

T&D and ROW Environmental Issues - Program 51

Program Overview

Program Description

As the electric transmission and distribution (T&D) infrastructure expands and ages, and as new right-of-way (ROW) standards are developed, power companies need to manage human health risks and minimize environmental impacts from, and species interaction with, power delivery systems to maintain safe and reliable grid operation. System components, such as service centers, substations, and cables, face issues related to spills, runoff, and remediation. Environmentally acceptable options are needed, for example, in selecting and managing T&D equipment containing polychlorinated biphenyls (PCBs) and dielectric fluids, managing substation stormwater runoff, and remediating contamination from the unique metals and organics present within the T&D infrastructure. Efficient, cost-effective ROW vegetation management and transmission line siting are increasingly important for compliance with new reliability standards. In addition, power companies need to reduce animal and avian interactions with T&D infrastructure and protect sensitive species and habitats during ROW construction and maintenance, while recognizing opportunities to optimize ecological assets on new and existing ROWs.

The Electric Power Research Institute's (EPRI's) T&D and ROW Environmental Issues program delivers information, tools, and methods for preventing, characterizing, and remediating soil and water contamination at T&D facilities, as well as for designing and retrofitting T&D facilities. Data and products from the program support development of scientifically sound regulations and cleanup standards for chemicals associated with T&D and ROW facilities and operations, as well as providing engineering, science, and business tools to aid in their management. The program also provides balanced, cost-effective solutions for addressing the economic and environmental challenges of siting, developing, managing, and upgrading T&D ROWs. Innovative tools, practical guidance, and state-of-the-art information help companies control ROW costs and improve service reliability while protecting natural resources and addressing public, regulatory, and other stakeholder concerns.

Research Value

Program research has documented savings of \$10 million per year industrywide for used oil management, \$1.5 billion per year for management of creosote and pentachlorophenol utility poles as nonhazardous waste, and \$500,000 at a single site by demonstration of the true risk of a mineral oil spill. The program also helped save one company \$1 million in spill prevention, control, and countermeasure (SPCC) regulatory compliance costs. Program research also expedites transmission line siting and ensures system reliability by addressing ecological issues associated with vegetation management standards, reducing ROW maintenance costs, and enhancing ecological value through Integrated Vegetation Management (IVM). The program also improves a utility's ability to assess and prevent bird strike impacts, enhances ecosystems along T&D ROWs, and provides materials to help companies communicate with regulators and address public concerns. This program provides

- scientific information and data to help power companies make cost-effective decisions on T&D ROW equipment life-cycle management choices and remedial approaches, based upon environmental risk factors;
- characterization information on substances related to environmental and human health risk, and strategies to reduce financial risk and operations and management costs;
- constructive engagement on federal oversight of transmission vegetation management, and information for regulatory development; and
- opportunities for proactive environmental management to decrease potential for outages and fines, and shorter time frames for siting new transmission lines.

Approach

This program addresses environmental challenges at substations, T&D infrastructure, and ROWs with options assessment, fate and transport studies, and remedial approaches. It facilitates communications with stakeholders through data and life-cycle studies, and it provides a critical venue for members to stay ahead of the curve on emerging issues, such as congener-specific PCB risks and ROW invasive species challenges, which have the potential to lead to increased operational costs in the future. The program conducts field studies, best-practice surveys, risk assessments, workshops, and technology development and demonstration projects. The program also sponsors an integrated direct support function for those utilities with immediate technical transfer needs. This program delivers

- tools to cost-effectively manage legacy PCBs and research to risk-inform PCB remediation activities;
- software tools for advanced spill simulation to examine environmental impacts of leaks such as oil spills, and to support discussions with regulators;
- technology evaluations for alternate transformer oil containment;
- pilot tests to expand remediation options for spills and leaching of substances such as arsenic;
- environmental risk management decision tools that assist in the prioritization of equipment inspection and replacement needs;
- collaboration with other industry groups such as the Avian Power Line Interaction Committee, International Society of Arboriculture, Utility Arborists Association, and government agencies;
- continuing support for the international symposia on environmental concerns in ROW management;
- IVM field assessments of transmission vegetation management practices to aid utilities in reducing vegetation management costs while addressing environmental and sustainability goals;
- long-term vegetation management field studies to reduce vegetation management costs and address issues identified during IVM field assessments; and
- development of innovative tools to reduce avian and other animal interactions at utility facilities.

Accomplishments

This program provides data, tools, and information that deepen understanding of the environmental consequences of company actions, including operations and remediation. Using sound scientific information from this program, companies have

- cleanup endpoints for substations contaminated with dielectric fluids or arsenic that represent acceptable risk and lower cost;
- substation retrofit plans acceptable to regulators that minimize risk and reduce costs;
- development of immediate estimates of potential oil losses in failure events;
- efficient management of materials and equipment as nonhazardous, where appropriate, at the end of useful lifetimes;
- deployment of a Bird Strike Indicator at utility sites to clarify operational impacts and reduce liabilities from avian interactions with facilities;
- analysis of compliance with North American Electric Reliability Corporation (NERC) vegetation management standards; and
- guidance and information to address invasive species on transmission ROWs.

Current Year Activities

Program R&D for 2014 will focus on investigating PCB risks specific to T&D equipment, developing new tools and guidance for managing substation spills, and providing information to expedite transmission line siting, reduce transmission outages and vegetation management costs, and minimize adverse avian interactions. Specific efforts will include

- improving approaches to identifying environmental impacts from leaking PCB-containing equipment and exploring associated risks,

- integrating a spreadsheet assessment tool for evaluating environmental and human health risk during the T&D infrastructure life cycle with engineering-based reliability data (collaboratively with the Power Delivery & Utilization [PDU]sector),
- demonstrating an *in situ* arsenic remediation technology at a utility site,
- investigating alternative substation oil containment technologies and stormwater control practices,
- conducting field investigations of cost-effective practices to control invasive species on ROWs
- providing options for overcoming economic and environmental challenges of transmission line siting,
- developing information to clarify and mitigate avian interactions and environmental impacts with facilities, and
- developing environmental information on best vegetative management practices to assist utilities in upgrading and siting of transmission lines.

Estimated 2014 Program Funding

\$2.8M

Program Manager

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Summary of Projects

Project Number	Project Title	Description
P51.001	PCBs: Mitigation and Remediation	This project develops options for identification of equipment containing PCBs, as well as data and analyses to inform regulations and decisions involving PCBs.
P51.002	Substation Oils and Trace Metals Environmental Issues	This project supports prevention, management, and remediation of leaks and spills of dielectric fluids and stormwater runoff through improved facility design and operation, thereby reducing operational, financial, environmental, and human health risks.
P51.003	Relative Risk Model Development for T&D Infrastructure	This project develops data and tools to proactively manage environmental and human health risks from incidents resulting from aging T&D infrastructure.
P51.004	Integrated Vegetation Management (IVM) and Inspection Techniques	This project develops information aimed at containing and reducing long-term vegetation management costs for T&D facilities while addressing reliability, regulatory, and environmental concerns.
P51.005	Transmission Siting Integrating National Corridors and NERC Compliance Requirements	This project develops guidance to assist system planners, line designers, environmental advocates, and route selectors in understanding the technical basis for various regulatory requirements that must be met in justifying and siting new transmission lines.
P51.006	Avian and Animal Interactions with T&D Infrastructure	This project develops information and tools to mitigate avian and other wildlife interactions with utility facilities to reduce outages and potential takes under federal law.
P51.007	Utility Poles: Assessment and Environmental Impact	This project develops approaches and provides data to help companies manage poles across the pole life cycle, using practices that ensure engineering performance, manage costs, and protect the environment and human health.

P51.001 PCBs: Mitigation and Remediation (100778)

Description

PCB-containing dielectric fluids were used extensively in electrical equipment until their use was banned in the late 1970s. Utility companies are continuing to remove legacy equipment that contains PCBs. This equipment can be difficult to identify, so strategies for identification and removal are needed. Some regulators and risk assessors are focusing on individual PCB congeners, especially the dioxin-like congeners, and may be requiring congener-specific monitoring at some sites. Information about congener-specific monitoring and risk assessment will be needed. Utilities are also challenged with the management of PCBs in solid media (e.g., legacy-PCB-painted equipment). An understanding of the risks associated with such materials is needed to develop optimal remediation and removal strategies. Implications of new regulations must be understood.

P51.002 Substation Oils and Trace Metals Environmental Issues (Q55817)

Description

Routine operation of T&D facilities, such as substations and service centers, may result in leaks, spills, or fires, as well as stormwater runoff, with potential human health and environmental impacts. Prevention requires good facility design and construction. Compliance and protection require good understanding of the risk of an incident and the toxicity of the fluids involved. New, greener fluids and designs are emerging that may reduce impacts in the future. Through conceptual, laboratory, and field projects, EPRI researchers study facility design and mitigation technologies, as well as chemical composition of, environmental fate and transport of, and risks from dielectric fluids.

Many utility sites have legacy arsenic and heavy metals contamination. In many cases, the contamination is limited to the soil; in some cases, groundwater has been contaminated. EPRI is investigating approaches to assessing and remediating arsenic contamination and to assessing and communicating human health and financial risks from contaminated sites.

Routine utility practices can generate lead and zinc contamination, most commonly limited to the soil. EPRI will investigate approaches to assessing and remediating the contamination and to assessing and communicating human health and financial risks resulting from lead and zinc contamination.

Promising remedial techniques, both *in situ* and *ex situ*, are being identified, investigated, and demonstrated. Current research focuses on the monitored natural attenuation (MNA) of metals such as arsenic. Research will be performed collaboratively with P49 (Coal Combustion Products—Environmental Issues)

P51.003 Relative Risk Model Development for T&D Infrastructure (069220)

Description

As the electric transmission and distribution infrastructure grows older, risks of leaks and spills of fuels, dielectric fluids, and other liquids or gases may increase, resulting in increased financial risk to companies as well as increased risk to human health and the environment. Companies need to understand the risks and vulnerabilities, and they need approaches to identifying and assessing those risks and vulnerabilities.

The Relative Risk Model and methodology is being designed to be integrated with existing equipment/infrastructure engineering evaluation tools to increase their effectiveness at member utilities. Collaborative investigations and demonstrations are planned with EPRI's PDU sector and with host utilities to accomplish these integration goals.

P51.004 Integrated Vegetation Management (IVM) and Inspection Techniques (101938)

Description

All ROWs are managed with the general goal of providing safe and reliable transport of electricity. ROW managers strive to meet these goals by developing low-growing vegetation that persists over the long term. For most ROW managers, active management is required to create desired vegetation and related environmental conditions. ROW vegetation management represents a major cost for the industry; individual company costs are in the range of \$5–\$20 million per year. Containing and lowering these costs while maintaining high reliability and enhancing ecological productivity are important to competitive success of the company and to environmental stewardship. This project develops information aimed at containing and reducing long-term vegetation management costs for T&D facilities while addressing reliability, regulatory, and environmental concerns.

P51.005 Transmission Siting Integrating National Corridors and NERC Compliance Requirements (069222)

Description

Siting of transmission lines is becoming increasingly important as the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC) develop new standards. Transmission line siting is complex. In the Department of Energy's National Interest Electric Transmission Corridors, the process follows FERC guidelines; outside of these areas, the siting process follows state guidelines. In either case, a comprehensive understanding of practical alternatives is essential to acquiring any transmission facilities permit, especially for the siting of a new transmission line. The applicant must demonstrate due diligence in justifying the new line as the best choice when compared with alternatives, such as upgrading or uprating of existing lines; use of more-compact, less visually intrusive line designs; additional utilization of existing corridors; and increased use of underground transmission cables.

As described in the FERC permit process, eminent domain proceedings are not the preferred method of obtaining rights-of-way. The permitting process is rather one of engaging the public through meetings and education. This approach requires an in-depth understanding of the primary technical issues by everyone involved in the siting procedures and is crucial in obtaining permits from state or federal regulators.

This project develops guidance to assist system planners, line designers, the public (including interveners), and route selectors in understanding the technical basis for various regulatory requirements that must be met in justifying and siting new transmission lines.

P51.006 Avian and Animal Interactions with T&D Infrastructure (101940)

Description

Birds and other wildlife interact with power structures in many ways. Some structures (towers, poles, stacks) and associated ROW habitats can provide favorable sites for bird nesting, roosting, and foraging and for hunting activities for a wide variety of bird and other animal species, without affecting operations. At the same time, birds are at risk from potential interactions with these structures, including collisions with wires and towers, and birds and other wildlife can be subject to electrocution (transformers, conductor configurations). These and other interactions can result in disruption of service and cause negative effects on bird and other wildlife populations. Adverse effects on certain bird species, such as electrocutions of eagles, may result in fines and other penalties. Proactive planning can foster environmental stewardship and reduce adverse impacts on avian and other wildlife populations. This project develops information and tools to mitigate avian and other wildlife interactions with utility facilities to reduce outages and potential takes under federal law.

P51.007 Utility Poles: Assessment and Environmental Impact (100315)

Description

Poles are a huge and valuable asset of a utility company. Companies need to manage poles across the pole life cycle with practices that ensure engineering performance, manage costs, and protect the environment and human health. This process begins with selection of the optimal pole for each setting, continues through careful use, and ends with final disposition that recognizes the asset value and minimizes ongoing risk.

Improved specification of new and replacement poles allows companies to better manage operational, financial, environmental, and human health risks. Optimal processes for prevention of leaching reduce environmental and human health impacts from pole treatments. Information on chlorophenols, dioxins, metals, and supplemental treatment chemicals is critical to obtaining science-based, cost-effective regulatory decisions, as well as supporting optimal business decisions by pole owners. Alternatives to landfilling and giveaway programs for treated wood poles are essential to help companies manage risks and recover the huge resource represented by wood poles at the end of their useful life.

Demonstrating low risk for treated wood can save owners billions of dollars by reducing disposal costs and facilitating recycling. Assessing nonwood alternatives can offer companies lower-risk, reasonable-cost options in some settings.

Supplemental Projects

Avian and Animal Interactions Interest Group (1-105253)

Background, Objectives, and New Learning

The Interest Group will focus on the reduction of avian and animal mortality and service disruptions. While technically speaking birds are animals, their broad protection under federal laws and the distinct nature of their interactions with electric utility facilities necessitates separate research consideration. The protection of other animals, principally snakes and mammals, is focused on preventing electrocutions when they enter electrical equipment in substations. Avian mortality, by contrast, is due to collisions on the transmission system and both collisions and electrocutions on the distribution system. With electrocutions of either group, there is also the potential for service disruptions. As such, a thorough knowledge of the nature of avian and animal interactions with utility facilities and their consequences is key to protection and reducing service disruptions.

Project Approach and Summary

The Interest Group activities will be conducted by EPRI staff and electric utility experts. Occasionally, consulting and federal agency experts will be invited to speak on particular topics of interest to the Group. As part of this process, EPRI will review past research, such as the development of the Bird Strike Indicator (BSI) and its applications. While EPRI has identified several research topics for consideration, it will be principally the charge of the Interest Group to identify research topics of value. Through discussion, knowledge gaps will be identified that can be addressed through research.

Benefits

Participation in the Interest Group will advance cost-effective approaches to further reduce interactions that result in mortality and service disruptions. Additionally, it will help address the increasing pressures from resources agencies, environmental groups and concerned utility customers. Reducing service disruptions is also important in today's competitive environment and represents an opportunity to gain an edge through increased reliability and reduced operations and maintenance costs.

Mineral Oils Spill Evaluation System-Multiphase User Group (073465)

Background, Objectives, and New Learning

Owners of many U.S. electrical substations are required to prepare Spill Prevention Control and Countermeasures (SPCC) Plans that estimate the potential for mineral oil spills to impact surface water. They also are required to summarize the equipment and organizational measures available to respond to such spills, if one occurs. If electrical equipment fails, the owner may need to make a timely estimate of the quantity of oil released to the environment and its distribution. EPRI has created the Mineral Oil Spill Evaluation System – Multiphase (MOSES-MP), Version 4 software to answer these needs.

Mineral Oil Spill Evaluation System – Multiphase is a user-friendly software tool for estimating whether spilled oil could reach a waterbody and preparing SPCC Plans that meet regulatory requirements. Version 4 contains new features that allow more accurate prediction of oil loss and transport. It has been updated for compatibility with current Windows operating systems.

Project Approach and Summary

The software consists of two modules. The first module, MOSES, predicts whether oil can reach surface water or nearby storm drains as a result of a release from electrical equipment or oil storage tanks, and calculates the volume of oil reaching surface water, consumed by fire, or retained on land. Using this module, the output and a template stored in the program, the software can create a draft SPCC Plan that can be tailored for an individual substation.

The second module, MP, simulates transport of oil through the soil using a one-dimensional flow model, to predict whether a spill will reach the underlying groundwater. This module can also estimate whether oil retained in soil could be redistributed and reach groundwater.

Power plant engineers that have used Version 3 will find that Version 4 maintains the same uncluttered interface, but has been enhanced and updated with new capabilities including:

- SPCC Plan templates and documentation updated to reflect changes to EPA regulations
- New container types
- User-defined equipment lists that can be accessed for multiple facilities
- Improved estimate of oil lost from transformer fires
- Added ability to predict oil loss from catastrophic equipment failure using fireball dimensions
- Improved oil transport calculations for sites with steep slopes and large spill volumes
- More accurate estimate of oil spread on riverbanks
- Compatible with newer computer operating systems (Microsoft Windows X-P, Vista, and Windows 7)

Benefits

Membership in this project and use of the software will promote more rapid response to oil spill incidents, allowing users to provide timely information to their management, to regulators and to the public.

The software provides a major cost-savings for substation owners that must prepare SPCC plans for multiple sites. The facility files produced by the software act as a repository for information on the substation equipment, site topography, and oil storage. The software produces draft SPCC Plans that comply with current U.S. Environmental Protection Agency (EPA) requirements and can be edited to conform to the user's corporate format. The software is adaptable, easy to use and can be quickly set up to provide estimates of oil loss in response to a leak or electrical equipment fire. It also can compare and evaluate containment options.

Direct Support for T&D and ROW Environmental Issues Supplemental Program (105254)

Background, Objectives, and New Learning

As the electric transmission and distribution (T&D) infrastructure expands and ages, and as new rights-of-way (ROW) standards are developed, power companies need to manage human health risks and minimize environmental impacts from power delivery systems to maintain safe and reliable grid operation in a cost effective manner.

This supplemental program provides funders with flexible and tailored direct support options to facilitate technical transfer of the knowledge and tools developed under EPRI's Program 51 (T&D and ROW Environmental Issues Program) into their utility and site programs.

Lessons learned from the supplemental program will be shared with the funders.

Participation requires a 3-year commitment and includes one direct support assessment during the commitment period.

Project Approach and Summary

This supplemental program will have a two-fold approach:

- Direct support will be provided to funders in the form of member specific technical assessments. Existing EPRI environmental T&D direct support options will be reviewed for integration into this program:
 - Assessment of Environmental Risk Management of T&D Infrastructure
 - Assessment of Regional Non-native Invasive Plant Species Vegetation Management Practices on Transmission ROWs, and
 - Assessing Performance of Integrated Vegetation Management of Electric Transmission Rights-of-Way
- The program will also serve as a forum to tailor these existing direct support options and to develop new support options for the funders. Lessons learned from the program activities will be shared with the funders through site peer visits, webcasts and summary reports.

Benefits

With the assistance of EPRI expert teams, funders will be able to directly apply EPRI research results to their utility-specific situations. As with past assessment activities of this nature, we would anticipate that such enhanced technical transfer activities would facilitate utility funders in identifying cost savings or environmental risk reduction opportunities within their programs.