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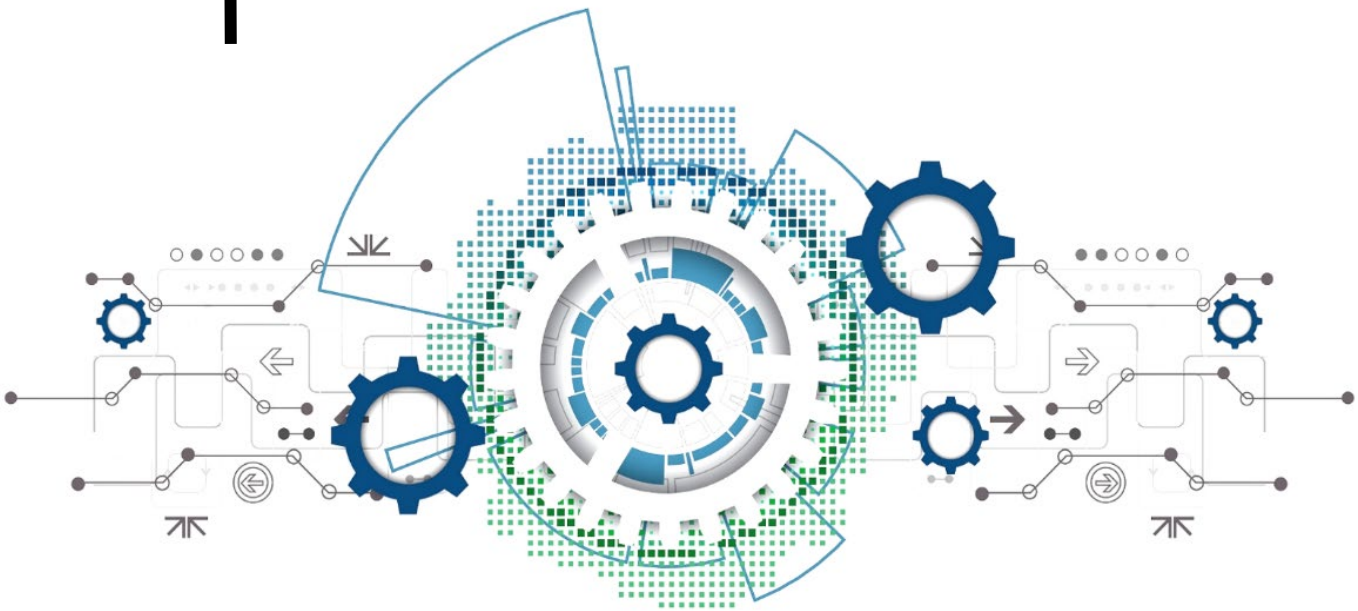
Technology Innovation Projects Closed in Fiscal Year 2024



Technology Innovation Project

Closing Project Brief

TIP 416: CEATI – Hydropower Operations and Planning Interest Group (HOPIG)

Context

Although hydraulic generation has evolved through many decades of technological change and environmental regulation, it continues to demonstrate an enviable track record of outstanding performance. It now operates in a world of unparalleled change with new paradigms which include: the competitive pressures of deregulation; increasing consumer reliance on hydropower's relative low cost and greenhouse gas emission-free source of energy; high stakeholder expectations; and ever increasing investor, government and public scrutiny. Many of the changes and challenges facing the industry such as climate variability and greenhouse gas emissions are beyond the control but impact the hydropower water manager.

The long term strategic direction of this group is to develop new and innovative technological approaches and options to support the role of the water manager in managing and enhancing the underlying fundamental value of the industry, and to provide a knowledge-based leading edge technological resource to assist the hydropower industry in meeting its many new challenges.

Topics & Issues

- Watershed Management
- Meteorology and Hydrology
- Data Acquisition, Validation and Dissemination
- Hydraulics and Hydraulic Structures
- Planning, Operation and Risk Management
- Hydropower Operation and Environmental Concerns
- Waterways and Public Safety

Annual Activities

- 2 Meetings
- 1-2 Workshops
- 5-7 Conference Calls
- Weekly Information Exchange

Why It Matters

Membership provides a forum to network with industry peers and share of common concerns related to the Topics and Issues outlined in this interest group.

Comparing best practices and sharing problem solving methods with the membership helps BPA develop an independent perspective of its performance and enables a culture of continuous improvement. This is specifically identified in BPA-sponsored CEATI Projects 433 and 432 (see next page)

Finally, collaboration leverages BPA's investment by providing access to results from many large projects that BPA could not support alone.

Goals and Objectives

The goal of CEATI's HOPIG is to develop and make available cost effective water management expertise, tools, and leading edge technology through collaboration across a wide community of knowledgeable participants including utilities, independent power producers, government and other agencies.

Through membership BPA has been able to develop benchmarking and best practices that can be used to evaluate the scope for improvement for members in areas related to the Topics and Issues of this interest group.

About CEATI

The Centre for Energy Advancement through Technological Innovation (CEATI) is a user-driven organization committed to providing technology solutions to its electrical utility participants. Together, they collaborate and act jointly to advance the industry through sharing and developing practical and applicable knowledge.

TIP 416: CEATI – Hydropower Operations and Planning Interest Group (HOPIG)

Project Start Date: January 2020

Project End Date: December 2023

For More Information Contact:

BPA Technology Innovation Office
technologyinnovation@bpa.gov

Links

www.ceati.com/HOPIG

Reports

Final report: STREAMFLOW ASSESSMENT TOOLKIT FOR CHANGING CONDITIONS – PHASE 2; No. T202700-0433B

Presentation: Streamflow assessment toolkit for changing conditions; No. 0433B

Final report: HYDROLOGIC FORECAST VERIFICATION STRATEGIES AND METHODS; CEATI REPORT No. T182700-0432

Presentation: HYDROLOGIC FORECAST VERIFICATION STRATEGIES AND METHODS; CEATI REPORT No. T182700-0432

Conclusion:

BPA participated in many activities of this CEATI interest group, including presenting "Under the Hood with BPA" webinar for the Inflow Forecasting Working Group in February 2023.
BPA received several project reports and presentations. Subsequently, BPA ended its membership in HOPIG.

Technology Innovation Project

Closing Project Brief

TIP 419: CEATI – Grounding and Lightning Program (GLP)

Context

The CEATI Grounding & Lightning program (GLP) is a consortium of international electric power utilities with several common goals that include benchmarking, sharing of information and knowledge on grounding and lightning protection of power systems and expanding the knowledge base through studies, R&D and the development of standards and guides. The Grounding and Lightning program (GLP) is interested in all aspects of grounding and lightning protection of Transmission and Distribution systems.

Electric power systems include the interconnection of the transmission, substation and distribution neutral grounding systems. It is a goal of the GLP program to remove barriers between these engineering areas to encourage the sharing of grounding and lightning knowledge and experiences. The effect of one system on another ground system is an important consideration.

It can be helpful, for instance, to understand how a substation grounding system is designed in order to develop a better grounding system for distribution pad-mounted equipment.

Focus Areas

The GLP Action Plan takes its lead from the GLP Strategic Plan. Focus Areas are:

- Lightning Protection and Performance
- Substation Grounding
- Personal Protective Grounding (PPG)
- Distribution and Transmission System Grounding
- Copper Theft from Grounding Systems
- Pipelines Located Near Transmission and Distribution Lines and Stations

Each of the activities in the Action Plan has been identified by GLP members as important to them in their grounding practices. All activities in GLP are driven by its members.

Topics & Issues

1. Context of the Organization
2. Leadership
3. Planning
4. Support
5. Operations
6. Performance Evaluation
7. Improvement

Annual Activities

- 2 Face-to-Face Meetings
- 2-Day Industry Conference
- Training Webinars
- Conference Calls
- On-Demand Information Exchange
- Collaborative Project Development

Why It Matters

Today there is a greater awareness and desire to ensure that grounding for safety is achieved. BPA participation supports efforts to improve lightning performance of the transmission system as addressed in this program.

Goals and Objectives

The CEATI Grounding & Lightning program takes a broad spectrum view, providing clarity and understanding to grounding and lightning related topics. For BPA, it provides an avenue for moving information from one technical area to another through peer-to-peer guidance, collaboration with utilities, as well as indicating the direction for future areas of research of interest to the Agency.

About CEATI

The Centre for Energy Advancement through Technological Innovation (CEATI) is a user-driven organization committed to providing technology solutions to its electrical utility participants, who are brought together to collaborate and act jointly to advance the industry through the sharing and developing of practical and applicable knowledge.

CEATI INTERNATIONAL | Grounding & Lightning

TIP 419: CEATI – Grounding and Lightning Program (GLP)

Project Start Date: January 2020

Project End Date: December 2023

For More Information Contact:

BPA Technology Innovation Office
technologyinnovation@bpa.gov

Links

CEATI - Grounding and Lightning

Current Projects

Reports

Final report: *GUIDELINES FOR GROUNDING STEEL POLES,* CEATI No. T203700-3728

Presentation: *GUIDELINES FOR GROUNDING STEEL POLES,* CEATI No. T203700-3728

Presentation: Grounding Systems Fault Current Split Calculations

Conclusions:

BPA found participation in this interest group to be useful. CEATI reports for grounding of steel poles were consulted to ground steel poles inside Gold Beach Switchyard. However, membership was not renewed due to higher budgeting priorities.

TIP 421: EPRI P204 - Advanced Buildings & Communities

Context

The Advanced Buildings and Communities program provides fundamental approaches and practical tools to scale up Grid-interactive Efficient Buildings and Connected Communities in order to support a decarbonized future for all.

This is important because as more utilities and governments set carbon reduction and electrification goals, and as utilities increase renewable generation to achieve these goals, advanced buildings and communities serve as important potential resources to help adapt load shapes while providing customers with comfort, cost-savings, and convenience.

However, several industry challenges remain in achieving this potential, such as the availability of viable technologies and solutions that are affordable and scalable; the ability to encompass different customer segments and building configurations, such as disadvantaged communities, multifamily housing, small and medium businesses, and retrofit versus new construction; and ensuring a wide range of stakeholders are involved in the dialogue.

The Advanced Buildings and Communities program seeks to address these challenges by examining the pathways and action plans to enable the transformation of the building ecosystem in an equitable manner.

2023 Activities

Research activities are organized into three project sets, the combination of which are designed to funnel directly into utilities' development and implementation resources for customer programs:

- 204K: Building Ecosystem Fundamentals and Insights
- P204I: Informing Codes, Standards, and Policy
- P204T: Utility Programs and Technology Transfer

Project Set 204K develops new fundamental research and knowledge, which then informs Project Set 204I, along with other learning from government-funded and supplemental projects; all of this is transferred to support utility customer programs via Project Set 204T.

Why It Matters

Membership in this program allows BPA to gain a better awareness of industry and government collaborative efforts.

A core component of “Decarbonization” relies on implementing extensive and deep energy efficiency measures. This is a direct value to BPA. Core elements of EPRIs Decarbonization effort are focused in core BPA research areas of HVAC, hot water and weatherization in Multi Family buildings.

Goals and Objectives

The program builds on the large body of related research being conducted by EPRI in integrated high-performance buildings and smart, resilient communities through government and supplemental projects. These include customer-centric demonstrations and deployments that focus on the application and integration of emerging technologies, and evaluating the actual operations of high performance communities.

Deliverables

Empirical evidence, performance data, recommendations, and best practices to inform utility conservation measure development and improvement.

- Building Performance Standards
- Resiliency Hubs with Buildings & Communities
- Commercial Buildings Research Roadmap
- Enabling & Quantifying Demand Flexibility with Buildings: Understanding the Value Proposition
- How to reduce the cost of electrifying buildings/communities

TIP 421: EPRI P204 - Advanced Buildings & Communities

Project Start Date: January 2020

Project End Date: February 2024

For More Information Contact:

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Links

Program 204: Advanced Buildings and Communities | Program Home (epri.com)

Results

Program 204 accomplishments include:

- Developed the Advanced Energy Communities (AEC) Dashboard (with end-use analytics) that provides a uniform approach to access and analyze AEC data for a variety of applications ranging from post-facto evaluations to "in-time" data visualization. The AEC Dashboard can be used to provide key insights into the performance of homes/buildings, advanced energy measures, and customer behavior.
- Developed a carbon calculator that can provide carbon impact of electrification and dual fuel pathways for existing and new buildings with hourly generation models.
- Demonstrated technologies and business models that enable reduced energy costs and improved comfort for low-income communities.
- Developed decarbonization and electrification pathways for new and existing building stock.
- Developed an understanding of technical and available flexibility capacity in buildings.
- Understanding and charting grid impacts of integrating advanced building technologies in Advanced
- Energy Communities.
- Demonstrated energy efficiency and demand response impacts of smart thermostats.
- Developed a roadmap for future utility-customer engagement with evolution of connected devices and ecosystems.

Conclusion

A large portion of this program has been focused on implementing cost effective energy savings measures in multi-family buildings; a focus for BPA Residential programs. The EPRI 204 program has been engaged in additional product field testing of significant interest and value to BPA Energy Efficiency programs. However, membership was not renewed due to higher budgeting priorities. BPA will continue to monitor the program.

BONNEVILLE POWER ADMINISTRATION

Technology Innovation Project — Closing Project Brief

TIP 423: CEATI – Transmission Overhead Equipment

Context

Many of the transmission lines built prior to the mid-1900s are still in service and those built during the expansion years of the 1960s and 70s are beginning to show their age, requiring added maintenance and assessment. During the life of a transmission line, asset management decisions are made on an ongoing basis with an emphasis on extending the life of the assets, maintaining or improving reliability and performance, cost optimization and ensuring the safe operation of the transmission lines system.

Focus Areas

Key focus areas of the group include life extension of assets to defer the need for major capital expenditures, the refinement and development of prudent and effective inspection, data collection and condition assessment practices, and maintenance techniques and prioritizations to reduce life cycle cost and maintain the performance of the transmission lines system.

Topics & Issues

Current topics and issues include:

- Asset Investment Decisions
- Maintenance & Business Practices
- Optimizing Maintenance
- Health/ Condition Assessment & End-of-Life Prediction
- Corrosion Control and Mitigation
- Reliability Issues, Evaluations and Solutions
- Technical Standards and Supplements
- Assessment of Promising New Technologies

Annual Activities

- Face-to-Face Meetings & Quarterly Conference Calls
- Working Group Conference Calls
- On-Demand Information Exchanges
- Technical Tours
- Benchmarking Surveys

Benefits

Through membership in this program, BPA's Transmission Line Engineers access all participant's knowledge of condition assessment and maintenance of overhead transmission lines in the evolving industry environment.

The program accomplishes its goals by benchmarking, sharing knowledge through collaborative projects, information exchanges, training webinars, workshops, conferences, and access to a global network of subject matter experts.

Goals and Objectives

The objective of the Overhead Transmission Equipment Program is to bring together interested transmission utilities to exchange information and knowledge on overhead transmission line inspection, condition assessment and maintenance practices and techniques and to facilitate studies and applied research that will optimize the management of overhead transmission line assets.

2023 Program Activities

The Overhead Transmission Equipment Action Plan for 2023 takes its lead from the Overhead Transmission Equipment Strategic Plan. All the activities in the Action Plan are aimed at delivering value to Overhead Transmission Equipment members.

Overhead Transmission Equipment Program covers topics from the following Focus Areas:

- Focus Area 1 – Condition and End of Life Assessments of Overhead Transmission Lines
- Focus Area 2 – Overhead Transmission Line Inspections and Data Collection
- Focus Area 3 – Overhead Transmission Line Information Management
- Focus Area 4 – Overhead Transmission Line Maintenance Techniques and Prioritization
- Focus Area 5 – Overhead Transmission Line Technical Guides and Supplements

TIP 423: CEATI – Transmission Overhead Equipment

Membership: Closed

For More Information Contact:

BPA Technology Innovation Office:
technologyinnovation@bpa.gov

Links

CEATI - Overhead Transmission Equipment

Reports

Overhead Transmission Equipment: ACTION PLAN FOR 2023 ACTIVITIES

ANALYTICS FOR MAINTENANCE OF OVERHEAD TRANSMISSION LINES; EDM International, Greg Bennett, et al. CEATI REPORT No. T213700-3288, May 2023

IMPROVING OVERHEAD TRANSMISSION LINE RESILIENCY IN RESPONDING TO EXTREME NATURAL AND MAN-MADE DISASTER EVENTS – MAINTENANCE PERSPECTIVE; DiGioia Gray & Associates, Richard Steeg, P.E. CEATI REPORT No. T213700-3286, Oct 2023

APPLICATION OF ARTIFICIAL INTELLIGENCE IN OVERHEAD TRANSMISSION LINE MAINTENANCE, EnerNex LLC, Muhammad Humayun, PhD, et al. CEATI REPORT No. T223700-3290, Nov 2023

BEST PRACTICES FOR TRANSMISSION LINE MAINTENANCE PROGRAM OPTIMIZATION: Overview of Maintenance Optimization Methodologies and Approaches, METSCO Energy Solutions Inc., Robert Otal, P.Eng. et al. CEATI REPORT No. T213700-3287 (final draft report)

Conclusions:

Although BPA received value from its participation as a sponsor, this CEATI interest group is broad and only 1/3 of the topics apply to BPA's Transmission Line Engineering organization. It was decided not to continue membership beyond this year because participation in other RD&D programs provide better value for BPA.

Technology Innovation Project

Closing Project Brief

TIP 431: EPRI Supplemental - Pandemic-Resilient and Sustainable Transmission and Distribution Systems

Context

The Coronavirus (COVID-19) pandemic has underscored the role of electricity delivery as an essential service. Transmission and distribution (T&D) system companies have adapted existing tools, designs, and processes to reliably maintain control center and field operations, while enabling safe, healthy environments for staff and customers.

Throughout the pandemic, EPRI has driven global collaboration, engaging more than 2,200 staff members from more than 300 companies through a T&D COVID-19 Impacts webcast series. Building on input from this collaboration and EPRI's pandemic-related research and analyses, this project aims to assess the near- and long-term impacts of COVID-19 and provide a rigorous technical basis for future pandemic-resilient and sustainable T&D operations strategies.

Key Activities

The project includes structured evaluations of the efficacy of existing and new technologies, processes, and tools applied in the context of these areas for T&D control center and field operations under pandemic conditions. Key focuses of this project include:

- Evaluating the efficacy of existing and new protocols and technologies and developing new or improved processes for health, safety, and disinfection for T&D applications;
- Developing new processes and tools that enhance control center and field crew operations and asset management under normal and pandemic conditions;
- Forecasting near-term demand capital/maintenance work impacts, identifying potential operational reliability challenges, and specifying associated mitigation options; and
- Assessing the long-term economic impact on system demand and sustainability strategies including impact to renewables deployment and curtailment, and other clean energy technologies.

Project Description

This project is divided into eight tasks. Each task is a specific technical research area and is made up of specific subtasks addressing the challenges identified in each area.

Why It Matters

Rarely do electric utilities around the world simultaneously face the same critical challenge as they are with the COVID-19 pandemic. This provides a unique opportunity to collaboratively develop a scientifically informed foundation for new T&D operations processes and technology applications that enable safe, reliable, affordable, and sustainable delivery of electricity under pandemic and non-pandemic circumstances.

The project provides the technical basis for evolving BPA's pandemic response plans and sustainability strategies to meet current and future needs.

Goals and Objectives

The goals for new learning from this research were:

- Enhance safe T&D workspaces through evaluating T&D disinfectant processes, personal protective equipment (PPE), and health monitoring.
- Maintain operational excellence by evaluating T&D work processes and facility designs to enable safe, reliable, and efficient operations.
- Prepare for future demand impacts by assessing and forecasting pandemic demand impacts and mitigating potential operating challenges.
- Understand sustainability implications by assessing pandemic impacts on decarbonization pathways and renewable energy targets.

Deliverables

Project deliverables include:

- Task reports with evaluation results and recommendations
- Videos, podcasts, and training modules for certain tasks
- Algorithm and/or tools for certain tasks
- Webcasts—interim results and select topics
- Technical reports

TIP 431: EPRI Supplemental - Pandemic-Resilient and Sustainable Transmission and Distribution Systems

Project Start Date: January 2020

Project End Date: Closed 2023

Links

Pandemic-Resilient and Sustainable Transmission and Distribution (T&D) Systems (epri.com)

For More Information Contact:

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EPRI Technical Contact
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Project Task Groups

Health and Disinfection Methods & Technologies

- Control Center and Field Disinfection Approaches
- Personal Protective Equipment, Testing & Monitoring
- Impacts and Opportunities with Teleworking

Evaluate Control Center Design, Processes & Cybersecurity

- Control Center Design Strategies
- Telecommunications, Cyber Security and Threat Detection
- Restoration Processes

Evaluate Field Crew Equipment& Processes

- Technology Solutions
- New Processes and Work Practices

Operator & Field Crew Training Methods

- On-the-job Training Technology
- Techniques & Training Materials

Near-Term Demand & Operational Impacts

- Load Analysis
- Load Forecasting Impacts & Tools
- Operational Impacts Analysis

Deferred Outages and Resource Adequacy

- Identify risks of deferred capital and maintenance
- Estimate impact of altered demand and generation availability on resource adequacy

Asset Management Strategy

- Factors that lead to uncertainty in supply chain affecting stock and spares strategies
- Statistical approaches to determine optimal spares and where they should be located

Long-Term Demand and Sustainability

- Market and model-based economic and energy sector demand impact (electric, transport, building, industry)
- Generation capacity factors; emissions and pollution
- Impact on electrification, efficiency, and renewables deployment and curtailment
- Impact of telework on environmental footprint

Collected Reports:

Pandemic Resilient and Sustainable Transmission and Distribution Systems - 3002019608

COVID19 Pandemic Response: Best Practices for Ventilation and Engineering Controls - 3002023066

COVID19 Pandemic Response: Best Practices for Workplace Testing and Health Monitoring - 3002023065

Program 40 Transmission Planning at a Glance - 3002022550

Transmission Operations Planning Research 2020 Annual Review - 3002020644

Strategic Sustainability Science at a Glance- 3002019833

Conclusion

This EPRI project concluded in 2023. BPA representatives found that participation in EPRI presentations and project updates were supportive in advancing BPA objectives. Information on vaccine and testing efficacy as well as on Personal Protective Equipment (PPE), and learning how EPRI and other utilities incorporate best practices and lessons learned from Safety and Facility perspectives was found to be particularly useful.

TIP 440: EPRI P40 TC - Transmission System Resiliency Analysis

Context

Utilities are increasingly being exposed to threats from natural disasters (hurricanes, tornados, earthquakes, geomagnetic disturbance, etc.) and man-made events (intentional damage to assets, cyber-physical attacks), which can devastate generation, transmission and distribution ("T&D") infrastructure, threaten lives, and disable communities. These events, referred to as **"high impact low frequency ('HILF')** events" (alternatively identified herein as "extreme contingency event(s)" and "extreme event(s)") are rare, but have the potential to wreak tremendous damage to power system infrastructure.

Evaluating these events and their effect on the security of the power system is becoming an increasingly important area of study. Termed "system resilience analysis" this type of analysis aims to ensure system survival following an extreme event. After such an event, secure system operation may not be possible and can cause cascading failure resulting in uncontrolled and undesired tripping of power system elements. Although understood qualitatively, the concept of system resilience is not yet well-established in terms of practical quantifiable assessments in power systems as compared to reliability. To bridge this gap, EPRI has been developing a framework called **Resilient System Investment Framework (RSIF)** to assess transmission system resiliency as part of the Transmission Planning program (P40).

Project Description

The RSIF tool is designed to leverage full AC power flow simulation using commercial power system simulation tools to assess the impacts and consequences of HILF events.

EPRI worked with project participants to conduct a case study analysis using the RSIF to assess the resilience of selected planning or operational planning scenarios. For each case study, the project will analyze a minimum of two power flow scenarios with an option to consider a third scenario if desired. For each power flow scenario, up to three sensitivities can be considered.

The project analyzed two extreme events across all the power flow scenarios, with primary focus on fire events.

Then RSIF can be applied to evaluate the impacts of potential paths of cascading failures and determine the risk of loss of load and generation present in the system. Working from a base case power flow scenario, the efficacy of different hardening considerations can be evaluated for each event.

Benefits

This project supports planners developing a more resilient transmission system against different types of extreme contingencies. At the same time, the results provide input for judicious transmission investments, thus balancing the increased resilience and the associated investment costs.

In addition, the RSIF can be used for operational planning assessments to evaluate the resilience of the system in response to extreme events that are driven by weather, thus providing insights for any preventive measures. Overall, significant improvement in system resiliency can be achieved by explicitly incorporating resilience analysis into transmission planning.

Accomplishments

The goal of this project was to use the Resilient System Investment Framework tool to assess transmission resiliency by looking at multiple HILF events and provide insights to transmission planners. Objectives include:

1. Identify and analyze how a set of extreme events impact transmission system resilience.
2. Identify weak assets in the system that are common across the HILF events considered.
3. Evaluate the efficacy of various proposed network improvement projects from resiliency as well as cost-benefit perspective.

Deliverables

Project participants receive reports specific to their study:

- Final project presentation summarizing overall results including ranking of HILF events, efficacy of various transmission reinforcement options and overall insights.
- An executive summary report.
- Intermediate webcasts and presentations as needed.
- Relevant base cases files developed as part of the project.

TIP 440: EPRI P40 TC - Transmission System Resiliency Analysis

Project Start Date: January 2020

Project End Date: December 2023

Links

EPRI Program 40: Transmission Planning

For More Information Contact:

BPA Technology Innovation Office
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EPRI Program Contact
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Reports

BPA Ratings Studies - Overview of 4 ratings projects
EPRI-Transmission Ops & Planning Annual Research Review-2020
Technical Update – 2021
Transmission System Resilience Analysis – 2021
BPA Transmission Resilience Assessment Milestone II-2022
Transmission Resilience Assessment -2023

Conclusions

BPA seeks ways to increase power flow by leveraging ratings that change seasonally. EPRI identified ratings that met risk criteria established by BPA that accounted for seasonal changes and location. The Ratings Risk Assessment indicated there may be times during peak summer loads when lines approach their limits.

The system provided accurate line ratings based on the weather model around 70% of the time. However, more accurate weather data is needed to provide a greater percentage (70 -99%) most of the time depending on line loading and sensor accuracy.

Studies show a significant number of sensors would be needed to accurately and safely rate lines. Real-time line monitoring could be an option to increase capacity or identify risk during high-load periods.

Technology Innovation Project

Closing Project Brief

TIP 451: EPRI P94 Energy Storage and Distributed Generation

Context

Energy storage is an important technology, due to its potential of supporting variable, renewable energy sources and decarbonization of the power system. Energy storage serves as a flexible and resiliency tool for grid planners, operators, and end customers, in both present-day and future electricity systems. Storage also supports a range of grid planning and reliability objectives, such as meeting short duration peak loads and supporting local reliability, and serving important reserve services for the bulk electricity system.

Project Description

P94A-Strategic Intelligence and Industry Collaboration project set supports research investigating key trends and developments in the rapidly evolving area of energy storage, distributed generation (DG), and microgrids.

This program integrates multiple activities, including technology evaluation, economic and technical modeling to support grid planning and operations, testing and field demonstration, and industry collaboration.

Technology Evaluation and Testing - Survey and investigate candidate energy storage, microgrid, and DG technologies and products. Develop and assess target metrics for performance, safety, cost, technology readiness, and environmental attributes.

Economic Modeling - Develop optimization and simulation tools and methods to support feasibility assessment and design for energy storage, microgrids, and distributed generation projects. These include but are not limited to Storage Value Estimation Tool (StorageVET®) and DER Value Estimation Tool (DER-VET®).

Technical Modeling - Support the accurate modeling of energy storage in grid planning and operations contexts and integration of novel software approaches.

Field Demonstration - Develop implementation and integration best practices for energy storage planning, procurement, deployment, operations and maintenance, and end-of-life.

Industry Collaboration - Bring together diverse industry thought leaders to share new research and develop common best practices through the EPRI Energy Storage Integration Council (ESIC) and ESA Storage Exchange Conference, Powered by EPRI.

Benefits

Energy storage technologies are quickly developing. Lithium-ion batteries have aggressively improved in cost and performance in the past decade to serve the consumer electronics and electric transportation industries, enabling new technically and economically feasible applications for energy storage. However, the need for new technologies and new approaches to existing technologies is also clear.

This project investigates the current state of the industry, including technology advancements, commercial deployment activity, policy and regulatory developments, and integration challenges.

Better understanding of the positive and negative impacts, as well as possible opportunities of grid scale storage to grid operations were important benefits of participating in this program.

Goals and Objectives

The increased knowledge base and access to new tools facilitates transmission planning that involves gird energy storage.

BPA’s participation developed working relationships with utilities, vendors and general proponents of grid-scale energy storage.

Deliverables

The key deliverables completed or under development for this project included participation in Project Set P94A activities and several collected reports listed below.

TIP 451: EPRI P94 Energy Storage and Distributed Generation

Project Start Date: January 2022

Project End Date: Withdraw 2023

Links

EPRI Program 94: Energy Storage and Distributed Generation

For More Information Contact:

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EPRI Program Contact
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Collected Reports

A Guide to ESIC: The Energy Storage Integration Council-3002012092

Electrical Energy Storage Data Submission Guidelines, Version 3- 3002025977

Carnegie Road Energy Storage System Failure Response, Recovery, and Rebuild Lessons Learned- 3002026396

Residential Energy Storage System Safety Guidelines- 3002026399

ESIC Energy Storage Commissioning Guide-3002027455

Results

Energy Storage Wiki (Subscriber Website) This wiki is a hub for EPRI's energy storage online resources including access to a lessons-learned database, safety incident list, archive of monthly email newsletter articles, Energy Storage Roadmap resource directory, and educational content for new stakeholders. Ongoing

Energy Storage Executive Briefing (Presentation) The briefing provides a review of key energy storage industry trends, such as deployments, technologies, costs, and utility use cases and is geared towards a utility executive audience to inform energy storage project decision making. 12/31/2022

Distributed Energy Resources and Energy Storage Forum (Subscriber Website) derforum.epri.com is an online forum that facilitates discussions between members and EPRI staff to address technical topics of interest. (Joint deliverable with Program 174-DER Integration) Ongoing

Energy Storage Knowledge Sharing Events and Webcasts (Presentations) This project will host in-person events and webcasts, such as Energy Storage Association (ESA) Storage Exchange, ESIC Strategy Meetings, member and industry presentations, and tailored educational webcasts to promote knowledge sharing. 12/31/2022

Conclusions

Participation in this EPRI Program has been beneficial to BPA producing useful reports and guidelines. However, membership was not renewed due to higher budgeting priorities. BPA will continue to monitor the program.

Technology Innovation Project

Closing Project Brief

TIP 455: EPRI P199 – Electrification Program

Context

Program experts understand that utilities and their customers are constantly striving to reduce costs, improve comfort and convenience, increase productivity, and enhance their competitiveness in the global marketplace. In many cases, electrification -- i.e., the application of novel, energy-efficient electric technologies as alternatives to fossil-fueled or non-energized processes -- can boost customer productivity and also enhance utilities" quality of service to their customers. Electricity offers inherent advantages of controllability, precision, versatility, efficiency, and environmental benefits compared to fossil-fueled alternatives in many applications. However, a lack of experience with commercially available and emerging technologies impedes many enterprises, particularly small- to medium-sized businesses and civil institutions, from pursuing electrification measures that can improve productivity, efficiency and reduce carbon impacts in their operations. Utilities and their customers would benefit from additional information and support.

Project description

The EPRI Electrification program provides technology and process evaluations and strategic guidance tools to assist in the efficient and grid supporting advancement of electrification targets, while helping customers achieve their decarbonization goals.

This research also collaborates with or informs other research areas at EPRI including programs such as: Grid-Edge Customer Technologies (P170), Customer Insights (P182), Electric Transportation (P18) and Advanced Buildings and Communities (P204), Distribution Operations and Planning (P200), EPRI's Technology Innovation program, and EPRI"s Low-Carbon Resources Initiative (LCRI).

Key activities in the program include the following:

• Further enhancements of technology insights and expansion of the Electrification Knowledge Base (EKB).

• Further quantification of the environmental and other non-energy benefits of electrification.

• Education and engagement of electrification stakeholders, including technology developers, equipment vendors and customers.

• Investigation of emerging technologies.

Benefits

The lack of access to the analytical framework that utility customers are using to quantify and make business decisions regarding electrification -- from the customer, grid, and societal perspectives -- impacts the BPA’s system from a power supply, energy efficiency and reliable transmission planning perspective.

This research program provides insight into influencing, prioritizing and addressing these knowledge gaps by (1) Developing and refining analytical tools along with a knowledge base of technologies, applications, and markets, and (2) facilitating stakeholder networks to help utilities evaluate and pursue efficient and reliable electrification opportunities.

Accomplishments

The electrification research focuses on core activities that advance the understanding, assessment, application, and program deployment of electric-powered technologies that yield positive net benefits to end-use customers and without negatively impacting the grid. • Project sets in this program have produced:

• A valuation framework to assess the net value of electrification to business customers, the utility, and the public in terms of operating costs, productivity, and the environment.

• An electric technology database/reference guide and decision support tool to facilitate technology selection and help utilities screen and select the most appropriate electrification applications for commercial and industrial customers in their service territories.

• A requirements assessment for electric service providers to facilitate advanced manufacturing objectives espoused by the federal government to promote industrial competitiveness.

• Customized utility electrification strategic roadmaps and training workshops.

• Utility electrification program development/ support.

• Customer electrification site assessments.

• Electrification technology cut sheets, case studies and white papers.

Deliverables

The Research Portfolio for this Program 199 resulted in reports and products related to utility program electrification. These are available to members:

PS199A: Analytical Tools and Knowledge Base – This project set provides members with tools, frameworks, and information regarding electric technologies, either via robust and analytically rigorous methods for quantifying the value of electrification, or via the web-based "Electrification Knowledge Base", which is a compendium of relevant technical information regarding electrification technologies.

PS199B: Technology Assessments and Case Studies – The focus is on technology assessments to assist project participants to identify the performance characteristics of commercially available technologies and their impacts to electrification programs.

PS199C: Technology Transfer and Stakeholder Networks – Participating groups aim to provide faster, more efficient ways to exchange market and technology information, aid in finding common solutions to industry problems and barriers to technology deployment, and ultimately advance electrification technologies.

PS199D: Technology Scouting - This project set seeks to identify key market trends and emerging technologies in the electrification area around the world.

TIP 455: EPRI P199 – Electrification Program

Project start date: January 2023

Project end date: December 2023

Links

EPRI P199 Electrification at a Glance

For more information contact:

BPA Technology Innovation Office
technologyinnovation@bpa.gov

EPRI
Allen Dennis, Program 199 Project Lead
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Collected Reports

Program 199: Electrification at a Glance-3002022583

Zero Emission Planning and Grid Assessment for the Port of Los Angeles-3002025783

Assessment of Building Electrification Technologies for New York State- 3002026091

Quantitative Analysis of Electrification Opportunities in Buildings, Industry, and Non-Road Transportation-3002027280

Industrial Technology Data Development-Boilers-3002027283

Electrification Knowledge Base Calculators Training-3002027292

Sustainability Aspects for Electrification Training on Background and Navigating Conversations with Customers- 3002027310

Emerging Technology Assessments-2023 Edition-3002027314

Electrification Program Scouting and Emerging Technology Annual Review- 3002027318

Conclusions

Participation in this EPRI Program has been beneficial to BPA producing useful reports and guidelines. However, membership was not renewed due to higher budgeting priorities. BPA will continue to monitor the program.

TIP 460: PNNL- Cavitation Testing Improvements for Cold Spray Sample Applications

Context

The United States hydropower industry was primarily developed from the 1930s to 1970s, and many of the original hydropower turbines are still in service. Damage associated with cavitation is a common wear mechanism that drives costly repairs and downtime. An alternative repair process, cold spray metal coating, is being developed to repair cavitation-damaged turbines to extend hydropower turbine life and reduce downtime. BPA is working with ***Pacific Northwest National Laboratory (PNNL)*** to test various cold spray applications for future use at ***Federal Columbia River Power System's (FCRPS)*** hydroelectric facilities.

Project description

The project supports PNNL research to improve and refine cold spray material application samples and cavitation testing for better test repeatability. Results will ultimately inform application decisions for use at the ***US Army Corps of Engineer's (USACE)*** Little Goose Dam demonstration in FY 24.

In previous testing, comparing data from 304SS plates and rods, we observed large differences in performance. This is likely due to high amount of cold working and the drawing process used to create the rod stock. By using heat treatments to normalize microstructures and enable creation of a calibration standard coupon to quantify and validate reproducibility of results across equipment and programs. Selecting materials for comparison with significant control of chemistries is important and guidance will be developed.

The project tasks develop the following:

- Improved nozzle machining methods,
- Material normalization procedures for calibration coupons
  - Enable coupons not significantly affected by metal fabrication method, form factor, or heat-to-heat chemical variances.
- Produce a dataset for 3-5 base metal alloys of interest to hydropower.
  - Produce data across multiple test campaigns at different times and with different operators to demonstrate high degree of reproducibility and repeatability with improved methods.

Benefits

Results from this research will help BPA understand the lab tested performance of different cold spray materials to help determine the best candidate for field demonstration. Further, this research may support confidence in cold spray applications for cavitation repair for hydroelectric equipment. Refining cavitation repair results to share with the USACE and the ***Bureau of Reclamation (BOR),*** can encourage connection and collaboration, and cooperative future investment.

Accomplishments

This project focused on testing techniques supporting the standardization of sample coupons and nozzles to understand the impacts on and the repeatability of performance of cold spray application.

The project accomplished two goals for this testing:

- Determining if the inconsistency in previous tests was due to variability in sample coupon composition and nozzle structure.
- Completed review of cold spray sample performance to determine the best application for the demonstration application at Little Goose Dam.

Application

In the near term, this research informs the decision-making process regarding the application of cold spray technology in turbine ring and blade cavitation repair at the Little Goose demonstration project.
Long term, BPA hopes this technology can be deployed at more FCRPS hydroelectric facilities to increase hydropower reliability and extend the lifetime of existing equipment.

Deliverables

The primary deliverables include a final report of findings and results described in the project tasks, and a presentation to BPA.

TIP 460: PNNL- Cavitation Testing Improvements for Cold Spray Sample Applications

Project start date: July 2023

Project end date: December 2023

For more information contact:

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Principal Investigator
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Participants

Pacific Northwest National Laboratory (PNNL)

Results

- Improvements to existing testing equipment were implemented including:
  - Improved datalogging implemented with key variables logged to ensure testing is properly controlled
  - Improved Nozzle machining method: Cylinders instead of buttons reduce cost and time to machine coupons and is functionally equivalent
  - Initial efforts at material normalization were explored but addition work beyond the scope of this effort is underway
- Datasets for 3 alloys of interest were generated.

Conclusions

The research was completed at the end of 2023, and the results were presented to BPA by PNNL investigators. The final report was delivered in May 2024.

The updates to the coupons used for testing ended up showing a larger variance than anticipated. They tested three types of metal that closely resemble the legacy materials used for the existing turbine blades at BPA facilities and did not get the repeatability they had hoped for.

Future work: The goal is to enable statistical significance for incremental improvements with only a few replicates

- Improved material normalization is needed to ensure that variance is from material and not equipment or test methods
- Efforts are in process for an aluminum-based equipment calibration and verification method

Next Steps:

There will be additional research and testing done by PNNL but funded through the US Department of Energy's ***Water Power Technology Office (WPTO)***. A pilot program at the Little Goose Dam hydropower facility will compare the effectiveness of PNNL's cold spray coatings vs. traditional weld repair. This testing program is scheduled for 2025.