Bronze Book | <p>EPRI's Underground Distribution Systems Program has provided a wealth of knowledge in the underground distribution area, from early work on premature failure mechanisms, to the effect of transients on cables, to advanced diagnostic techniques for determining the condition of underground assets. This project continues the history of providing distribution engineers and planners with a ready reference to underground cable design and construction theory and practical application knowledge.</p> <p>This multiyear project provides new information in a comprehensive reference book that covers all aspects of an underground distribution system, from the substation to the service box.</p> |

| Project Number | Project Title  | Description   |
|----------------|--|---|
| P30.008        | Distribution Tech Transfer and Knowledge Development | EPRI's Distribution Knowledge-Based Services cost-effectively supports utility distribution engineering managers and staff with exclusive technical resources, training, and standards information. Members gain access to the best distribution engineering expertise in the industry to deal with specific challenges in a timely manner and stay informed on key technical developments. |

## P30.007 Underground Distribution Reference Guidebook - The Bronze Book (062127)

### Key Research Question

There has not been an updated reference guide on the topic of underground distribution systems published in the past 20 years. Important topics include underground system components and system design, cable designs, cable materials, cable electrical characteristics, lightning effects and arresting, ampacity, diagnostics, component aging phenomena, accessories, corrosion, installation, testing, operation, and maintenance. EPRI is in a unique position to develop and publish such a resource for the industry.

### Approach

EPRI's Underground Distribution Systems Program has provided a wealth of knowledge in the underground distribution area, from early work on premature failure mechanisms, to the effect of transients on cables, to advanced diagnostic techniques for determining the condition of underground assets. This project continues the history of providing distribution engineers and planners with a ready reference to underground cable design and construction theory as well as practical application knowledge.

This multiyear project provides new information in a comprehensive reference book that covers all aspects of an underground distribution system, from the substation to the service box. The guidebook may feature:

- Industry style similar to previous editions
- Presentation of science and technology with the same depth as similar editions
- Expanded coverage of international practices, technology, sources of information such as CIGRE, and use of SI and imperial units
- Material oriented to designers and engineers with a training level of at least two years of university training in mathematics and physics
- Presentation style that utilizes advances in electronic media, including integration of software routines and incorporation of video and tutorial materials.

### Impact

- Provide comprehensive current information on underground distribution systems
- Support training of utility personnel

### How to Apply Results

Covering all aspects of underground distribution from the substation to the service box, this manual will be a reference for practicing engineers and a training tool for new engineers or those transitioning to underground distribution.

### 2010 Products

| Product Title & Description | Planned Completion Date | Product Type     |
|-----------------------------|-------------------------|------------------|
| Update on the Bronze Book   | 12/31/10                | Technical Update |

## P30.008 Distribution Tech Transfer and Knowledge Development (067436)

### Key Research Question

Distribution companies face a variety of pressures and technical challenges. Personnel such as utility planners, engineers, and operators must stay familiar with the latest technologies, software tools, standards, and procedures for optimizing distribution system performance. At the same time, many utilities are losing valuable experience as the aging workforce retires.

### Approach

EPRI's Distribution Knowledge-Based Services cost-effectively supports utility distribution engineering managers and staff with exclusive technical resources, training, and standards information. Members gain access to the best distribution engineering expertise in the industry to deal with specific challenges in a timely manner and stay informed on key technical developments. The project includes:

- **Distribution Hotline Access:** Members will have access to a distribution hotline, gaining quick-response access to EPRI's power system experts to assist in answering technical questions related to distribution engineering, operations, and maintenance. Sanitized versions of the hotline calls and responses will be available via a website.
- **Member Forum:** A web-based forum, with topics covering any issue related to distribution system design and operations, such as equipment problems, maintenance strategies, equipment applications, reliability problems, and more. All messages can be queried with a search engine.
- **Updates on important new developments in the industry standards community:** Updates on activities in IEEE standards development affecting distribution systems, including reliability standards, distribution equipment standards, and distribution operations standards.

### Impact

- Increases productivity and technical expertise of member's staff
- Represents member interests with respect to standards development
- Provides cost-effective and time-effective updates on industry developments

### How to Apply Results

Utility managers and staff can immediately use the knowledge provided by this program to improve distribution system design, maintenance, and troubleshooting practices. The service is provided through a standards exchange and member forum, which allows for easy access to knowledge, discussions, and expert staff.

### 2010 Products

| Product Title & Description | Planned Completion Date | Product Type       |
|-----------------------------|-------------------------|--------------------|
| Distribution Hotline        | 12/31/10                | Technical Resource |