2019

Electric Research & Development

Report and Project Status Sheets

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by Consolidated Edison Company of New York, Inc.
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CONTENTS

INTRODUCTION

Consolidated Edison Company of New York, Inc. ("CECONY") and Orange and Rockland Utilities ("O&R") continue to maintain a high degree of focus on research and development (R&D), because R&D helps CECONY and O&R ("the Companies") maintain reliability, manage risk, and control costs. The characteristics of our system, large population, high load density, tremendous infrastructure density, high marginal costs for new infrastructure, and the demand for continuation of our renowned reliability, and increasing customer expectations of excellent engagement present the Companies with technical issues that are unique in New York State and in the industry. These factors, and an increasing focus customer sited technologies, and with our service territories' unique demographic, require us to be at the forefront of developing cutting edge power delivery improvements, development of innovative solutions, and new engagements with clean tech incubators and universities.

The Companies' research program is focused on obtaining the greatest results for challenges unique to the Companies over various product delivery times, addressing current enterprise risks as well as longer term strategic value. The Companies' portfolio balances short term and strategic, as well as balancing a mix of small and large projects.

GOALS AND OBJECTIVES

The electric utility industry is responsible for delivering electricity in a safe, reliable, economic, environmentally sound, and transparent manner and with due consideration to sustainability and the conservation of natural resources. To fulfill this obligation, continuous improvement in every phase of the Companies' operations is required. Success is dependent, to a great extent, on a sound research, development, and demonstration program, with support, advice, and cooperation from our customers, the Companies, government, industry, and other electric utilities.

R&D works to provide technologies that support the long-term sustainability of our businesses. R&D does this by identifying, developing, demonstrating and providing advanced equipment, hardware, software methodologies, analytics, etc. to company operations. R&D's overall role and responsibilities involve formulating and implementing a research program which addresses the strategic and near-term needs of the Companies' electric transmission and distribution (T&D) systems, including building on R&D's work on customer engagement technologies and innovations into our operations, planning, and forecasting capabilities, enhancing system security and resiliency.

The following are guidelines used in establishing the Companies' research programs:

- Develop advanced technologies and analytical techniques to improve efficient, cost-effective, reliable, resilient, safe, maintainable energy delivery, and to extend the operating life of existing company equipment.
- Develop advanced energy systems offering the potential of enabling customers to better manage and reduce their energy costs, while also reducing adverse environmental impact.

- Develop advanced technologies and techniques to increase worker and public safety and improve productivity.
- Develop advanced technologies and techniques to harden the infrastructure of the operating systems against adverse weather and improve cyber and physical security and load and weather forecasting.
- Support environmental research that will aid in operating and planning the electric systems in a cost-effective and environmentally excellent manner.
- Develop and demonstrate new technologies that will permit our customers to use electricity more effectively and economically.
- Assess the merits and feasibility of highly innovative ideas and technologies that could lead to practical solutions, products, and new opportunities for future use on our systems.

ORGANIZATION

Since its formation in 1970, the R&D Department has kept pace with the changing electric utility industry to ensure that continued progress is made in identifying research that will improve service, reducing cost to the consumer and minimizing the environmental impact of supplying adequate amounts of electric power. R&D has aggressively pursued new emerging technologies that improve the Companies' operations, serve our customers, and help create new markets.

R&D operates in a collaborative and transparent environment with a cost-conscious mindset. Our strategy to meet the corporate cultural transformation is:

- We are open, fair, trusted and trusting, internally and externally:
    - Relying on and encouraging the talents of others within the Companies
    - Conducting open discussions at our monthly staff meetings and departmental meetings that are held to address specific issues
    - Conducting timely and frequent outreach activities with internal customers and external stakeholders and technologists.
- Recognizing the substantial interest that customers and other external stakeholders have in every aspect of our business, we affirmatively and successfully engage with customers and external stakeholders in every aspect of our business:
    - Continually learning more about technological innovations in our, and other, industries
    - Benchmarking against utility and non-utility industry leaders
    - Seeking out new ideas across a broad spectrum of different industries, academia, policy-makers, governmental agencies, research consortia, and incubators
- With a cost-conscious mindset, all employees act like business owners
    - Identifying needs of the Companies that may have solutions in R&D
    - Developing and deploying advanced technologies and analytical techniques to meet those needs
    - Developing and deploying advanced technologies to improve worker and public safety

- Developing and deploying advanced technologies to improve company efficiency
- Effectively balancing our portfolio to meet both near term operational needs and longer-term strategic issues
- Working to increase value and leveraging expenditures

Staffing and Departmental Organization

CECONY's R&D Department comprises two major sections: Electric, and Gas & Steam R&D. Personnel in the department come from company operating areas and with external technology experience - with many years of company-specific experience, and from other industries and academia to provide broader experience. Each of our staff seeks to develop extensive internal contacts and a detailed understanding of our business needs, and a philosophy on what constitutes good R&D. Working collaboratively with other groups in the Companies, the staff establishes and implements the R&D program. The support of our internal customers, with their professional staffs and labor forces, helps keep R&D close to their needs and insures that solutions get implemented. Approximately 15% of the Companies' staffing and labor costs on R&D projects are provided by company organizations outside the R&D department. This approach achieves cost savings, provides a customer focus, and maintains program flexibly.

Electric Transmission and Distribution research projects implement new technologies to enhance efficiency, improve safety, improve reliability and operating performance, and extend the useful life of electrical equipment and the mitigation of environmental impacts of this equipment. These projects also support the Companies' Customer Service, Energy Efficiency/Demand Side Management, and Utility of the Future and Distributed Resources Integration organizations by advising, developing and helping to introduce better end-use technologies and by providing the planning tools required to understand and influence electricity usage to benefit the Companies and its customers. Included are R&D activities in the areas of electrical distribution, transmission, substations, power systems planning, operations, energy management and use, and computing applications.

The Technology Transfer program stresses the importance of maximizing return on our investment in research programs. Ideation sessions, Technically Speaking seminars, expanded staff meetings, workshops, status reports, technical publications, research databases, and Corporate Affairs notices keep employees informed about and engaged with new and emerging technologies.

Program Development and Management

CECONY's R&D Department, guided by corporate goals and objectives and in consultation with other company organizations, determines technological R&D needs, develops the R&D portfolio, and establishes programs that implement the plan. Individual projects are funded either solely by the Companies or jointly through various arrangements with federal and state agencies, industry group R&D organizations, technology incubators, other utilities, and manufacturers. With support from engineering and operations personnel, the R&D Department also establishes test sites and demonstration facilities for evaluating new technologies. Once commercial feasibility of a technology is established and demonstrated by adequate field trials, the technology is no longer considered R&D. The R&D Department monitors initial implementation of new technology to ensure that expected benefits are achieved and

potential implementation problems are addressed. It also monitors new technical developments that might be of future benefit to the Companies and customers.

R&D and other personnel in the Companies articulate the needs to steering committees established to advise and direct industry-wide research through the Electric Power Research Institute (EPRI) and other industry consortia.

Project Selection and Management

The process of selecting R&D projects is guided by the experience of the professional staff and the Companies' senior management with input from an array of design and operations workers and managers. The goal is to match the needs of the Companies' operations to opportunities for solutions using advanced technology. The first step is to determine whether the project meets the New York State Public Service Commission's definition of R&D. An analysis of candidate projects is then made, with potential advantages being reviewed against financial resources required for successful development. The probability of achieving commercial success in a reasonable time is also considered, and other R&D activities are reviewed for possible duplications. R&D projects must have a path to likely implementation should they prove viable. Project appropriation requests include milestones for payments, specific metrics used to determine the success of the R&D project as well as an implementation plan defining how the product or process would be integrated into operations if the R&D effort is successful. A cost/benefit analysis is performed, to the extent possible. Qualitative benefits are discussed, and every effort is made to apply quantitative analysis. Emphasis is placed on projects that show near and mid-term benefits, as well as long term programmatic issues that have significant impact on the Companies. This general approach facilitates a comparison of various candidate technologies and aids in project selection and prioritization.

Upon receiving funding approval, a project leader is selected, usually from the corporate area most affected by the research results, such as Electric Operations, Central Engineering, Customer Service, or Environment Health and Safety. The project leader takes responsibility for achieving objectives and facilitates technical coordination between company organizations. The project leader and an R&D engineer share responsibility for administering the project and ensuring that reports are made at appropriate milestones.

The combined experience of the R&D engineer, project leader, and other personnel is a critical factor when developing the field evaluation and demonstration phase that many projects require before moving from the developmental stages to commercially feasible applications.

Technology Transfer

The Companies continue to stress the importance of maximizing return on its investment in research programs. Seminars, workshops, status reports, technical publications and research databases keep employees informed and engaged with new and emerging technologies. Employees participates as advisors to EPRI and have access to internet-based technology libraries, enabling on-line searches of databases that include ongoing research projects, publications, products, experts, and patents. As the program has matured, more individuals throughout the Companies have become aware of research information and products that are of value to them in achieving corporate goals and objectives.

RESEARCH AND DEVELOPMENT PROGRAM

The purpose of the Companies electric R&D program is to develop and demonstrate new processes/methods, technologies, and tools that will improve the electric system as well as its operating and business practices through both an internal program and external industry research organizations. R&D is driven by the goal to provide new technology options to fill near term operational needs and longer term strategic needs of the corporation. The program strives to provide proactive problem solving opportunities that have the potential for making step-changes or even quantum leaps in the way we do business. The near term operational goal is to demonstrate technologies that have been developed and are ready for deployment into the field. The medium term goal is to develop technologies that fill a need, improve performance, or enhance customer experience and the long range goal is to identify new technologies that presently don't exist. Included within this goal are the following general concepts:

- Assess the impact of emerging technologies on business operations, competitiveness and profitability and deliver more innovative products.
- Anticipate changing technology needs driven by our internal business, by external regulation and by our customer needs. Based on these needs, develop and implement plans to bring new technology options to the Companies.
- Establish and maintain relationships, with high-value industry, incubators, and other groups and organizations to maintain contacts, gather strategic information and develop new partners for co-funding of research projects.

R&D pursues these goals and initiatives through a wide variety of external and internal programs and activities.

Collaborative R&D

The Companies continue their commitment to industry-group R&D programs and actively participate in the decision-making process of such national organizations as EPRI, the National Electric Energy Testing, Research & Applications Center (NEETRAC), and the Centre for Energy Advancement through Technological Innovation (CEATI). For projects that are of common interest to the Companies and the industry, particularly on large demonstrations, once the basic research and proof of concept have been completed, the Companies work collaboratively with various utilities, industry, government and private organizations located outside the state or even the nation. The Companies' flexible R&D program allows for reducing the risk associated with initial development of technologies of specific importance to the Companies. Other entities may then be willing to help fund demonstrations of operational systems. The Companies have also found that manufacturers are not willing to undertake technology development on problems that are unique to the Companies unless there is support in the form of funding the basic research and feasibility of proof of concept, and providing a reasonable market for the product. This requires the Companies to fully fund product development or to look for partners with similar needs. Collaborating with other utilities provides both financial leverage and market support. Many partners are outside of New York State and sometimes outside the United States. Collaborative organizations such as EPRI, NEETRAC, and CEATI provide a useful forum to help fund multi-million dollar demonstrations.

The Companies have budgeted $4.1 million in 2019 in support of industry group research. Forms E-1 and E-3 identify the estimated expenditures for industry group R&D programs, as well as the Companies' total expenditures for internal and contractor programs.

General R&D Support

General and administrative R&D support includes those costs relating to research performed by the Companies that is not specific to a program area. Such efforts have widespread application and benefits throughout the Companies and for customers. Other general R&D support includes administrative costs that support research and technical services in all other R&D program areas. R&D has budgeted $2.3 million in 2019 for general and administrative support of the electric R&D program.

2018 R&D Successes

In 2018 R&D's notable successes include:

- Field demonstration and evaluation of Mobile Access Points (MAPs) to mitigate the risk of disruption to the Advanced Metering Infrastructure (AMI) network.
- Installation of substation operations simulator to enhance training and help retain and transfer knowledge.
- Development of a newly designed high-pressure fluid-filled (HPFF) / cross-linked polyethylene (XLPE) cable transition joint for retrofit of existing HPFF cabling system with XLPE.
- Demonstration and evaluation of vented restrained manhole covers designed to safely dissipate the potential energy resulting from an underground secondary event.
- Field demonstration of the use of unmanned aircraft systems (UAS) for storm response.
- Identification and evaluation of Blockchain use cases in a joint study with the other New York State utilities.

Awards

- 2018 saw R&D Champion Award to 1 company employee who furthered the work of R&D.
- One **EPRI Technology Transfer Award** was received by Con Edison Research & Development in collaboration with Distribution Engineering for 2018 work: Mitigation of Underground Structure Events.

2019 Program

The 2019 internal and contractor R&D program is segregated into four (4) sub programs: transmission, distribution, substations, and customer. Program areas of focus, goals and objectives and some of the program elements underway are summarized for each area.

Transmission Program

Goals and Objectives

- Develop replacement options
- Minimize environmental impact of dielectric fluid
- Maximize use of existing facilities

The Transmission research program is directed toward improving the reliability, upgrading the capacity, and extending the life of the Companies' underground and overhead transmission systems. R&D activities in the area of transmission include: developing and testing alternative underground transmission cable technologies, locating disbonded coatings on underground transmission pipes; development of techniques and equipment to expedite detection and location of faults in transmission feeders; examination of the present and expected performance of 138-kV and 345-kV cable systems; and implementation of state-of-the-art sensors, hardware and software, and projects to reduce the impacts of geo- and electromagnetic, and intentional electromagnetic events.

Distribution Program

Goals and Objectives

- Improve worker health and safety
- Reduce Risk
- Increase productivity
- Improve public safety
- Improve asset management
- Enhance system reliability and resiliency
- Enhance the customer experience
- Reduce costs/maintain competitiveness
- Improve data analytics and security

The Distribution R&D program focuses on developing, demonstrating and assisting in the early deployment of new technologies that will improve safety, system reliability and integrity, promote environmental excellence, and reduce costs of construction, maintenance and operation of the distribution systems. R&D activities in the area of distribution include:

- Manhole event mitigation
- Stray voltage detection and mitigation
- Real-time fault location system for primary distribution feeders
- Hardening of infrastructure against adverse weather
- Improved damage assessment systems
- Exploration of partial discharge detection as a diagnostic for incipient failures and other anomalies in distribution cables, joints and transformers
- Advanced development at the Distribution Cable and Joint Cable Center of Excellence located at the Con Edison Van Nest facility, with EPRI, to evaluate existing distribution assets and develop improved technologies, equipment and materials that can be used to replace aging infrastructure

The Distribution R&D program continues participation in **NEETRAC**, an effective venue for collaboration on research, development, prototyping and testing the widening range of technologies and equipment that are becoming possible or are being developed by vendors. Using NEETRAC sustains technology transfer, participates in important standards development activities, and leverages R&D funds via federal and other funding and collaboration with utilities. Participation also enables the Companies to exclusively define the scope and initiate expedited direct-placed projects.

Cable and Joint Center for Excellence is an initiative to support our core wires business, including maintaining reliability and enhancing the workforce. The Center, at CECONY's Van Nest location, has been established to evaluate underground network feeders and develop improved solutions for necessary replacements. The Center consolidated the cable and joint autopsy programs that were previously dispersed among various operating groups. The Center analyzes condition assessment and remaining life techniques to better prioritize replacements and sustain reliable network service.

Substations Program

Goals and Objectives

- Reduce O&M costs
- Maximize use of existing facilities
- Improve safety
- Develop lower-cost, smaller-size, and more efficient, reliable, and environmentally acceptable equipment

The Substation R&D program focuses on reducing the O&M costs of substation equipment and extending the useful life of installed equipment. R&D projects in this area include the demonstration of advanced monitors to assess, both on-line and in real time, the condition (including the operating status) of power transformers, load tap changers and circuit breakers. Utilities in dense urban environment are experiencing increased fault current levels due to additional distributed energy sources as well as systems being operated at higher power levels than in the past. Projects include fault current mitigation technologies, arc flash protection, and sulfur hexafluoride ("SF6") management.

Customer Program

Goals and Objectives

- Improve the customer experience
- Reduce costs/maintain competitiveness
- Integration of data collection

Customer Engagement projects focus on efforts to enhance the customer experience and lower costs. Included are assessments and demonstrations of new technologies that offer improved load control, non-intrusive analysis of customer load patterns, improved interconnection practices, and Distributed Energy Resource ("DER") and Electric Vehicle ("EV") facilitation.

Additional Information

Additional information on the Companies' R&D program may be obtained directly through:

King Look
Director R&D Department
(212) 460-4801
lookk@coned.com

Combined Companies

Form E-1

Research and Development Program Plan Expenditures

($ 000)

	Actual 2018 Expenditures	Estimated Expenditures 2019	2020	2021	2022
1. Total company expenditures for internal and contractor programs					
Administration	2,367	2,306	2,392	2,448	2,510
Transmission/Substation	1,679	1,560	1,555	1,610	1,532
Distribution	592	2,518	2,439	2,440	2,439
Electric Vehicles	25	25	100	30	0
All Other (Common, Customer and Environmental)	345	290	217	186	321
Total Internal and Contractor Programs	**5,008**	**6,699**	**6,703**	**6,714**	**6,802**
2. Company contributions to industry research and development programs					
EPRI	3,445	3,463	3,464	3,467	3,467
CEATI	438	250	250	250	250
NEETRAC	138	132	132	140	140
Other	383	284	279	250	250
Total Industry Group Expend.	**4,404**	**4,129**	**4,125**	**4,107**	**4,107**
Sub-total Electric R&D Expenditures	**9,412**	**10,828**	**10,828**	**10,821**	**10,909**
Less O&R Portion Billable To New Jersey	(169)	(187)	(189)	(190)	(192)
Total New York Electric R&D Expenditures	**9,243**	**10,641**	**10,639**	**10,631**	**10,717**

CECONY R&D Administration & Electric EPRI are shared with with CECONY customers getting 92.45% & Orange and Rockland R&D at a 7.55% rate

Orange and Rockland R&D expenditures are shared 75.42% by New York customers and 24.58% by New Jersey customers

Consolidated Edison Company of New York, Inc.

Form E-1

Research and Development Program Plan Expenditures

($ 000)

	Actual 2018 Expenditures	Estimated Expenditures 2019	2020	2021	2022
1. Total company expenditures for internal and contractor programs					
Administration	2,197	2,132	2,211	2,263	2,320
Transmission/Substation	1,679	1,560	1,555	1,610	1,532
Distribution	441	2,294	2,189	2,190	2,184
Electric Vehicles	0	0	100	30	0
All Other (Common, Customer and Environmental)	345	290	217	186	321
Total Internal and Contractor Programs	**4,662**	**6,276**	**6,272**	**6,279**	**6,357**
2. Company contributions to industry research and development programs					
EPRI	3,185	3,202	3,202	3,205	3,205
CEATI	438	250	250	250	250
NEETRAC	138	132	132	140	140
Other	301	209	204	175	175
Total Industry Group Expend.	**4,062**	**3,793**	**3,788**	**3,770**	**3,770**
Total Electric R&D Expenditures	**8,724**	**10,068**	**10,061**	**10,049**	**10,128**

CECONY R&D Administration & Electric EPRI are shared with with CECONY customers getting 92.45% & Orange and Rockland R&D at a 7.55% rate

Orange and Rockland Utilities, Inc.

Form E-1
Research and Development Program Plan Expenditures

($ 000)

	Actual 2018 Expenditures	Estimated Expenditures 2019	2020	2021	2022
1. Total company expenditures for internal and contractor programs					
Administration	169	174	181	185	189
Distribution	151	224	250	250	255
Electric Vehicles	25	25			
Total Internal and Contractor Programs	**345**	**423**	**431**	**435**	**444**
2. Company contributions to industry research and development programs					
EPRI	260	261	262	262	262
Other	82	75	75	75	75
Total Industry Group Expend.	**342**	**336**	**337**	**337**	**337**
Total Electric R&D Expenditures	**687**	**759**	**768**	**772**	**781**
Total Electric R&D Expenditures - New York	**518**	**573**	**579**	**582**	**589**

Orange and Rockland R&D expenditures are shared 75.42% by New York customers and 24.58% by New Jersey customers

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Administration (Common Distribution 77.60% to Electric)					
Salaries	$1,814	$1,896	$1,952	$2,011	$2,072
Other Expenses	$364	$221	$250	$248	$248
Pilot of IHS Goldfire Semantic Software for Enhancing R&D Knowledge Transfer		$3	$4	$4	$4
Patent Searches in Connection with Company R&D Technology Applications	$189	$186	$186	$186	$186
Subtotal Administration	**$2,367**	**$2,306**	**$2,392**	**$2,448**	**$2,510**
Industry Groups					
EPRI for Electric Distribution	$1,841	$1,622	$1,623	$1,626	$1,626
EPRI for Electric Transmission	$1,605	$1,841	$1,841	$1,841	$1,841
Applications Research - CEATI	$437	$250	$250	$250	$250
Applications Research for Distribution, Substations and Transmission - NEETRAC	$138	$132	$132	$140	$140
Innovation Challenge Pilot	$78	$100	$100	$100	$100
R&D Management Best Practices	$38				
International Utility Work Group Participation	$19	$25	$25	$25	$25
IEEE Xplore Digital Library Access Cost Sharing	$5	$5			
CIGRE Membership	$3	$4	$4		
3G System of the Future Benchmarking		$25	$25		
EPRI/NYSERDA/DOE TRAVEL BY ALL OTHER NON-R&D PERSONNEL	$85	$10	$10	$10	$10
EPRI/NYSERDA/DOE TRAVEL BY SYSTEM & TRANSMISSION OPERATIONS PERSONNEL	$43	$20	$20	$20	$20
EPRI/NYSERDA/DOE TRAVEL BY ENVIRONMENTAL AFFAIRS PERSONNEL	$22	$10	$10	$10	$10
EPRI/NYSERDA/DOE TRAVEL BY Con Ed PDU PERSONNEL	$8	$10	$10	$10	$10
Subtotal Industry Groups	**$4,322**	**$4,054**	**$4,050**	**$4,032**	**$4,032**
In-House Projects					
General Common Projects (Common Distribution 77.60% to Electric)					
EPRI Collaborative Research on Timing Security Assessment and Solutions Phase II	$78				
Evaluation of Stone Wool (Roxul) for Fire Barrier Applications	$47				
Blockchain Technology Consortium	$40				
EPRI Collaborative Research on Industrial Control Systems (ICS)-Penetration Testing (PT)	$30				
Development of Unmanned Aerial Vehicle (UAV) Corporate Response	$30				
Evaluation of Custom Molded Earplugs	$13	$12			
Development of AMI Mobile Access Points (MAPs)	$4				
ICS IDS/IPS (Intrusion Detection/Intrusion Prevention Systems)		$39	$31	$23	
Protections for connected OT assets			$39	$39	
Vendor Cyber Security Risk Assessment			$39	$23	

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
ICS Penetration Testing		$39	$23	$23	
Evaluation of a Wearable Noise Level Awareness Technology		$12			
Evaluation of a posture awareness device		$4			
Evaluation of a Vehicle / Pediastrain Safety device - Smartcone		$66			
Technical Understanding of RFID on Large Metallic Assets		$47			
Evaluation of an asset tracking device that utilizes App. Webbing - The "Tick"		$4			
Develop Weather Prediction Tools with NY State Mesonet		$39	$23	$31	
Off-Grid, Remote Surveillance Solutions			$62	$47	
Subtotal Common	**$242**	**$260**	**$217**	**$186**	**$321**
Transmission					
High Ampacity XPLE Insulated Pipe-Type Cable	$781	$400	$400		
Development of Carbon Fiber Wrap Sleeve	$442				
Disbonded Coating Detection Field Validation	$104	$50	$65	$50	
Development of a Tool to Provide Probabilistic Electrical Forecast	$75				
Evaluation of NDE Methods for Carbon Fiber Wrap Application	$70				
138 kV Transition Joint Qualification Test	$48		$75	$50	
Inspection Plan For Overhead transmission feeders - UAVs demonstration	$34				
Mitigation of GEO and Electro Magnetic Events	$23	$25	$25	$25	
Next Generation for Perfluorocarbon Tracer (PFT)	$16			$100	
Expanded Use of Physical Operating Margin Software	$5				
Long Standoff Magnetomery Corrosion Detection Demonstration	$4				
HPFF Joint casings Corrosion Protection Aging Test	$3				
Optimization of PFT Leak Excavation				$15	
End Wall Corrosion Detection Demonstration		$50	$60	$50	
Dielectric Oil Separator (Oil Release Blocker) Demonstration		$70	$75	$50	
EHV Overhead Feeder Dead End Connector Assessment		$75	$75	$50	
Participation in EPRI "Sunburst 2000" Program Related to Geomagnetically Induced Currents		$30	$30	$30	
Surface Wave Technology for Disbonded Coating Detection on Underground Pipes Feasibility Study				$100	
Disbonded Coating Detection for Underground Pipe Feasibility Study		$65			
EHV Transmission Feeders Insulator Risk Assessment				$25	
Aeolian Vibration Study for EHV Overhead Feeders			$25	$25	
Transmission Manhole Oil Minder		$100	$75	$50	
Overall Inspection Plan for Overhead Transmission Feeders				$50	
Development of Fault Locating Sensor for Underground Dielectric Cabling system		$80	$25	$25	
Identify and Develop PD Measuring Plan for 59th St Aging Hybrid feeders				$25	
Manhole coating inspection Tool				$25	
138 kV HPFF Retrofit Tie Cable In-field Deployment Study		$100	$50	$50	
138 kV HPFF/XLPE Transition Joint Development		$25	$25	$25	
Automated EHV Drone Damage Assessment		$75	$75		
EHV HPFF Cabling System Remaining Life Study				$50	

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
EHV Overhead System Induced Voltage Study		$50	$50	$50	
Oil-filled Cable Leak Blocking Additive		$50	$50	$50	
Carbon Fiber Sleeve Wrap Development		$150	$100		
Carbon Fiber Wrap Long Term Aging Study			$100	$100	
345 kV HPFF Retrofit In-field t Study				$250	
Infrared Leak Locating technology				$50	
Subtotal Transmission	**$1,605**	**$1,395**	**$1,380**	**$1,370**	**$1,292**
Substation					
Demonstration of Battery Monitoring System	$62				
Predictive Field Testing of Vacuum Interruptors	$59				
Demonstration of Cubicle Inspection & Repair Safety Device	$53				
Transmission Modernization Demonstration	$40	$40	$40	$40	
Demonstration of 138 kV MGC Bus System at Elmsford Substation	$32				
Demonstration of Remote BreakerRracking Systems	$18	$125			
Substation Operations Simulator	($190)		$25	$25	
Next Generation Substation Battery Demonstration			$10		
Substation Busbar Rating Upgrade Study			$25	$25	
Predictive Field Testing of Vacuum Interruptors			$75		
Advanced substation projects				$150	
Subtotal Transmission	**$74**	**$165**	**$175**	**$240**	**$240**
Subtotal Transmission & Substation	**$1,679**	**$1,560**	**$1,555**	**$1,610**	**$1,532**
Distribution					
EnerTech Strategic Partnership Program	$126				
Structure Monitoring Device United Instruments	$104				
Manhole Control and Containment for Public Safety	$82	$50	$50	$50	
Structure Observation System - Active Site Monitor User Interface and Response	$78				
Distribution GIS and Grid Model Data Management	$75				
Low Voltage Smart Crab	$67				
Development of Zinc-Birnessite Batteries for Grid Storage	$63				
Study of weather parameters that lead to impactful storm events -> Development of Wind Gust Ensemble Weather Prediction Tool	$61			$60	
Assess Super Capacitor Energy Storage and PV Integration Technology EPRI/NYSERDA	$53				
Self Flush for Service Boxes	$50				
Monitoring of Backfeed Conditions Using Communicating Microprocessor Relays	$50	$50	$60	$30	
Public Safety Equipment Failure Prediction and Prevention Enhancement	$49				
Enhanced Vault Roof & Grating Design Development	$38				
Contact and Stray Voltage Assessment Enhancement-EPRI	$35				
Network Transformer MV Bushing Forensic Failure Analysis	$32				
Underground Splicing Machine Development Phase 2	$30				

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Underground Structure Sand Fill Development to Mitigate Manhole Events	$29	$30	$30	$30	
Develop Weather Impact Model - Weather Forecasting and Outage Prediction Platform	$26	$50	$50		
Development of a Testing Plan for Li-Ion Energy Storage Systems	$23				
Impact Study of Kinetic Energy Release of MH Covers	$23				
15kV 40kA Submersible Vacuum Fault Interrupter with Grounding Position	$18			$60	
Vault Sump Pump Real Time Monitoring Development (RADPAR appd)	$18				
Secondary Reliability Index Optimization Development (RADPAR appd)	$16				
Infrared Secondary Inspection ("ISI")	$13			$50	
Technoeconomic Analysis of Electric Rail Regenerative Braking Benefit to Electric Power System	$11				
Navigating DER Interconnection Standards and Practices (EPRI Supplemental 3002012048)	$10				
Distribution Automation of Network Protectors via DA-Takeout Pilot	$10				
Development of Training Course for Electric Operations in Virtual Reality Environment	$6	$150			
DOE PARC Development of Transensor for Distribution Transformers	$6		$10	$10	
Compact Submersible 25kA Primary Fault Interrupting Switch & Control Cabinet	$5				
Early Summer Load Forecasting Tool	$5				
SERVICE LINK™ APPLICATION FOR METER EXCHANGES	$3				
Structure Monitoring System	$2	$50	$50	$40	
Public Safety Program Cost Benefit Analysis	$2			$20	
Mobile Contact Voltage Detection Development and Demonstration (Narda)	$2	$100	$100		
Underground Conduit Development to Mitigate Manhole Events	$1		$100	$60	
Trial Installation of New Splice Box at TLC	$1				
JSSE Mobile Application	$1	$25			
High Impedance Fault and Arcing Fault Detection on Overhead Distribution Lines	($1)	$50	$50	$30	
Rapid Attack Detection, Isolation and Characterization Systems (RADICS)	($21)		$10	$10	
NYSERDA Micatu Optical Sensors Development for Distribution Systems ($200K from NYSERDA)	($83)		$20	$20	
Random Network Protector Auto-Exercise to mitigate Alive on Backfeeds	($133)				
Arc Fault Detection in Network Protector Relays Field Demonstration	($545)			$20	
EPRI Smart Inverter - Reactive Power Support		$50	$50		
Assessing Augmented Reality for Utility Industry				$60	
Demonstration of Novel Electric Distribution Tools and Equipment		$40	$40	$50	
Demonstrate Manhole Cover Restraint Systems		$25	$25	$10	
Vegetation Management Analytic for Urban Forest to Reduce O&M and Improve Customer Experience		$25			
Enhanced Active Ventilation Debris Mitigation System for Manholes			$10	$25	
Enhanced Pole Design for Mechanical Resiliency During Storms		$20	$10	$30	
Improved PTO Connector for Submersible Network Transformers		$15			
Investigate Network Transformer Bushing Failures and Develop Mitigation Plan		$15			
Develop Enhanced Sensor Suite for Cathodic Protection & Corrosion of Submersible Network Transformers			$25		
Enhanced Coating Development for Submersible Network Equipment				$15	
Next-Generation Network Protector Development and Demonstration				$50	
Computer Vision Analytic Development for Identification and Assessment of Submersible Network Equipment				$45	
Enhanced Miniturized Manhole Vactor Assembly Development		$15			

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Augmented Reality Development to Reduce Cost & Improve Efficiency of Maintenance & Repair of OH Equipment		$10			
Enhanced Low-Cost Sensor Suite for Situational Awareness of Integrity of Overhead Infrastructure				$40	
Computerized Tool to Track Location and Work by Foreign Mutual Assistance Crews				$10	
DOE SHINES				$60	
CO2 Heat Pump Demonstration				$30	
Smart Inverter Study - To Determine Setting Files for Dist Grid Connection		$100	$50		
Obstruction Clearance Using Robotic Technology for Electric Conduit / Ducts		$30	$30	$20	
Demonstration of Safety Tools and Equipment for Electric Operations		$50	$125	$50	
Remote Closing Device for Feeder Reactor Switch				$50	
Remote Manipulator to Safely Cut & Clear Downed Overhead Wires			$30		
Sensored Feeder Cable Accessory Development and Demonstration				$15	
Enhanced Intelligent Compact Low-Cost OH Lateral Fault Isolation			$10	$40	
OMS Enhancement Allowing Direct Functionality from Live Computer Map				$25	
Develop Business Case for Shared Mobile Mutual Assistance for Command, Control & Field Switching		$15		$5	
Develop & Demonstrate Business Case for Vegetation Management QA-QC via Drones				$15	
Network Transformer Dissolved Gas Detector Development		$50			
Sensored Low Voltage Crab Development and Demonstration				$50	
RFID - Relay Breaker Tracking		$40		$0	
Common Information Model development for Enhanced OMS/DMS Integration		$100	$60	$60	
Novel UG Secondary Connector - Melni				$10	
Enhanced Tools and Assemblies Development for Pulling Cable				$10	
Design & Development of Enhanced Rigging Assemblies for Cable Trucks				$25	
Enhanced Network Secondary Cable Fire Rating Development			$40		
Open Mains detector		$30			
Enhanced Auto-Loop		$20	$10		
Phase II - Demonstrate Generlink with AMI Technology in Pilot Study		$100	$100	$75	
Fiber Optic voltage sensor application for 27kV and 13 kV			$30	$30	
Next Generation Underground Sensor System				$50	
Dynamic CVO			$40	$30	
Enhanced Video Alarm				$20	
Performance Evaluation for Vented Restrained Manhole Covers		$50	$20		
Investigate Improvements to Spearing Device		$50			
Evaluation of Illuminated Shunt Boards and Optimal Design		$15			
Vault Grating Redesign to Reduce Risk				$15	
Drone Detection Demonstration				$20	
Near-Real-Time OH Broken Wire Diagnostic Tool Development		$15			
ABF- Islanding system		$65			
Smart Crabs		$75	$75	$50	
Risk Mapping Using Social Media		$50	$40	$50	
Blockchain Evaluation and Demonstration		$150	$150	$100	
Mobile Site Safety Storm Response Team		$20	$30	$20	

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Enhanced Storm Damage Assessment Capture and Analytics Development		$50			
Adaptive Route Selection Analytic for Damage Assessment via Vehicle Street Patrol		$15			
Develop and Demonstrate Business Case for Drone Storm Damage Assessment				$15	
Storm Restoration Work Package Prioritization and Planning Enhancement Development		$50	$45		
Defect Identification of OH lines				$20	
Transportable Energy Storage System (TESS)		$50	$30	$10	
Optimal Rail Energy Recuperation				$50	
Enhanced Communications Development for Near-Real-Time Unit Substation Situational Awareness				$10	
Remote Sensing and Inspection Development for Unit Substation Situational Awareness			$25		
Enhanced Remote Sensing of Unit Substation Batteries				$15	
Enhanced Grid Data Analytics to Reduce Cost and Enhance Customer Experience				$25	
Enhanced Distribution System Sensor Suite, Communications and Computer Intelligence Analytics Development			$50	$50	
Near-Real-Time State Estimation of Low Voltage UG Distributed Network System				$50	
Enhanced Secondary Network Reliability Index Tool Development		$15		$0	
Deep Machine Learning Epidemilogical Analytics Development for a Leading Indicator for Safety Performance			$20		
Advanced Sensing for Network Protector Health Assessment Development				$25	
Intelligent Use of Network Protector Relays in the Emerging Smarter Grid		$25	$50		
Utility Analytics Collaboration		$25	$50	$50	
Regen Braking Pilot Demonstration		$50	$100	$50	
Wide Area Power Grid Distributed Control Project - DOE ENERGISE			$150		
ICS Data Acquisition Using Forensic Techniques		$20	$10	$20	
Collaborative Research on Cyber Combat Simulator (CCOMS)- Phase 0-EPRI		$50	$40	$30	
EPRI ICT 161G (formally Telecomm initiative)		$79	$79		
EPRI Blacksky comms phase II		$40			
Tenant Submetering Pilot				$20	
Thermal Battery Storage Demonstration for Gas Demand Reduction		$30	$10		
Subtotal Distribution	**$441**	**$2,294**	**$2,189**	**$2,190**	**$2,184**
Customer					
Collaborative Research to Advance ANSI CTA-2045	$60				
EPRI Data Center Collaborative	$25				
Pre-Commercial Scale-Up of a Gas Fired Absorption Heat Pump (GAHP)	$10				
ICS Data Acquisition using Forensic Techniques	$7				
EPRI Telecommunications Initiative	$1				
Subtotal Customer	**$103**	**$0**	**$0**	**$0**	**$0**
EH&S					
Virtual Reality Development to Reduce Cost and Improve Safety of Training for Field Switching, Spearing and Fault Locating		$10			
Evaluation of a Lone Worker Safety Device		$20			
Subtotal EH&S	**$0**	**$30**	**$0**	**$0**	**$0**

FORM E-3
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Electric Vehicles					
Evaluate an automated car reservation program for company use - ZipCar ConEd			$50		
Electric bus study				$30	
Electric Vehicle Load Disaggregation			$50		
Subtotal Electric Vehicles	**$0**	**$0**	**$100**	**$30**	**$0**
Subtotal In-House Projects	**$2,465**	**$4,144**	**$4,061**	**$4,016**	**$4,037**
Total CECONY Research & Development Before O&R Proportion for NY Electric/Gas & NJ RECO	**$9,154**	**$10,504**	**$10,504**	**$10,497**	**$10,580**
Total CECONY Research & Development For O&R Proportion for NY Electric/Gas & NJ RECO	($430)	($436)	($443)	($448)	($452)
Total CECONY Research & Development After O&R Proportion for NY Electric/Gas & NJ RECO	**$8,724**	**$10,068**	**$10,061**	**$10,049**	**$10,128**

FORM E-3
Orange & Rockland Utilites (ORU)
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2018 - 2022 (000)

Title	2018 Actual	2019 Estimate	2020 Estimate	2021 Estimate	2022 Estimate
Industry Groups					
Travel	**$82**	**$75**	**$75**	**$75**	**$75**
In-House Projects					
ORU Electric Distribution Volts & Amps Sensors Production testing - Phase III EDVAS	$99	$47			
Participation in ChargEV Coalition	$25	$25			
Driver Risk Management System for Vehicle Fleet Safety - SmartDrive	$21				
ORU - Electric Distribution VA Sensors Production Testing Phase II ver1	$17				
Montvale Shopping Center Reliability Improvement Plan	$8	$40			
SEL-651R Emulation of the Eaton-Cooper Form 6 Recloser	$6	$100			
Monitoring Requirements & State Estimation to Improve Electric Distribution Visibility - EPRI		$38			
Development of Common Information Model (CIM) services for Messaging Bus			$100	$100	$100
Development of Data Analytics and Data Warehousing of Advanced Sensors			$50	$50	$50
Communication and Data Analysis			$75	$75	$75
Distribution System Advanced Integrated Sensors			$25	$25	$30
Subtotal In-House Projects	**$176**	**$250**	**$250**	**$250**	**$255**
Total ORU Research & Development Before CECONY Affiliated Billing (IN) & New Jersey RECO (OUT)	**$258**	**$325**	**$325**	**$325**	**$330**
Total ORU Research & Development Allocated to New York Jersey	($66)	($110)	($111)	($116)	($122)
CECONY Affiliated Billing (7.55% of Administration & Industry - Electric Power Research Institute - EPRI)	$326	$358	$365	$373	$380
Total ORU Research & Development Allocated to New York	**$518**	**$573**	**$579**	**$582**	**$589**

TITLE EPRI - ELECTRIC DISTRIBUTION & TRANSMISSION

CSN Multiple POET Multiple TASK Multiple

PROGRAM AREA Industry Group

DURATION On Going ENGINEER William Fairechio

PROJECT LEAD William Fairechio

AUTHORIZED Annually Funded

Objective

Membership in EPRI research and information programs provides current information on new electric research initiatives.

Benefits

Participation in industry research programs will help identify new technology applications which will aid in meeting corporate goals and surface new research initiatives.

Technical Status

Our 2019 EPRI base portfolio consists of 79 projects and programs. Our investment is focused on four technical areas: transmission & distribution, energy and the environment, generation and cyber security. Funding for our EPRI base program is the largest single item in R&D's budget and we review our investment carefully with our core business customers with an eye to getting the best balance of value and cost. Our portfolio is driven and developed by the following factors:

- Maintaining a balance among internal and industry group projects
- Focusing on core business, i.e. electric T&D, including emerging REV-related, system of the future
- Continued focus in environmental, health and safety developments
- Continuing support for customer innovation
- Enhancing our portfolio in information and communication technology and cyber security
- Staying abreast of state of the art technology developments that help us to operate our T&D system more safely and efficiently

TITLE Applications Research Program - CEATI

CSN Multiple POET Multiple TASK Multiple

PROGRAM AREA Industry Group

DURATION 12/27/2018 to 12/2019

ENGINEER Sergo Sagareli

PROJECT LEAD T. Fredeman, R. Shuman

AUTHORIZED Annually Funded

Objective

Objective of this program is to improve current practices, knowledge and technology used in power transmission and distribution. Con Edison engineers participate in nine interest groups and task forces in CEATI, that cover many aspects of distribution, transmission and substations equipment design, asset management, as well as system operation and planning. On each project there are assigned monitors/advisors to provide feedback and steer research in the direction that will bring most benefits. Project funding is leveraged by cost sharing among companies in the groups. CEATI conducts industry-wide surveys that provide venue for knowledge and best practices sharing among utilities.

Benefits

Participation in CEATI drives enhanced coverage of the important advances in transmission, substation and distribution as well as increases innovation, reduces cost, improves the quality and sharing of knowledge.

Technical Status

Technological innovation and increasing competitiveness of renewable energy resources, combined with aging infrastructure, extreme weather events, and system security and resiliency needs, are leading to significant changes in how electricity is generated, distributed, managed and consumed. The companies are faced with changing regulations, developing technologies, and growing integration of energy and information services driven by the emerging Smart Grid, as well as Reforming the Energy Vision (REV) initiative. As these changes take place, we are challenged to cost-effectively allocate resources, appropriately deploy new technologies, and enhance the capability of our workforce as the changes are taking place. In addition, the need to sustain delivery of energy at lower costs is an overarching goal that must be achieved.

In 2018, CEATI provided 27 deliverables: project final reports, conferences and workshops in 9 Interest Groups that comprised Con Edison's portfolio.

Some examples:

- Conditioned Based Asset Management of Overhead Line Infrastructure-A Probabilistic Framework
- Transmission Line Defect Rating Criteria and Methods
- Prepare Inspection Methods (Visual) for Transmission Line Assets/Components with an Emphasis on Collecting Complete and Accurate Data
- Guidelines for Transmission Line Pole and Tower Steel Capacity Based on Corrosion Degradation

- Standardization of OHTL Inspection Data Collection - Routine Patrols Documentation
- Design Guide for Anti-Cascading Structures
- Impact of Climatological Influences on Overhead Line Design - Phase 1
- Development of a Failure Investigation Protocol and Guidelines for Using Failure Data
- State of the Art Review of Glass Fiber Reinforced Polymer (FRP) Composite Lattice Structures for Transmission Lines
- Submarine Cable Operations and Maintenance Guidelines - Navigational Risk Assessment
- Asset Management Practices for Distribution Utilities
- Grid Modernization Snapshot
- Evaluation of Online Monitoring Technologies for Distribution Assets – Technology Watch
- NERC PRC-005 Best Practices for Compliance
- Translating the Health Index into Probability of Failure
- Voltage Sensitive Load Loss: Guide to Planning Studies and Mitigation Factors

TITLE NEETRAC Applications Research

CSN Multiple POET Multiple TASK Multiple

PROGRAM AREA Industry Group

DURATION 08/16/2018 to 3/2020 ENGINEER Frank Doherty

PROJECT LEAD George Murray

AUTHORIZED Annually Funded

Objective

Continue participation in NEETRAC, and thus help drive innovation, sustain technology transfer, participate in important standards development activities, and leverage R&D expenditures via other utility and governmental funding and collaboration. NEETRAC participation also enables Con Edison to initiate expedited Direct-Placed projects whose focus and scope we exclusively define, as demonstrated recently by important quality assurance analysis provided for a new vendor's 138kV cable for a Rainey to Corona feeder, and forensic failure analysis for 138 kV feeder failures.

Benefits

Due to the broad array of projects, it is not feasible to predict discrete economic benefits; however, one example is instructive - by improving diagnostics and analytics and thereby preventing six network feeder failures, we would more than offset the annual cost of membership. In addition, through this collaboration, Con Edison will help drive innovation in power delivery, smart grid and data analytics domains that are vital to Company sustainability, and to key corporate priorities of Safety, Operational Efficiency and Enhanced Customer Experience.

Technical Status

In Progress - In 2018 we received results of sixteen projects, including: Verification of Wood Pole Diagnostics; UAV Information Exchange; Pole Fire Prevention Techniques; Student Capstone Underground Robot Development Project; Estimating Remaining Cable Life Data Mining & Analysis; Living Library of Water Tree Data; Detailed Thermal Profile of MV Underground Joint; Evaluation of Medium Voltage Underground Joint Connector Test Protocol; Distribution Insulator Polymer Performance Evaluation; Experimental Design for Testing of Wood Crossarms; Arc Proofing Tapes for Cable Test Program; Continuing Evolution of MV Underground Cable Usage; Operating Extruded Distribution Cable Systems at Elevated Temps White Paper; Reconditioning Methods for Steel Utility Structures Scoping Study; Overhead Connector Statistics Analysis; and Thermochromatic Paint Monitoring. The knowledge developed in these project drives innovation here and informs next generation designs and operating procedures. Participation continues in 2019.

TITLE Innovation Challenge Pilot

CSN 90897 POET 22782146 TASK 0001

PROGRAM AREA Industry Group

DURATION 09/19/2017 to 04/2019 ENGINEER Brenda Hill

PROJECT LEAD Waimen Sanchez

AUTHORIZED $155,000 EXP. THROUGH 2018 $78,377

Objective

The project addresses the challenge of effectively managing a more structured ideation process and ultimately encouraging participation in the innovation process. We are accomplishing this by subscribing to and piloting an innovation management software solution. Innovation management software enables the digital management of enterprise innovation, starting from the generation of ideas developed by internal and external sources through multiple stages of evaluation to the selection of top ideas destined for implementation. The initial Ideation Pilot included 1) performing brainstorming sessions with two internal organizations, 2) utilizing software to manage idea voting and team collaboration and 3) prioritizing final ideas selection through an expert review process.

Benefits

The benefit to piloting a new ideation process allows the company to focus on challenges on topics we believe offer the potential of deriving customer value. Challenge questions focused on areas of highest need for customers and R&D customers are aware of the companies' commitment and process to achieve innovative solutions. In addition, this tool broadens participation by using a crowd sourced solicitation process that encourages innovative thinking and promotes an innovative culture beyond traditional R&D customer networks. Lastly, it is an efficient use of everyone's time. By using a stage gate methodology, we quickly and easily filter ideas for relevance and competence, minimizing unproductive interactions internally and externally.

Technical Status

With the advent of the internet and online collaboration, things like intellectual property, organizational boundaries and the identification of new markets has become a much more public and shared experience. The boundaries that once separated different disciplines and organizations is dissolving and innovation is opening up to become a much more collaborative process. As the face of the energy industry changes, utilities more than ever need to leverage knowledge both externally and internally. Con Edison uses this software solution to support a more structured ideation program that would ultimately encourage greater participation across the companies in the ideation and innovation process.

TITLE R&D MANAGEMENT BEST PRACTICES

CSN 92255 POET 10046626 TASK 0036

PROGRAM AREA Industry Group

DURATION 12/14/2011 to 12/2019 ENGINEER Brenda Hill

PROJECT LEAD Brenda Hill

AUTHORIZED $145,000 EXP. THROUGH 2018 $118,000

Objective

The Company is looking for ways to determine the technology management best practices used by other utilities and other industries involved in research and development.

Benefits

The benefits is to have tools available for development and continuous improvement of R&D metric, access to R&D program data of other utilities for comparative analysis, strengthening of our understanding of emerging technologies and a network of peer contacts.

Technical Status

Participated in the Research Technology Management (RTM) Forum, an organization comprised of 12 of the largest utilities in North America. Monthly conference calls and webinars to discuss best practices for technology management within and outside the utility industry.

TITLE International Utility Work Group Participation

CSN 92439 POET 10064342 TASK 0313

PROGRAM AREA Industry Group

DURATION 08/7/2007 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD M. Castoro

AUTHORIZED $420,000 EXP. THROUGH 2018 $340,455

Objective

The International Utility Working Group (IUWG) under the Innovation Group (formerly - 3G System of the Future Program) has a primary goal of benchmarking with dense urban load centers in US, Europe and the Far East.

Benefits

The Group's goals are to identify new technologies and designs that would support future system designs. This working group has already provided technical design input to our transfer switch plans, aided our discussions with the New York City on joint tunnel use and business development planning, and continues to evolve in more specific uses.

Technical Status

The International Utility Working Group (IUWG) meets for an annual benchmarking meeting where 10 utility companies are represented and information is exchanged in an open, productive environment. The 2018 meeting was hosted by SP Group, held in Singapore April 23-27. The sessions included technical, executive and joint sessions, supplemented by guest speakers, and a field visit.

Conference Participants:

- United Kingdom Power Networks (UKPN)
- Tokyo Electric Power Company (TEPCO)
- Singapore Power (SP)
- Shanghai Municipal Electric Power Company (SMEPC)
- Kansai Electric Power Company (KEPCO)
- Enedis (EDF – France)
- Consolidated Edison
- Commonwealth Edison (ComEd)
- China Light and Power (CLP)
- Ausgrid

2018's conference explored a wide variety of topics, ranging from the future of the industry to workplace safety and health practices. Some common themes across the participating utilities dealt with the changing landscape due to increased integration of distributed generation, energy efficiency, customer solutions, and innovation promotion. Utilities are looking for ways to remain competitive while embracing these changes. To continue to compete in this space, utilities are improving the ways in which they engage with their customers. By embracing new technologies, and implementing incentive and community engagement programs, utilities are improving the way they are viewed by the

public.

With a rapidly changing industry landscape, utilities are looking to innovation more seriously than ever. By developing innovative culture with their employees, the companies are finding higher levels of engagement and are pursuing more diverse portfolios of ideas.

In addition to finding new solutions, many companies are focusing on asset management and asset health. Participating utilities are working to develop programs that utilize static and dynamic data to produce real-time monitoring and predictive forecasting.

2018's conference brought about numerous project ideas that the Innovation Group is investigating to determine if they meet our system needs.

TITLE IEEE Xplore Digital Library Access Cost Sharing

CSN 90897 POET 22782146 TASK 0001

PROGRAM AREA Industry Group

DURATION 08/4/2011 to 12/2019 ENGINEER Brenda Hill

PROJECT LEAD Brenda Hill

AUTHORIZED $15,000 EXP. THROUGH 2018 $10,000

Objective

The Company is looking for ways to determine the technology management best practices used by other utilities and other industries involved in research and development.

Benefits

The benefits is to have tools available for development and continuous improvement of R&D metric, access to R&D program data of other utilities for comparative analysis, strengthening of our understanding of emerging technologies and a network of peer contacts.

Technical Status

Username and password provided to R&D staff for access to IEEE Xplore electronic library.

TITLE CIGRE Membership

CSN 14106 POET 20829413 TASK 0001

PROGRAM AREA Industry Group

DURATION 02/21/2014 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD Bill Winters

AUTHORIZED $15,000 EXP. THROUGH 2018 $12,500

Objective

CIGRE aims to:

- Allow engineers and specialists from all around the world to exchange information and enhance their knowledge related to power systems.
- Add value to the knowledge and information exchanged by synthesizing state- of-the-art world practices.
- Make the synthesis of CIGRE's work available to the decision-makers of the industry (CEOs, directors, managers, and regulators).

Benefits

Access to knowledge and information on most recent developments in the state of the art and technical literature through:

- CIGRE e-library: technical brochures, scientific papers, symposia proceedings and other technical papers;
- CIGRE bi-monthly magazine Electra and monthly newsletter;
- Participation in CIGRE sessions, symposia, colloquia and Working Groups (WG).

Technical Status

The International Council on Large Electric Systems (in French: Conseil International des Grands Réseaux Electriques or CIGRÉ) is one of the world’s most authoritative professional organizations in the field of large power systems, since it was founded in Paris, France in 1921. CIGRE membership consists of international experts and leading organizations who exchange knowledge, share best practices and join forces for the Power System of Today and Tomorrow.

TITLE EPRI - Collaborative Research on Timing Security Assessment and Solutions Phase II

CSN 90988 POET 23553958 TASK 0001

PROGRAM AREA Common - E. H. & S.

DURATION 12/12/2018 to 12/31/2020 ENGINEER Serena Lee

PROJECT LEAD William Vesely

AUTHORIZED $100,000 EXP. THROUGH 2018 $100,000

Objective

This project focuses on security challenges that affect multiple operational domains; such as generation, transmission, and distribution systems. Specifically, this project is to address GPS (Global Positioning System) and Time Synchronization vulnerabilities that impact power, control, and telecommunication systems and networks. This would include identifying and prioritizing sites and systems to continue testing and pilot mitigation methods to aid in the protection of power, control, and telecommunication systems that directly impact reliability and safety.

Benefits

This research project is intended to research and test potential mitigations and solutions that address malicious GPS / time synchronization attacks to power, control, and telecommunications systems. Quantitative benefits cannot be determined at this point since it is the monetary value of disruption of services to customers. Results of this project will inform potential mitigation measures and solutions.

Technical Status

In 2018, Phase I of this project is complete. EPRI has evaluated seven (7) GPS clocks for GPS vulnerabilities, the downstream effect to GPS vulnerabilities for applications related to transmission protection relays, communications and monitoring. EPRI has presented the results via technology transfer presentation in December 2018. In 2019, EPRI is planning to deliver the project report and move into planning of activities related to phase II of this project.

TITLE Evaluation of Stone Wool (Roxul) for Fire Barrier Applications

CSN 90899 POET 22834142 TASK 0001

PROGRAM AREA Common - E. H. & S.

DURATION 10/17/2017 to 04/2019 ENGINEER Steve Labudzinski

PROJECT LEAD Troy Evans

AUTHORIZED $50,000 EXP. THROUGH 2018 $61,636

Objective

The objective of this project is to evaluate a new fire barrier material called Roxul made of stone wool that meets fire code requirements(FDNY). The plan is to design and build a fire protection barrier using Roxul in Van Nest for the storage of gas cylinders adjacent to a building or structure in order to avoid the need to construct a structure with a 2 hr fire rated wall.

Benefits

The benefits to the company are costs savings associated with compliance to new FDNY regulations. The purchase of pre-fab structure or construction of a building is estimated to $190K to $300K, respectively. Modifying the current structure is estimated at $50K. It also offers a qualitative benefit of enabling the Company to comply quickly with new FDNY regulations. The Company has other locations that have similar circumstances.

Technical Status

The cage used for the storage of flammable gases in the Van Nest yard was deteriorating due to weathering and needed to be replaced. A new gas cylinder storage structure using Roxul has been completed and is awaiting FDNY inspection. The project is considered complete and no additional funding has been requested. The only remaining action item is the inspection which will determine the benefit of using Roxul for fire safety use.

TITLE Blockchain Technology Consortium

CSN 90788 POET 22736431 TASK 0001

PROGRAM AREA Common - Technology

DURATION 08/23/2017 to 12/2019 ENGINEER Steven Go

PROJECT LEAD Joseph Nogan

AUTHORIZED $85,000 EXP. THROUGH 2018 $51,411

Objective

This project aims to build the underpinnings of blockchain technology for New York's Utilities. The project will allow the Utilities to get familiar with the functionality of this technology and its application in the energy sector. The work plan we have identified three phases, phase A - education, opportunity, identification and alignment on blockchain, phase B - use case proof of concept(s) and phase C - field trial of blockchain use case(s). By year end of 2018, we completed four steps in phase A and aimed to start phase B. Throughout these steps, we created a collaborative and educational experience by facilitating effective communication between stakeholders. The team will continue to host virtual and in person stand up meetings and maintain a project wiki (an information sharing tool that is accessible by consortium members) with essential functional and technical resources.

Benefits

Blockchain may provide an opportunity to transform some existing utility processes. For example, beyond the much-talked-about applications behind the meter, utilities may be able to leverage this technology for supply chain, asset management and organizational performance applications. There will be areas where blockchain has limited-to-no impact, whereas for other areas, the technology may support and make existing processes more robust and efficient, for other areas, however, may experience some level of disruption such as forced technology adaptions. Overall, we hypothesize that the potential benefits for Utilities include reducing transaction times from days to near real-time, removing overhead intermediaries and reducing risk due to tampering and fraud.

Technical Status

New York's Utilities created a joint effort to learn more about blockchain technology, understand its potential, and identify how they may be able to harness benefits across their respective organizations and customer groups. The potential of blockchain in the energy and utilities industry could be transformative. Over the past 24 months, a host of utilities engaged with the technology and launched pilots. By beginning to interact with the technology now, New York's Utilities will understand the true impact of blockchain across their jurisdiction and where this technology may both support and disrupt utility processes and functions. Throughout phase A, the team identified eight use cases which were prioritized by highest potential impact to the electric utility industry. Within these eight use cases, the team will identify a customer-centric use case to conduct a Prove of Concept (PoC) experiment. The expected deliverables will be 1) a value statement and high-level business case with market potential, 2) business requirements for selected use case and, 3) Request for Proposal (RFP) documentation. Upon completion, we expect to provide a value proposition and business rationale for blockchain technology.

TITLE EPRI Collaborative Research on Industrial Control Systems (ICS)-Penetration Testing (PT)

CSN 90915 POET 23235806 TASK 0001

PROGRAM AREA Common - E. H. & S.

DURATION 05/31/2018 to 12/2019 ENGINEER Serena Lee

PROJECT LEAD Steve Kim

AUTHORIZED $40,000 EXP. THROUGH 2018 $40,000

Objective

This project will exercise available penetration testing tools and techniques on ICS system to transfer knowledge from industry experts to organizations responsible for the resiliency and secure service delivery. Use of existing tools, in operational ICS environments, to identify and exploit known and new vulnerabilities will provide needed insight to individuals specifically tasked with system operations. Guidance that utilities can use to exercise penetration testing respective of their various organizational needs will be developed and shared with the community at large. This guidance will assist Utilities penetration testing operations to detect potential threats and vulnerabilities.

Benefits

The project will provide tools and techniques that can be used in the event of cyber incidents perpetrated against ICS deployments. This project will identify new vulnerabilities, and means of exploitation, specific to equipment, deployed in ICS environments providing insights that systems operators can utilized to better secure new and existing deployments.

Technical Status

The ICS Penetration Testing supplemental project continues to progress. We have performed a variety Attack methods against a selection of equipment. For example, some more traditional penetration testing has been performed on certain devices looking to exploit some older dependencies in their firmware package. Some work has also been performed looking at the firmware for certain devices to see what can be learned about the underlying system of the devices from the firmware. In addition to internal efforts, we have been working to put a third party service under contract to deep dive into some of these systems as well. The penetration testing efforts have been in parallel to the training efforts that were kicked off with training in August. Based on some feedback from members new training opportunities are being explored as a possible effort in 2019 as well.

TITLE Development of Unmanned Aerial Vehicle (UAV) Corporate Response

CSN 90905 POET 23186497 TASK 0001

PROGRAM AREA Common - E. H. & S.

DURATION 04/6/2018 to 05/2020 ENGINEER Jade Wong

PROJECT LEAD Diparchi Patel

AUTHORIZED $140,000 EXP. THROUGH 2018 $38,750

Objective

Prior to moving into operational phase, it is important to establish standardized procedures and protocols governing the use of UAV for safety and compliance with the government regulations. The Corporate Procedures need to include UAV integration plan and program launch guide leveraging industry best practices for central governance and operational oversight. The expertise and knowledge based provided by the consultants will serve as a resource in successful implementation of the UAV program.

The deliverables include the following:

- UAV Safety Procedures that promote safe, efficient and lawful operation of UAV within Con Edison system, regardless of the nature of the mission.
- Detailed Flight Operations Manual and Standard Procedures (recommending the best UAV practices and required specifications for) outlining the entire UAV operational workflow from initial planning of field activities through extracting data.
- Guidance document for vendor selection (vetting criteria); equipment purchase and procurement process; UAV insurance requirement, qualifications for the contractor pilots (minimum work experience)
- Data management manual (data storage, sharing and analysis platforms)
- Recommendations on industry best practices for community outreach programs (notification to customers prior to flight operations)
- Policy to restrict access to the drone to ensure operational compliance

Benefits

The March 2018 post storm and blue sky damage assessment exercise demonstrated the effectiveness of employing UAVs for storm damage assessment.

Technical

UAVs are helping electric utilities maintain and inspect their critical infrastructure safely and quickly. UAV technology is recognized as a potential tool to improve safety, reliability and advance operational excellence by most utilities. Con Edison requires aviation expertise and services of consultant to develop a safe and sustainable UAV program in compliance with latest regulations for system wide UAV integration/implementation. These procedures will cover all UAV operations conducted on behalf of Con Edison, whether our internal employees or a commercial vendor. Operating requirements may vary from business to business and for each mission type; therefore UAV policies will be flexible and comprehensive enough to meet current and future use of UAV technology.

TITLE Evaluation of Custom Molded Earplugs for Hearing Conservation

CSN 90923 POET 23293646 TASK 0001

PROGRAM AREA Common - E. H. & S.

DURATION 07/03/2018 to 05/2019 ENGINEER Steve Labudzinski

PROJECT LEAD Prakash Kothari

AUTHORIZED $17,000 EXP. THROUGH 2018 $17,130

Objective

This project evaluates custom molded earplugs, manufactured to fit individual ears based on the ear's imprint, which provides repeatable performance, consistent protection and increased comfort for longer periods of time for employees working in noise exposure areas. In addition, these earplugs have the capability to be fitted with a variety of filters which have the ability to customize the level of protection. Employees who wear disposable ear plugs or ear muffs will evaluate the earplugs and provide user feedback of proper fit. This project may also evaluate different filter types when appropriate.

Benefits

The benefits are both quantitative and qualitative. Each employee has the potential to experience hearing loss due to noise exposure at the workplace. The qualitative benefit of utilizing custom molded earplugs protects our employees from high noise levels is instance of employees not complying with the requirement to use hearing protection may decrease by making them more comfortable. In addition, custom molded earplugs can be made to fit any ear, including those with unusual shapes due to birth trauma, disease, or surgery, whereas disposable earplugs are designed for normally shaped pinnae and ear canals. The quantifiable benefit is potentially a decrease in OSHA recordable hearing loss cases. In addition, 33 employees experienced an OSHA recordable hearing loss case in 2017. The use of molded ear plugs would reduce hearing loss cases.

Technical Status

Employees work in an environment where noise levels are constantly changing (traffic noise, tool use, emergencies, etc.). In these work environments, employees need to communicate with others while the noise levels fluctuate between safe and unsafe levels. When wearing standard hearing protectors (i.e. foam earplugs, ear muffs, etc.), employees may need to remove their protective device in order to hear a colleague and this may expose them to the noise hazard(s). The custom molded earplugs have a filter to remove high frequency noise enabling coworker communication without removal of the plugs. In addition, the standard foam earplugs (disposables) are uncomfortable for some to wear, resulting in ear pain and headache. Currently the custom molded earplugs are being field evaluated. The initial response from the pilot trials is positive with participants saying the earplugs are comfortable and worn routinely for long periods without the plugs popping out. A decision will be made whether to expand the pilot to other groups.

TITLE Development of AMI Mobile Access Points (MAPs)

CSN 90901 POET 22815920 TASK 0001

PROGRAM AREA Common - Technology

DURATION 10/3/2017 to 04/2018 ENGINEER Steve Labudzinski

PROJECT LEAD Joseph Venezia

AUTHORIZED $30,000 EXP. THROUGH 2018 $21,863

Objective

The availability of alternative equipment to provide a temporary Mobile Access Points (MAPs) will mitigate the risk of disruption to the AMI network. Mobile Access Points (MAPs) will enable continuation of AMI related services while restoration is in progress. This will impact restoration priority and allow for operational flexibility. Having a MAP will also serve the purpose of siting new Access Points (APs) by determining the optimum location for a permanent AP. The objective is to identify and work with a vendor(s) to design and build a prototype AMI MAP. The prototype will meet our specifications and defined requirements. The project plan is to field evaluate the prototype MAP for a minimal of 6 months and if the prototype is determined to be useful and used, it will be capitalized.

Benefits

The availability of alternative equipment like MAPs that enable continuation of AMI related services while restoration is in progress will impact restoration priority. If a utility can deploy MAPs that enable the continuation of AMI related services while restoration is in progress, the restoration of the permanent AMI infrastructure could be moved down the priority list. This allows work crews to focus their efforts on priority areas without sacrificing AMI related capabilities, including those capabilities that could prove useful during or just after an incident.

Technical Status

The company is deploying AMI technology as part of its infrastructure and technology enhancement. The AMI network utilizes APs that AMI devices such as meters and field sensors communicate through. APs are powered by a secondary connection from the electric distribution system leaving it vulnerable to loss of power from events such as large storms that may cause wide-spread AMI network outages. Outages may impact network coverage that can result in low visibility of meters and sensors. Loss of communication through an AP during a storm recovery effort may result in loss of system insight required by the Incident Commander to understand the extent of damage to the grid and the progress of restoration efforts. A prototype MAP has been built and field tested successfully. The plan is to build more units to support our AMI infrastructure as the project is considered complete.

TITLE High Ampacity XLPE Insulated Pipe-Type Cable

CSN 90569 POET 22328231 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 11/28/2016 to 12/2019 ENGINEER Jade Wong

PROJECT LEAD Michael Buckweitz

AUTHORIZED $3,071,000 EXP. THROUGH 2018 $2,451,567

Objective

The objective is to qualify the design of a new XLPE insulated EHV cable system and a HPFF to XLPE transition joint.

- Task 1 - Manufacture a preliminary cable design to confirm low loss operating characteristics of the design, and the mechanical pulling properties of the cable in a 10" pipe. Include also a high voltage tests on the cable to confirm suitability of the high stress insulation design.
- Task 2 - Manufacture and test the final cable design as per above. The cable design will include an overall foil laminate moisture barrier over the 3-core XLPE cable assembly.
- Task 3 - Installation simulation test in steel pipe with bends.
- Task 4 - Straight joint installation demo in manhole.
- Task 5 - Design, manufacture, and electric type tests on straight through joint and three core cable system in mock up manhole
- Task 6 - Design, manufacture, and electrical type test on transition joint for HPFF and three-core XLPE cable system including fault current withstand test.

Benefits

The elimination of dielectric fluid leaks to the environment and reduction in Company maintenance and repair needs. Increased transmission system reliability due to reduced feeder outages.

Technical Status

Con Edison has approx. 700 miles of underground High Pressure Fluid Filled (HPFF) transmission feeders. Many of these feeders, particularly at the 345 kV level, are also force cooled for increased current capacity. Most of the HPFF feeders have been in services for more than 50 years and over the years, dielectric fluid leaks have materialized on the pipes due to corrosion effects caused largely by disbonded coating. When the pipe coating does not adhere to the surface of the pipe, as in disbonded coating, water penetrates at the interface and galvanic corrosion of the pipe ensues. This condition is one that cannot be effectively overcome by the application of additional cathodic protection. Currently, the Company is actively recoating pipes in some of the most problematic areas as an interim measure, but long range, this option would be expensive. Increasing dielectric oil leaks and repair maintenance costs of the aging 345kV HPFF cable feeders in particular, warrants investigations into novel solutions. The project is assisting asset management and the environmental groups in addressing these issues. The project will develop an oil/water free EHV cable system to retrofit the deteriorated HPFF transmission feeders to eliminate feeder dielectric fluid leaks. The new feeders will consist of XLPE insulated cables in lieu of the oil filled cables while taking advantage of the existing 10" steel pipes to serve as a cable conduit and thus eliminating dielectric fluid leaks. We had started the manufacturing of

the prototype cable with aluminum foil laminating process. In Nov 2017 we had completed project milestone 1/ design and manufacturing a low loss XLPE insulated cable in pipe, preformed the high voltage electrical testing to confirm the cable's high stress insulation and low loss design, the result rating is 1350 amp which meets 90% of current EHV forced cooled rating. In Oct 2018 we had completed project milestone 2 – demonstration of cable pulling in multiple bend environment; and milestone 3 – design, develop, and installation of regular straight joint in a standard Con Edison transmission manhole. The milestone 4 – electrical qualification of straight joint and milestone 5 – electrical qualification of transition joint are scheduled for Q3 and Q4 2019.

TITLE Development of Carbon Fiber Wrap Sleeve

CSN 90938 POET 23339652 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 07/30/2018 to 10/2019 ENGINEER Jade Wong

PROJECT LEAD M. John Constable

AUTHORIZED $350,000 EXP. THROUGH 2018 $442,305

Objective

A new design concept using factory pre-made Carbon Fiber Wrap (CFW) Sleeve is being developed to replace the manually intrusive CFW repair process for dielectric fluid leak in underground High Pressure Fluid-Filled Transmission (HPFF) pipes in high stray voltage areas. The objective is to improve quality, reduce the unit cost of the manual process, minimize workmanship defects through automation, and increase production. This process will be installed on straight lengths of pipe, using the original carbon fiber wrap application on barrels, and other pipe fittings. The new design involves manufacturing molded carbon fiber split sleeves similar to the repair barrels without the curved end cap ends, and end clamps. The end clamps will be installed at the start and end of the sleeve application, and the sleeves installed between the end clamps in two layers. Once the clamps and sleeves are installed, a vacuum will be drawn on the assembly filling any air gaps between the layers. During installation of the clamps/sleeves a visual quality control will be performed with minimal material sampling, and adhesion testing as required.

1. Document the research, development, and testing process for 3rd party verification and certification (EPRI and ASME).
2. Design and fabricate molds for the 5"" and 10"" diameter pipes. Molds will be fabricated at Van Nest Shops to reduce project cost using internal resources.
3. Develop and test for the sleeve design from initial concept through production.
4. Vendor certification process to qualify vendors to install the new sleeve design, in addition to using the manual wrapping process on custom or barrel sections of piping.
5. Comprehensive training module which will include presentation material, and online video tutorials for field support/refresher prior to any application.
6. A field repair package and tool, including materials, instructions, and documentation for certified personnel to perform a custom repair on a pipe encapsulated with carbon fiber.
7. A third party test plan, which including vendor identifying to test composite material and steel in a corrosive environment, when exposed to stray currents protected by cathodic protection system.
8. Develop and validate nondestructive techniques for sleeve manufacturing and field installation.

Benefits

The unit cost per trench foot is approximately $5,000 per trench foot using the current carbon fiber wrapping process, which require multiple layers to be wrapped and a thorough quality control process to maintain workmanship and system. The new sleeve design shifts most of the field workmanship concerns to the factory production where quality control can be closely managed, maximizing quality and production. Field installation and assemble of the molded sleeves and end clamps will be at a lower unit cost than manual wrapping of the pipes.

Technical Status

The HPFF pipe type, electrical transmission feeders have been in service for over 40 years and the protective coal tar coating is severely degraded. This degraded coating causes external corrosion of the pipe, dielectric fluid leaks to the environment, and excessive consumption of cathodic protection current. This corrosion damage is further aggravated by the stray current and cyclic stresses from nearby subway system. The current repair method to mitigate corrosion and dielectric fluid leaks on the feeder pipes requires total abatement of the asbestos containing coal tar coating and welding a split barrels over the existing leak. This repair process is intrusive and considered a high hazard since the work is performed while the feeders are pressurized and energized. Prototype of the Carbon Fiber Sleeve was completed on Q4 2018. The hydrostatic test is scheduled for Q1 2019, electrical and heat transfer test are scheduled for Q2 2019. In addition, the study of rating impact and study of cathodic protection impact by CFW Sleeve are scheduled for completion in Q2 2019 and Q3 2020 respectively. The project expense will be adjusted pending partial capitalization.

TITLE Disbonded Coating Detection Field Validation

CSN 90668 POET 22363074 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 12/20/2016 to 12/2019 ENGINEER Jade Wong

PROJECT LEAD Mark Bauer

AUTHORIZED $245,000 EXP. THROUGH 2018 $218,779

Objective

The objective is to demonstrate and validate using the AC variable impedance methodology to detect coating anomalies on buried pipes.

- Task 1 Selecting pipelines and determining hardware set up in field conditions.
- Task 2 Testing, calibrating, and establishing essential parameters in field or large scale conditions; using pipe with no failures as a baseline and testing pipe that contains disbonded coating failures.
- Task 3 Issuing field test report.

Benefits

Based on this project, Transmission Operations can perform proactive leak repair instead of emergency repair. We can avoid the emergency response and remediation process should a dielectric fluid leak occur.

Technical Status

Various High Pressure Fluid-Filled (HPFF) feeders on the Con Edison Transmission System, especially feeders M51-M52 and 18001-02 have experienced dielectric fluid leaks that were caused by the shielding effect of disbonded coating on the pipe. When the coating is not adhered to the surface of the pipe, water can penetrate under it and support galvanic corrosion of the pipe surface. This condition is one that cannot be overcome by the application of cathodic protection because the coating prevents cathodic protection current from reaching the pipe surface. Disbonded coating has occurred on pipes that were coated with coal tar enamel or somatic (asphalt) coating. Since the 1980's, Con Edison has been using extruded polyolefin coating which has not developed similar problems to date. In 2017, we had completed disbonded coating testing for five spans of underground HPFF feeders and completed result validation for one span and received good result. The validation requires detail and extensive construction package for excavation. In 2018 we had completed and successfully validated the detection model for extruded polyolefin coating for feeders M51-M52 on Harlem River Drive. In addition, we discovered stray voltage on the underground buried pipe which led to rapid corrosion on the pipe. In 2019 we plan to validate the detection model for West End Ave span for feeders M51-M52. We also plan to develop and install real time stray voltage sensor for underground pipe in Q2 2019.

TITLE Probabilistic Electric Load Forecast Model

CSN 99871 POET 21713555 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 10/20/2015 to 12/2020 ENGINEER Constantine Spanos

PROJECT LEAD Brian Cerruti

AUTHORIZED $90,000 EXP. THROUGH 2018 $75,280

Objective

Often decisions are made based on single value forecasts, which fail to expose the risks inherent in commodity load forecasting. Uncertainty analysis is currently lacking in the load forecast infrastructure. The project looks to build a Probabilistic Load Forecast Model that can account for both sources of uncertainty in load forecasting (day-to-day weather variability and the weather to load uncertainty) to objectively assess uncertainty in the load forecast. Investigate methods to incorporate Probabilistic Load Model output into operations.

Benefits

The probabilistic load forecasting tool can provide two primary benefits:

1. First, the tool provides guidance on the system load for fuel purchases two days ahead, offsetting potential costs that may result from purchasing too little or too much fuel.
2. Second, the tool provides guidance to electric operations at the distribution level in staffing levels, planning system work, and deploying equipment to the field. As such, a better understanding of the load forecast can provide cost savings to electric operations (for example, by minimizing unnecessary overtime costs), and it can also improve system reliability.

Technical Status

The below tasks have been accomplished for the project

Tasks (checked boxes are completed):

- ☒ Vendor to build an Electric Load Forecast Model.
- ☒ Apply Electric Load Forecast Model to a variety of Numerical Weather Prediction model outputs.
- ☒ Transform load forecasts into a probabilistic load forecast using a Root Mean Squared Error approach.
- ☐ Use output of model to modify decision support tools on the existing vendor provided load forecast web portal (Examples of decision support are the ability to assess the probability of exceeding a given load or Temperature Variable value over the next seven days and the capability to view the objective spread in possible load outcomes).

TITLE Evaluation of NDE Methods for Carbon Fiber Wrap Application

CSN 90541 POET 22933777 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 11/30/2017 to 06/2020 ENGINEER Jade Wong

PROJECT LEAD Vijay Srinivasan

AUTHORIZED $135,000 EXP. THROUGH 2018 $114,180

Objective

In Phase 1, screen a wide range of nondestructive evaluation (NDE) methods at many different labs. In preparation for that, Central Engineering fabricated eight specimens with defects of various sizes in various locations. We plan to evaluate only methods that can be implemented in NYC streets where these wraps may be taking place. Phase 1 is expected to be completed in 12 months starting Q1 2019. If successful, we will start Phase 2 to develop and implement field ready instruments in Q1 2020. Field ready instruments will be used as a quality control check shortly after the wrap is complete, and used in all future wraps. Methods to be tested include high frequency eddy current, laser shearography, microwave, millimeter wave, infrared thermography and multiple ultrasonic techniques.

Benefits

Identification of potentially successful method(s) would provide a pathway to field implementation of a reliable quality control check that can be performed shortly after wrapping process is completed.

Technical Status

Con Edison's transmission system is comprised mainly of underground High Pressure Fluid-Filled (HPFF) system. Dielectric oil leaks from underground steel pipes occur as a result of corrosion on the pipes. Carbon Fiber Wraps is being studied as an alternate ways to provide a rapid pipe repair solution. Methods of locating and sizing defects in carbon fiber composite wraps on steel pipe is still under development. Electric Operations and Mechanical Engineering are working on an ultrasonic method, but it is does not have the capability to analyze areas that are not in intimate contact with the steel. We plan to evaluate and establish a NDE method that can be implemented in NYC streets for buried pipes with carbon fiber wrap repair. The research work has been started with Michigan State University and scheduled completion date is Q4 2019.

TITLE 138 kV Transition Joint Qualification Test

CSN 90778 POET 22671523 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 07/10/2017 to 08/2018 ENGINEER Jade Wong

PROJECT LEAD Arie Makovoz

AUTHORIZED $145,000 EXP. THROUGH 2018 $122,060

Objective

Phase 1 Design and manufacture of prototype HPFF/XLPE cable transition joint. Phase 2 Perform electrical design tests on prototype transition joint in a laboratory setting, simulating actual field conditions. The goal is to determine the detectability of failure conditions and failure mechanism on the designed transition joint. Manufacture proposed transition joint and perform Qualification Test at a third party laboratory with simulation of actual field conditions. The transition joint will be subjected to tests that include, but are not limited to:

a) Partial Discharge test
b) Tangent Delta measurement
c) Heating cycle voltage test
d) DC withstand test
e) Impulse test
f) Power frequency voltage test

The transition joint will undergo extensive analysis and examination as part of the qualification testing procedure and will be dissected upon completion of all tests. Final test report and dissection analysis will be provided to for Con Edison review and comments.

Benefit

The main benefit of this initiative is reliability enhancements of our transmission system and environmental excellence. Potential benefits expected from this pilot demonstration include elimination of dielectric oil leaks which result in significant reduction in the operation and maintenance cost, provide an alternate supplier results in greater flexibility in the Company's strategic options; effective resource allocation, and increased customer satisfaction.

Technical Status

The Con Edison power transmission system is mainly built on High-Pressure Fluid Filled (HPFF) cable circuits. Approximately 575 miles out of a total of 690 miles of underground transmission cables are HPFF. The average age of these underground cable systems is about 47 years. The oldest feeders currently in service are around 70 years old. HPFF transmission feeders are a critical component of our electric system. They are composed of many cable sections connected by splices (joints) in underground manholes. Failures in these joints can cause extensive and expensive service outages and repairs. Additionally, only one supplier of HPFF pipe-type cables exists in the world today. Consequentially, HPFF cable replacement is not always a feasible option when performing cable restoration. To counter, in a cost-effective manner, the inevitable repairs that are required of pipe-type systems, transition joint between HPFF and XLPE cables is essential. For this reason, this joint must be

available upon demand. It is necessary to design and implement this type of transition joint to maintain the reliability of the Con Edison power delivery system. Additionally, such a venture would result in fewer cost expenditures for maintenance and/or installation of increasingly limited supply HPFF pipe-type cables. In 2017, Con Edison was working with two different manufacturers on the 138 kV transition joints development. The first manufacturer had failed twice in the electrical qualification test in North America's laboratory and decided to re-design with different material and move the testing facility to Europe and third qualification test failed in Q3 2018. Fourth qualification test is scheduled for Q2 2019. The second manufacturer had successful passed the qualification test in Q4 2018. This project is scheduled to be closed out in Q1 2019.

TITLE Inspection Plan for Overhead Transmission Feeders - UAVs Demonstration

CSN 99914 POET 21525566 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 06/23/2015 to 12/2019 ENGINEER Jade Wong

PROJECT LEAD Frank Mangiamele

AUTHORIZED $150,000 EXP. THROUGH 2018 $112,826

Objective

UAVs demonstration near Pleasant Valley Substation, Farmer Field Road:

- Task A. Replica of Transmission Tower Inspection using real time HD still and video
- Task B. Replica of Transmission Line Inspection using thermal sensor imagery, real time HD still, and video
- Task C. Light Detection and Ranging (LiDAR) demonstration for vegetation management and right – of-way inspection
- Task D. Setup the UAVs program for Con Edison Transmission Line Maintenance (TLM) group maintenance
- Task E. Setup the UAVs program for engineering's LiDAR and thermal sensor
- Task F. Setup the UAVs training program for TLM member to prepare for 2016 readiness

Benefits

1. The first major benefit is the accuracy of the mandated maintenance of overhead transmission structure
2. The second major benefit is enhanced safety for TLM member

Technical Status

Unmanned aerial vehicle system (UAVs) technology can be used to improve electric utility operations for both planned and emergency work. This R&D project is studying the benefits and advantages, both operational and economic, of using UAV technology for TLM and Engineering when coupled with different monitoring and recording technologies. The UAV equipment will be up-fitted with sensing or detecting devices such as digital cameras or LiDAR sensors to inspect electric utility structure and transit the data to a computer in real time for immediate processing. The study of the capabilities and use of UAVs for TLM operations will demonstrate how safety can be enhanced, both for utility workers and the general public when compared to manned aerial technology. This R&D project will also analyze the cost differentials between the use of manned and unmanned aerial technology. In Sept 2015 we demonstrated the UAV overhead inspection by replication of two mandated inspection with UAV; the detailed lattice tower inspection and feeder patrol. In Dec 2016, we completed the training classes for linemen for operating the UAV readiness. We also demonstrated the use of UAV for dead end connector inspection. In Nov 2017 we had completed the LiDAR vegetation management demo. In 2018 we started the process for applying for FAA waiver for UAV flight beyond line of sight. We are set for UAV flight beyond line of sight demonstration for Q2 2019.

TITLE Mitigation of GEO & Electro Magnetic Events

CSN 92111 POET 10064342 TASK 0071

PROGRAM AREA Transmission / Planning

DURATION 02/24/2010 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD S. Sambasivan

AUTHORIZED $475,000 EXP. THROUGH 2018 $411,162

Objective

Addressing Bulk Electric Systems (BES) reliability concerns with regard to Geomagnetically Induced Currents (GIC) and Electro-magnetic Pulse (EMP) Event or Intentional Electromagnetic Interference (IEMI) that have been at the core of the number of Congress, DHS and DOE documents, leading to the development of the new NERC TPL-007 Reliability Standard, requiring assessment of the system vulnerabilities, as well as development of the monitoring, modeling and mitigation measures.

Benefits

Proactively addressing these issues gives Con Edison a reliable operation of BES during geomagnetic storms, as well as an understanding of any future mandatory requirements that may be adopted.

Technical Status

In 2018, newly developed by research institute GIC sensor was installed at Millwood substation. New sensor measures GIC in phase conductors, while existing sensors only measure DC in neutral. Two more sensors will be installed in 2019, to allow engineers to better understand GIC flows on all levels of transmission in the substation.

Previous progress:

- Project team participated in development of new NERC TPL-007 Reliability Standard, providing comments to Standard Drafting Team, leading to improved requirements beneficial to Company and Industry.
- GIC (Geomagnetically Induced Currents) monitoring equipment installed in 14 locations considered vulnerable by conducted assessment studies.
- Transmission system model was developed, expanded beyond Con Edison systems' footprint, refined for higher accuracy, and validated against existing historical records.
- In 2017, project team focused on EMP (Electromagnetic Pulse) mitigation. As a solution for ECC survival in case of high altitude nuclear explosion, project sponsored development and design of mobile control center based on military specifications MIL-STD-188-125.

TITLE Next Generation for Perfluorocarbon Tracer (PFT)

CSN 90222 POET 20946547 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 05/22/2014 to 12/2019 ENGINEER Jade Wong

PROJECT LEAD Joseph Moawad

AUTHORIZED $200,000 EXP. THROUGH 2018 $106,114

Objective

For the existing leak detection process, the following major areas will be studied:

1. Preparation - optimize the sampling rate and re-evaluate the absorption apparatus.
2. Chromatography- evaluate column design.
3. Detection- increase the sensitivity and output of the electron capture detector (ECO).
4. Presentation - improve visualization and formatting of chromatographic data.

A new concept that will also be pursued under this initiative will be the investigation and demonstration of a handheld portable gas chromatograph (GC) for bar hole PFT detection.

Benefits

Enhanced leak detection and analysis will result in the following:

1. Reduced environmental impact.
2. Improved overall transmission feeder reliability.

Technical Status

The current generation of perfluorocarbon tracer (PFT) leak detection equipment was developed in the early 2000s. The existing PFT instrumentation clearly has the capability to detect PFT in the air. This is demonstrated by the measurement of the normal environmental background PFT, the instrument response to standard injections, and the instrument response during most leak events. However, there have been leak searches where the instrumentation did not detect PFT in the concentration that would be expected based on the observed conditions. There have also been recent incidents where the PFT vehicle passed directly over a subsurface structure containing quantities of PFT tagged oil, but the instruments on the vehicle did not measure PFT concentrations significantly above normal backgrounder readings.

In these cases described above, the instrumentation did not respond in a manner that normally would have been expected. However, it is recognized that it is possible that unusual and unverifiable subsurface conditions may have existed that resulted in the unexpected movement of PFT through the subsurface at the leak locations. To determine if this is the case or if the existing PFT instrumentation has potential deficiencies that may be affecting the analysis of the readings, an effort to study and optimize the current sampling and analysis techniques is underway.

In 2017, we attempted to redesign the front end concentrator of the PFT GC to make it faster and easier for maintenance with modular component and cannot meet the required concentration level. In Q2 2018, we completed to design an extension of the PFT GC extension absorption to allow the detection range to reach areas where the PFT van cannot reach. In Q1 2019, we plan to create a historical trending model to reduce the locating selection process time.

TITLE Expanded Use of Physical Operating Margin Software

CSN 92116 POET 10064342 TASK 0075

PROGRAM AREA Transmission / Planning

DURATION 02/17/2005 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD Matt Koenig

AUTHORIZED $250,000 EXP. THROUGH 2018 $231,541

Objective

The project objective is to obtain, develop and apply additional Physical Operating Margin Software modules to Transmission Planning applications, and to increase System Operations' familiarity with the capabilities and functionalities with a view toward possible future use of -RT (real time) versions of this software by System Operations and other company organizations.

Benefits

Improved planning and operational information for Transmission Planning and System Operations.

Technical Status

Vendor periodically upgrades their software to improve the speed, the online risk monitor display, line tripping mechanism, software for Online Risk Monitor and implements other enhancements, including more detailed collaborative model of the Con Edison NYPA & LIPA interfaces. Additional training on new POM features and functions is being conducted yearly.

In 2018, a workshop was held July 30-31 in NYPA’s offices in White Plains, attended by 15 Engineers from NYPA and Con Edison. Participants were presented with new program features, received software updates and hands-on training on their use.

2019 participation in the project will be determined in discussions with Transmission Planning group.

TITLE Long Standoff Magnetomery Corrosion Detection Demonstration

CSN 90765 POET 22642692 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 04/12/2017 to 02/2019 ENGINEER Jade Wong

PROJECT LEAD Ronald Pietrowski

AUTHORIZED $50,000 EXP. THROUGH 2018 $38,979

Objective

Demonstrate using long standoff magnetometry technique in surveying metallic buried structures for surface anomalies: Task 1 to design a laboratory setup and physical model by emulating the field conditions of buried pipe with corrosion conditions. Task 2 to characterize the response of long standoff magnetometry for an existing transmission feeder in actual field environment; open trench pipes with coating and no coating; and regular buried pipe in ground.

Benefits

From the result of the R&D project, Transmission Operations can perform proactive leak repair instead of emergency repair. We can avoid the emergency response and remediation process should a dielectric fluid leak occur on the buried pipeline.

Technical Status

Several of the Con Edison underground High-Pressure Fluid Filled (HPFF) transmission feeders have been in service for more than 50 years and over the years, dielectric fluid leaks have materialized on the pipes due to corrosion effects caused largely by disbonded coating. When the pipe coating is damaged and does not adhere to the surface of the pipe, as in the case of disbonded coating, water penetrates at the interface and galvanic corrosion of the pipe begins. Cathodic protection systems are installed on the HPFF underground pipes to prevent corrosion but, cathodic protection systems do not protect steel pipes in cases where disbonded coating exist and on equipment contained within manhole structures that are subject to atmospheric conditions.

Due to the increasing number of dielectric fluid leaks and associated maintenance repair costs of an aging HPFF cable system, a means of determining the amount of corrosion before a leak occurs warrants investigation. The R&D project will assist Transmission Operations, the Mechanical Engineering Group of Central Engineering, and the Environmental Health and Safety Group address this emerging issue.

In November 2017, we demonstrated using long standoff magnetometry technique to detect and locate metallic defects on buried pipes in a laboratory. We will plan to schedule field tests by 1st quarter 2019.

TITLE HPFF Joint casings Corrosion Protection Aging Test

CSN 99866 POET 21726098 TASK 0001

PROGRAM AREA Transmission / Planning

DURATION 10/16/2015 to 10/2019 ENGINEER Jade Wong

PROJECT LEAD Thomas Villani

AUTHORIZED $50,000 EXP. THROUGH 2018 $39,763

Objective

Corrosion tests will be performed on joint casing with corrosion tapes or epoxy. These casings will be exposed to conditions similar to the field or manhole conditions to determine the life expectancy of the corrosion protections.

Tasks:

- Conducting an aging test to provide aging conditions on different methods used to protect the joint casings from corrosion.
- Determining the life expectancy of each corrosion proof method.
- Final report to include methodology and testing results.

Benefits

The main benefit of this initiative is improved environmental performance by proactively detecting disbonded coating and preventing dielectric fluid release to the environment. In addition, this initiative will enhance the reliability of our transmission system. Potential benefits expected from this pilot demonstration include: potential reduction in cost during normal and emergency conditions, proactive repair that results in greater flexibility in the Company's strategic options, effective resource allocations, and increased customer satisfaction.

Technical Status

Various HPFF feeders on the Con Edison Transmission System had dielectric fluid leaks that were caused by the shielding effect of disbonded coating on the pipe. When the coating is not adhered to the surface of the pipe, water can penetrate under it and support galvanic corrosion of the pipe surface. This condition cannot be overcome by the application of cathodic protection because the coating prevents cathodic protection current from reaching the pipe surface. Disbonded coating only occurred to the pipes that were coated with coal tar enamel or somatic (asphalt) coating. Since the 1980's, Con Edison had been using extruded polyolefin coating on which similar problem has not been developed. Coating delamination or coating blistering are produced by environmental conditions and resulting in cathodic protection cannot reach pipes under disbonded coating and vulnerable to corrosion.

Coating can be damaged by handling during pipe storage, transportation, or installation, or can develop later in service by transient over-voltage, high operating temperature, external agents such as chemicals in the ground, or dig-ins; in addition, external parts adjacent to the pipe line such as valves and casings can cause damage.

In Q4 2017, we prepared and sent joint casing to the laboratory. In Q1 2018, we started an aging test for 12 months to provide aging conditions on different methods used to protect the joint casings from corrosion and determine the life expectancy of each corrosion proof method. We plan to review the aging test result in Q1 2019.

TITLE Demonstration of Battery Monitoring System

CSN 99801 POET 21923635 TASK 0001

PROGRAM AREA Substations

DURATION 02/29/2016 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD Marissa Castoro

AUTHORIZED $100,000 EXP. THROUGH 2018 $63,028

Objective

The objective of this project is to install a remote battery monitoring system at a pilot location at E. 13th Street Substation. This pilot installation will test the success of the system before future installations are made at other Con Edison substations and power plants. The accepted monitoring system must be reliable, cost effective, and have low maintenance requirements and shall integrate with both, Valve Regulated Lead-Acid (VRLA) and Vented Lead-Acid (VLA) battery systems, widely used in Company facilities.

Benefits

The implementation of the remote battery monitoring system will reduce the number of hours by operating personnel for taking manual readings. This system will also decrease the amount of time that engineering and support groups will take to create NERC compliant reports.

Technical Status

There are many battery systems throughout the Con Edison system, specifically in Substations. Batteries are maintenance intensive assets which require work for operating personnel as well as engineering and management oversight for review of inspection data. A large number of batteries fall under NERC PRC-005 requirements. To meet these requirements, Con Edison personnel must either discharge test every 5 years or be able to effectively assess battery condition using impedance readings. Discharge testing is expensive and can shorter the life span of the battery. Another option to discharge testing is to install a monitoring system which meets all of the NERC requirements. The monitoring system will remove the necessity for field personnel to take manual readings at the batteries for routine maintenance which can be time consuming and ergonomically difficult depending on the battery room configuration. Also, the system will alert the station of any potential issues so that it can be resolved in a timely manner. The system will also provide a means to create reports which must be submitted to NERC. In 2017, Central Engineering and R&D developed detailed requirements and specifications for battery monitoring systems and issued RFP. Monitoring system was designed in collaboration with selected vendor and procured.

In 2018, system installation was completed. Results will be evaluated after 12 months in service.

TITLE Predictive Field Testing of Vacuum Interrupters

CSN 90941 POET 23341245 TASK 0001

PROGRAM AREA Substations

DURATION 08/2/2018 to 06/2020 ENGINEER Sergo Sagareli

PROJECT LEAD Eric Fell

AUTHORIZED $75,000 EXP. THROUGH 2018 $58,730

Objective

Current practice of periodic testing of vacuum interrupters only confirms their suitability for service at the time of the test. This means that circuit breaker can fail shortly after the test, causing damage to equipment and creating potentially unsafe situation in substation. With the capability provided by the MAC TS4 test set, we can trend and determine if vacuum interrupters need to be replaced prior to their next maintenance cycle. The intent of this case study is to show that we can avoid potential future failures of in-service vacuum interrupters, maintain substation reliability and personnel safety.

Benefits

Due to additional information obtained by predictive testing, probability of breaker failures while they are in service will be reduced, thus increasing reliability of service and reducing risk of station personnel exposure to hazards associated with breaker failures that may cause arc flashes and violent explosive disintegration of the equipment.

Technical Status

Presently, vacuum integrity test sets used in Substation Operations strictly give a Pass/Fail result. This result is a way to determine if the vacuum interrupter is suitable for return to service at the time of the test only. The frequency for testing feeder circuit breakers for Con Edison SSO is every 10 years per Engineering Spec CE-ES-1000. With the current test sets, there is no way to estimate remaining life and/or determine if the vacuum interrupter will make it to the next testing cycle. Substation Operations and Central Engineering's asset management group created database, where results of the tests completed with MAC TS4, will be entered and analyzed, to establish criteria for breaker removal from service prior to their failure.

TITLE Demonstration of Cubicle Inspection & Repair Safety Device

CSN 90972 POET 23489778 TASK 0001

PROGRAM AREA Substations

DURATION 10/25/2018 to 11/2019 ENGINEER Sergo Sagareli

PROJECT LEAD Eric Fell

AUTHORIZED $100,000 EXP. THROUGH 2018 $52,973

Objective

Substation operations has developed a safety device that can be placed inside any GE PowerVac or Powell Power/Vac switchgear cubicle to enable mechanics to safely and efficiently perform cubicle inspections, preventative maintenance and repairs. Presently, we are not able to perform the full scope of a cubicle inspection, maintenance or repairs safely or effectively without a bus section outage. By using this device, a bus section outage would not be required and live parts such as live load and feeder bus connections can be visually inspected/examined for future maintenance. Additionally, critical components, such as secondary blocks and racking mechanism components, can be safely accessed and repaired/replaced. The project plan is to manufacture the safety devices as described in the Invention Disclosure, filed with US Patent Office, purchase a cubicle for testing purposes and conduct testing in the DNV-GL independent lab (formerly KEMA).

Benefits

The device creates a safe work environment that isolates the mechanics from the energized bus and components. It serves as protection while performing inspections, cleaning, preventative maintenance and repairs. The device improves employee safety, work practices, efficiency, reliability and cost savings by eliminating the need for bus section outages as a result of complete inspections and repairs.

Technical Status

Currently, inspection and maintenance of medium voltage circuit breaker cubicles are not done thoroughly. This is due to a number of factors including lack of or inadequate safety barriers to work in close proximity to energized circuits and system operations restrictions in holding out the cubicle for inspection/maintenance. Additionally, to perform repairs on medium voltage circuit breaker cubicles, a bus section outage is required to provide safety for station personnel. While the cubicles are equipped with shutters that isolate the medium voltage bus compartment from the rest of the cubicle, they provide little to no protection from making accidental contact with the energized bus; potentially resulting in arc flash. The project provided multiple devices for testing in high voltage lab, as well as - for pilot use in various substations operating areas.

TITLE Transmission Modernization Demonstration

CSN 99841 POET 21805596 TASK 0001

PROGRAM AREA Substations

DURATION 12/17/2015 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD Matthew Walther

AUTHORIZED $159,370 EXP. THROUGH 2018 $160,715

Objective

Con Ed is utilizing the 13th Street Substation as a pilot site to demonstrate the concept of a "Smart Substation" where the data integration and communications infrastructure will be installed to collect, store and analyze data from multiple monitoring technologies. This effort will focus on the development and implementation of algorithms, alerts and alarms that will utilize the collected data to improve reliability and reduce maintenance costs. In a substation there are transformers, breakers, switches, arresters, bushings, bus bars, relays, control panels, current and voltage transformers, battery systems, etc. A visual inspection may not point to the internal problems developing inside these assets. Hence, the need for continuous or frequent monitoring of key parameters and analysis of the monitored data to identify evolving problems before the situation gets out of control. Equipment failures can lead to outages on the network, thereby, impacting reliability and affecting customers directly or indirectly. Hence, it will be of immense value to monitor, and gauge the health of the assets and assess impending problems. If implemented correctly problem may be fixed at their infancy, downtimes can be reduced and reliability will be enhanced – the benefits will be manifold.

Benefits

Benefits provided by this project may be described as improved quality of information and situational awareness by allowing field forces and Engineering to see information analyzed by various algorithms, hence better quality of decision along with improved timing.

Technical Status

Progress reported by vendor on the model development. Further steps are depending on the data feeds to be made available from the online DGA monitors from Kelman units into a central repository, providing data sharing and analysis.

Future tasks for project completion:

- Enhance PTX so it can process data from online DGA monitors (to be installed by capital project in 2019-2020)
- Demonstrate enhanced model using data from online DGA monitors at E. 13th Street substation

Previous progress:

Task 1 - Asset Health Diagnostic Algorithms
Task 2 - Protection and control technology transfer
Task 3 - Insulator Contamination Monitoring – Upgraded leakage current sensors at E 13. Street Substation

TITLE Demonstration of 138 kV MGC Bus System at Elmsford Substation

CSN 99786 POET 21991536 TASK 0001

PROGRAM AREA Substations

DURATION 04/14/2016 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD David Korovin

AUTHORIZED $600,000 EXP. THROUGH 2018 $573,098

Objective

Project objective is to resolve bus tripout issue by alternative means, providing bus system reliability by technically feasible means. Existing open-air aluminum pipe type bus will be replaced by DURESCA busbar - fully insulated busbar system, type RIP - resin impregnated paper, manufactured by MGC Moser-Glaser AG of Switzerland. System will be designed, manufactured, installed, tested and commissioned by MGC, under Con Edison Engineering and Substation Operations oversite.

Benefits

The project will increase reliable operation of Elmsford substation and 4 other adjacent substations, interconnected via feeder 38W34.

Technical Status

In Elmsford s/s, the bus run from the A phase pothead on feeder 38W34 runs adjacent to highway 287. The highway retaining wall is approx. 25 feet from the bus run and approx. 25 feet high. This bus run to section 1E is approximately 15 feet high. We have had 2 tripouts on this section, caused by snow and salt being plowed on highway 287 and going over the retaining wall. The snow and salt tracks down the porcelain insulators, causing tripouts. This causes a major feeder outage, affecting 4 stations. Construction of the protective wall between the bus and highway was found non-feasible, since its installation within property line may reduce NESC-mandated clearances. Substation Engineering has suggested an alternative solution - installation of insulated busbar system. In 2017, insulated bus section design was finalized, equipment procured and installed. In 2018, SCADA adjustments related to new bus section were implemented. New bus section remains in use, without any issues, and will be capitalized in 2019.

TITLE Demonstration of Remote Breaker Racking Systems

CSN 92736 POET 20707502 TASK 0001

PROGRAM AREA Substations

DURATION 08/4/2014 to 12/2019 ENGINEER Sergo Sagareli

PROJECT LEAD Marissa Castoro

AUTHORIZED $500,000 EXP. THROUGH 2018 $67,165

Objective

Central Operations' Breaker Peer Team, the SSO Training Effectiveness Committee, and the SSO Safety Committee have been working together with various vendors to develop a system that would eliminate arc flash hazard during breaker racking operation. The remote racking systems allow service personal to be outside the arc flash protection boundary, increasing safety from arc flash hazards and thus reducing the need for a full-body arc flash hazard suit.

Benefits

Expected benefit is increased employee safety due to elimination of possibility of injuries caused by arc flashes during manual racking of breakers in and out of switchgear cubicles. Remote racking will keep employees away from arc flash protection boundary defined by OSHA and NFPA-70E (Standard for Electrical Safety in the Workplace). After evaluation of devices' operation in various select substations, recommendation was made for implementation of this new technology Company-wide.

Technical Status

Arc flash hazard has been always recognized by industry and OSHA as one of the most serious dangers to employees working with electrical equipment, because consequences of arc flash may lead to serious injuries and even death. Protection for employees operating electrical equipment is being provided by personal protective equipment (PPE), equipment design, establishing safe operating procedures and other means. One of the possibilities of employees' exposure to arc flash arises when performing breaker racking operation, due to either operating errors or equipment failure. There have been instances when employees wearing prescribed PPE were still injured, and using PPE of the higher level of protection, such as full-body suit, is usually associated with loss of mobility and reducing visibility, which is interfering with employees’ ability to perform the task at hand.

In 2018, Phase 2 of the project to develop mobile remote-controlled robotic system continued, resulting in design and construction of prototype. Test and delivery is planned for Q2 2019.

TITLE Substation Operations Simulator

CSN 99909 POET 21546317 TASK 0001

PROGRAM AREA Substations

DURATION 07/9/2015 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD Mark SanAntonio

AUTHORIZED $250,000 Entire Project Capitalized in 2018

Objective

With the high level of turnover and increased retirement of experienced personnel, it is becoming more challenging than ever to retain and transfer their knowledge and skills. With a training simulator at the learning center (TLC), nearly every department in Central Operations will benefit from being able to see and operate real field equipment in a controlled environment. Currently, training is being done using text books, table top exercises and field visits.

Benefits

Substation Operators and Mechanics, as well as other Central Operations personnel are benefiting from the training that replicates real field experience, in a safe and controlled environment. The simulator is facilitating knowledge transfer, and also serving as a testbed for development and implementation of new ideas in substations design, operations and maintenance.

Technical Status

In 2018, all major installation works were completed and TLC started to use substation simulator for training purposes. Project was capitalized.

Previous progress:

In 2015, design of the training simulator was completed. It is based on a typical 138kv string of circuit breaker with disconnect switches on both sides, connecting transformer to pothead or buswork. Disconnect switches and pothead support structure have been installed and circuit breaker was sent to ABB for refurbishment.

In 2016, the circuit breaker was refurbished by ABB, delivered to TLC and installed on the pad.

In 2017, installation of conduits for electrical wiring and civil work, which included constructing of the retaining walls and filling the space between two concrete pads, as well as other minor work for personnel safety (signs, railings and steps) were completed.

TITLE EnerTech Strategic Partnership Program

CSN 90909 POET 23208467 TASK 0001

PROGRAM AREA Distribution

DURATION 05/11/2018 to 08/2019 ENGINEER Serena Lee

PROJECT LEAD Joshua Gould

AUTHORIZED $125,000 EXP. THROUGH 2018 $125,224

Objective

EnerTech manages a series of venture funds with an exclusive focus on making investments in companies that serve markets that are of interest to Con Edison. One of EnerTech's strategic differentiators compared to other ventures funds is its deep understanding of the target markets and the breadth of relationships it holds with industry incumbents. One method EnerTech uses to stay current on industry trends, needs and dynamics is to recruit limited partners for its funds from the industry participants. The EnerTech Strategic Partners Program (ESPP) is another method of developing direct relationships with industry participants. The program provides it members with direct access to EnerTech in a manner similar to as if it were a limited partner in one of the EnerTech managed funds while providing EnerTech with an expanded "ecosystem" of industry relationships.
Con Edison plans to use its participation in the ESPP as a way to consider whether to become a limited partner in the future.

Benefits

The benefit to membership allows the company to strengthen its market intelligence and insight on emerging companies and market segments. In addition, it is an efficient use of everyone's time. By using an external partner, we quickly and easily filter technology companies in the energy space for relevance and competence, minimizing unproductive interactions internally and externally. As a member, Con Edison has the potential to: a) Become more knowledgeable about venture investing in the energy technology space, b) Become more informed as a potential direct investor in early stage companies; especially those in the EnerTech portfolio, c) Become more informed as a potential business partner with early stage companies; especially those in the EnerTech portfolio d) Become more informed as a potential acquirer of early stage companies; especially those in the EnerTech portfolio.

Technical Status

In 2018, Con Edison derived great value from our relationship with EnerTech in the following ways:

1. Exposure to new companies and technology: In 2018, EnerTech provided information on 356 new energy companies including 269 in Con Edison's areas of interest, with 72 energy storage related opportunities as well.
2. Operational efficiency opportunities: EnerTech introduced Con Edison to various companies who can help drive cost savings and operational efficiency. For instance, EnerTech introduced an augmented reality training vendor to Con Edison who could help the company save significant money on training and improve employee and public safety.

3. Commercialization: EnerTech has helped Con Edison identify and find appropriate commercial structures for working with companies who can offer new products and services to Con Edison customers. For instance, EnerTech's advice has been invaluable to partnership discussions with a DER metering vendor, whose product Con Edison intends to offer to solar installers and customers.
4. Insight & information: Finally, EnerTech has provided valuable information and networking to help the company make better decisions. One example of that is a meeting around blockchain applications for energy that EnerTech organized with external partners in April.

TITLE Structure Monitoring Device

CSN 90964 POET 23465154 TASK

PROGRAM AREA Distribution

DURATION 10/16/2018 to 06/2019 ENGINEER Serena Lee

PROJECT LEAD Stanley Lewis

AUTHORIZED $150,000 EXP. THROUGH 2018 $104,728

Objective

For underground secondary events and energized objects, a wireless transmitter, signal processor and sensor(s) can monitor an underground structure or any other object remotely. When certain gases, temperature or voltage rises past a pre-determined value, the device will send an alert to a central monitoring application representing attention is required. We currently have an existing contract for such devices, but would like to bring in another contractor with new ideas and designs into the arena. The project's plan would be to assist an alternative vendor with funds for research, engineering, and purchase ten prototype devices.

Benefits

This project will enable Con Edison to improve, and manage a monitoring device that will allow us to respond to emerging cable defects before they develop into manhole events. The project will also help to bring an alternate supplier into consideration for the monitoring device which should enable competitive pricing.

Technical Status

The vendor is in the development and testing phase of the product and receives technical input from Con Edison. We expect to have a prototype ready by 3rd quarter of 2019.

TITLE Manhole Control and Containment for Public Safety

CSN 90404 POET 21085053 TASK 0001

PROGRAM AREA Distribution

DURATION 09/2/2014 to 09/2019 ENGINEER Serena Lee

PROJECT LEAD Rongzhi Li

AUTHORIZED $140,000 EXP. THROUGH 2018 $117,284

Objective

Full-element limiters are installed throughout our underground networks for the purpose of fault isolation to underground mains when they fail. In some cases, the faulted cables may clear slowly or not at all depending on the fault current. This protracted clearing can lead and/or contribute to underground secondary events such as burnouts, manhole fires, manhole explosions, CO evacuations and energized equipment. A pilot program is being initiated that will install half-element limiters to approximately 100 selected mid-block structures in order to evaluate the effectiveness at manhole event risk reduction.

Benefits

The program primary objective is to reduce the number of manhole events and energized structures by employing new techniques and/or practices. These proactive approaches will find defects before they become problematic lessening the severity of the manhole events thus allowing for scheduled repairs.

Technical Status

In 2018, an additional 37 structures were completed in Brooklyn/Queens and Manhattan regions.

Engineering tracks and reviews the system performance of ½ limiters. So far, we have not seen any negative impacts to system reliability. Looking forward in 2019, we will continue to install ½ limiters until we reach the target for the pilot. To date, we have completed 50 structures.

TITLE Structure Observation System - Active Site Monitor User Interface and Response

CSN 90985 POET 23542096 TASK 0001

PROGRAM AREA Distribution

DURATION 11/30/2018 to 12/2020 ENGINEER Serena Lee

PROJECT LEAD Melanie Cotton

AUTHORIZED $150,000 EXP. THROUGH 2018 $78,000

Objective

Locations that have reported underground events cannot always be immediately reached due to crew availability, particularly during storms or heat waves. A company first responder, as soon as available, is sent to the underground structure to verify whether the site is active. If the site is dormant, the first responder moves on to another location and does not wait on site for crew arrival. While a location is pending crew arrival, there is no way to monitor the status of the event. Without continual monitoring, the event can escalate prior to crew arrival and pose a threat to public safety. In this project, we seek to develop a continuous monitoring solution.

Benefits

This project will enable Con Edison to manage a device that monitors reported underground event locations prior to crew arrival, particularly when crews cannot immediately be dispatched. The user interface associated with Active Site Monitors (ASM) will allow the control center to monitor locations and prioritize the response to manhole events. Catching underground events in early stages are important to public and employee safety and can reduce the associated repair costs.

Technical Status

For underground secondary events, a wireless transmitter, signal processor and sensor(s) could monitor an underground structure and the surrounding area remotely. In this project, we are developing an Active Site Monitor (ASM) in conjunction with a Structure Observation System (SOS) device to monitor event locations from street level. When a gas or temperature reading rises past a pre-determined value, the device will send an alert to a central monitoring application to indicate attention is required. We currently have a dashboard to monitor devices, but would like a user interface that the Control Center can use. This interface would give images of the locations, alarms, and GPS location. This permits the Control Center to prioritize locations and dispatch crews as needed. The ASM is intended for locations without any SOS monitoring, for locations already monitored by an SOS there is a need and opportunity to supplement alarm monitoring and response. The prototypes have been delivered in 2019.

TITLE Distribution GIS and Grid Model Data Management

CSN 90677 POET 22366288 TASK 0001

PROGRAM AREA Distribution

DURATION 09/14/2017 to 12/2020 ENGINEER Steven Go

PROJECT LEAD Kevin Wong

AUTHORIZED $235,000 EXP. THROUGH 2018 $225,000

Objective

The project addresses the challenge of effectively managing grid information from its source in the field through its appearance as a geospatial model in the GIS, to its ultimate transformation into grid models consumed by multiple applications across the planning, protection and operations domains of the distribution utility. Project objectives include 1) demonstration of cost-effective strategies for achieving and maintaining accurate GIS data and consistent grid models for use across distribution planning, engineering, and operations, 2) Creation of industry consensus on the functionality of tools required for managing distribution grid models and the importance of effective grid model management, 3) Encouragement of field crew engagement in the use and maintenance of grid model data and the use of such data to improve field crew productivity and safety and 4) Creation of industry architecture for distribution geospatial and grid model data management.

Benefits

The Information Technology team is exploring various GIS options for CECONY. The EPRI project is developing a distribution network data model (DNDM) that would allow for data standardization, improved data accuracy and data quality for distribution assets. The project will also look into data standardization of non-utility customer assets to allow for future integration into emerging technology platforms such as DERMS and ADMS. ORU has an existing GIS system that would benefit from having a DNDM as we integrate increasingly large number of non-utility assets. The public may benefit as utilities are able to improve their operating efficiencies and workforce safety and productivity, optimize the value of DER installed on their systems, defer their capital expenditures, and continue to operate their grids reliably and safely in a world with a high penetration of DER.

Technical Status

Effective management of geospatial and grid model data is one of the major challenges facing electric distribution utilities today. Network analysis tools in multiple domains across the enterprise create fractured data storage, duplicated data entry, ‘one off’ point-to-point interfaces, and business processes. Utilities struggle with incorrect or missing GIS data, difficult-to-maintain grid models, and information that is out-of-sync with the field. These problems will scale up as DER penetration increases, and distribution grids grow increasingly complex. Utilities will need a solid foundation of well-managed geospatial and grid model data on which to deploy the new software tools that effective grid planning and operation will depend on in a future that includes substantial DER. This project was kicked off towards the end of 2017. The team had identified key modeling tools to focus on. We are scheduling deep dives with subject matter experts across ConEd to discuss challenges and opportunities throughout 2019.

TITLE Low Voltage Smart Crab

CSN 90981 POET 23527126 TASK 0001

PROGRAM AREA Distribution

DURATION 11/21/2018 to 12/2020 ENGINEER Serena Lee

PROJECT LEAD Rongzhi Li

AUTHORIZED $235,000 EXP. THROUGH 2018 $67,350

Objective

The goal is to develop an integrated device inside the cable crab with the capability to measure cable loading, limiter condition and temperature reading (hotspot). The device would remotely communicate measurement data to the end user. Con Edison will be partnering with vendor(s) to develop prototypes of a fully implemented monitoring device. The vendor(s) will provide engineering design and fabrication of 6 communication devices, 18 crab joints with embedded sensors for field testing, and also provide user platform for viewing measurement data.

Benefits

The program primary objective is to detect underlining power quality issues associated with cable overloading and blown limiter through the use of a remote monitoring system. If successful developed and implemented, the system will help to quickly respond imminent power quality events, resulting in the reduction of underground manhole events.

Technical Status

In 2018, Engineering initiated a project to develop an intelligent low-voltage cable crab joint module and identified a potential developer. We are working to complete a final proof of concept in 2019.

TITLE Development of Zinc-Birnessite Batteries for Grid Storage

CSN 99780 POET 22040396 TASK 0001

PROGRAM AREA Distribution

DURATION 05/6/2016 to 12/2018 ENGINEER Constantine Spanos

PROJECT LEAD Steven Goldman

AUTHORIZED $187,500 EXP. THROUGH 2018 $187,500

Objective

This NYSERDA supported project sought to develop a very high energy density, very low cost, long cycle life Zn-MnO (birnessite) alkaline battery, which accesses a high fraction of the full second electron capability of MnO2. A recent discovery by a regional research university has enabled access to the full second electron capability of MnO2, which is 617mAh/g, with excellent cycle life.

Battery energy storage at the MWh scale is under widespread development as a means to improve grid stability. This original alkaline battery technology can provide similar energy densities at lower cost while using safer materials than lithium-ion (the predominant storage chemistry, facing numerous permitting challenges in NYC). These research efforts will have significant benefit to Con Edison when the technology becomes commercial.

Benefits

Low-cost energy storage is an important research objective in order to meet state policy goals. A successful demonstration of a high energy density, very low cost, long cycle life and safe Zn-MnO2 (birnessite) alkaline battery would open doors for growth in urban storage deployments. The opportunity to allow storage at Lithium Ion energy densities with a cost below lead-acid lowers future capital costs for storage end-users (including Con Edison). The Electric Power Research Institute projects Lithium Ion technology to have a cell cost of $100-120/kWh in 2020. This research project demonstrated similar energy densities at approximately $50/kWh with a path toward full-commercialization.

Technical Status

The below tasks have been accomplished for the project

Tasks (checked boxes are completed):

- ☒ Develop the birnessite cell (termed the X1 cell prototype) that will be targeted to reach an energy density of 200 Wh/L with a demonstrated capital cost of <$50/kWh (Li-ion energy densities, in an aqueous battery, and at a fraction of the cost).
- ☒ The partnering research university will finalize commercialization plan.
- ☒ The partnering research university will prepare final report.

As of late 2018, the NYSERDA project has been completed. The research university's commercial spinoff has begun offering the developed technology. In addition, the company is conducting further research to enhance the performance and cycleability.

TITLE Development of Wind Gust Ensemble Weather Prediction Tool

CSN 99755 POET 22514823 TASK 0001

PROGRAM AREA Distribution

DURATION 3/24/2017 to 12/2019 ENGINEER Constantine Spanos

PROJECT LEAD Michael Berlinger

AUTHORIZED $113,000 EXP. THROUGH 2018 $60,821

Objective

Wind gusts are the main drivers to overhead system impacts. While there are models and methodologies to forecast sustained winds, forecasting wind gusts is challenging. Currently, there are no existing methodologies using ensemble models (multiple forecasts to capture forecast uncertainties). This project has the potential to help the company improve its wind gust forecasting capabilities in both the short- and long-term time scale, and then clearly communicate realistic probabilities of weather events that threaten our company and customers. With more accurate system impact predictions, the company can better plan for storms.

Benefits

The Company's ability to use deterministic (single forecast) and ensemble (sets of forecasts) weather models to forecast wind gusts has the potential to improve our forecasting capability and communication of weather-related risk in the short and long term.

Technical Status

Tasks (checked boxes are completed):

- ☒ Test the wind gust algorithm using a variety of numerical weather models (GFS, GEFS, NAM, SREF) against real site data for verification, and utilize historic training datasets to correct the bias in wind gust forecasting.
- ☒ Create automated spatial plots for wind gust descriptive statistics (mean, min, max), and incorporate the data into a webpage maintained by the University.
- ☐ Develop an archiving procedure for events on the web page.

TITLE Assess Super Capacitor Energy Storage and PV Integration Technology EPRI/NYSERDA

CSN 99748 POET 22595615 TASK 0001

PROGRAM AREA Distribution

DURATION 05/16/2017 to 12/2019 ENGINEER Constantine Spanos

PROJECT LEAD James C. Skillman

AUTHORIZED $30,000 EXP. THROUGH 2018 $56,161

Objective

Supercapacitor technology that has the potential to provide quick ramping capability for distributed energy resource (DER) integration, peak shaving, and rail regenerative braking applications. This project tests and demonstrates smart inverter grid support and supercapacitor energy storage functionality for application in network distribution systems. This performance assessment will contribute to improved understanding on the use of supercapacitors for DER integration in network systems. The project receives NYSERDA funding (expenses to-date will be reimbursed by NYSERDA)

Benefits

Some of the benefits that this specific energy storage technology solution can potentially offer are: High efficiency (reduces energy required during charge/discharge cycle); Negligible heat generation during device operation (eliminates the need for installing energy intensive cooling systems, therefore delivering energy savings); High cycle life and efficiency allowing peak shaving from rapid peaking load profiles, reducing peak demand on the grid and increasing network capacity utilization.

Technical Status

As part of this NYSERDA supported project, the vendor's energy storage system was delivered to EPRI in February of 2018 and grid simulation testing is in progress (delayed due to a need for system replacement after sustaining shipping damage). A final report will be prepared by EPRI in 2019 and released to the public before the end of 2019 summarizing the system's evaluation, and will include an economic analysis investigating potential cost savings the device can offer. Con Edison has issued an RFP and hired an engineering design firm in October of 2017 to work on site plan drawings and permitting application preparation for the potential installation of the supercapacitor adjacent to a solar PV system.

<u>Tasks (checked boxes are completed):</u>
EPRI and Con Edison will independently evaluate the vendor's supercapacitor energy storage and inverter control technology:

- ☒ Con Edison to conduct site preparation and analysis for an onsite demonstration project
- ☐ Preparation of detailed engineering drawings and full economic assessment
- ☐ EPRI evaluation including test plan development, system commissioning, and conducting tests in the laboratory environment with ability to create different solar and grid conditions to evaluate the performance limit of the unit
- ☐ EPRI preparation of final test report

TITLE Self Flush For Service Boxes

CSN 90975 POET 23493190 TASK 0001

PROGRAM AREA Distribution

DURATION 10/29/2018 to 06/2019 ENGINEER Simon Odie

PROJECT LEAD Lawrence C. Sutherland

AUTHORIZED $50,000 EXP. THROUGH 2018 $49,870

Objective

The project will work to develop a mobile mini-vactor prototype solution independent of Environmental Operations (flush). Several proof of concepts were conducted in the past, along with field trials (slurry vacuum, pneumatic vacuum, etc.) with limited success. Plans are now to conduct a 4th proof of concept with an upsized vacuum device. The device is capable of approximately 3000 cfm flowrate, and will be modified for wet slurry intake, and configured into a towable unit with a local vendor shop in collaboration with Con Edison's Transportation Operations.

Benefits

With a mobile trailorized mini-vactor the field services group will be capable of expediting small-scale self-initiated flush operations for planned and emergency service box work. This will result in enhanced productivity through reductions in delay time. The mobile mini-vactor prototype will be towable, allowing for the equipment to have a high utilization, sharable between sites.

Technical Status

BQ Services has been investigating and developing small "self-flushing" devices since 2017. These would assist with debris cleaning capabilities for service boxes prior to conducting work. There are approximately 250k underground structures system-wide, where about 70% are service boxes (170k). EH&S has approved field trails and waste offloading plans using earlier designs, however, trials were unsuccessful at meeting requirement due to low flow and flow impingement. Early device designs included a slurry-type vacuum and pneumatic vacuum staged with a repository drum. These had low cfm rates (<300 cfm) and low static pressure head resulting in clogs. This later proof of concept will evaluate a device capable of approx. 3000cfm. Major components of the module include fabricated module skid, debris vessel, vacuum drive engine, vacuum system, vacuum system controls/engine instruments, water tank, pressure washer, equipment storage rack, and trailer.

TITLE Monitoring of Backfeed Conditions using Communicating Microprocessor Relays

CSN 99862 POET 21736172 TASK 0001

PROGRAM AREA Distribution

DURATION 10/30/2015 to 12/2020 ENGINEER Serena Lee

PROJECT LEAD Selameselassie Retta

AUTHORIZED $255,000 EXP. THROUGH 2018 $153,173

Objective

The proposed project will employ communicating MPRs (Microprocessor Relays). The communicating MPRs are capable of two-way wireless communications via an external modem. This additional communication capability will allow for supervisory control and data acquisition (SCADA) which will provide control centers the ability to remotely monitor and operate the network protectors. Control centers will be able to quickly identify the problematic NWPs (Network Protector) during an ABF (Alive on Backfeed) condition. SCADA control of NWPs also allows for the proactive identification of defective NWPs, thus preventing potential ABFs.

Benefits

This project will seek to identify and repair defective network protectors (NWP) before they can cause an alive-on-backfeed (ABF) condition. This project seeks to increase the accuracy of detecting second faults. Accurately detecting second faults or confirming there is only one fault during an outage will allow control center personnel to make more informed decisions when processing a feeder. Locating a second fault will allow field forces to repair this additional damage during the initial feeder outage. This would eliminate failed on test events due to a second fault. This project will examine additional capabilities and flexibilities that may be gained on managing our network system by having two way communication with our microprocessors. The two way communication will allow for enhanced monitoring of two way power flow that may occur in the presence of DERs and ensure reliability in such situations.

Technical Status

In 2018, we built the control center application screens and data base functionality with ability to remotely change remote operability of the NWP status and ability to change NWP relay settings remotely from the control center application. We have installed this equipment at 15 of the 31 locations so far. Of those installed, the communication has been tested successfully.

TITLE Public Safety Equipment Failure Prediction and Prevention Enhancement

CSN 90389 POET 22885948 TASK 0001

PROGRAM AREA Distribution

DURATION 11/16/2017 to 12/2018 ENGINEER Frank Doherty

PROJECT LEAD Stan Lewis

AUTHORIZED $150,000 EXP. THROUGH 2018 $164,778

Objective

Engage contract infrastructure inspectors to perform targeted detail inspections and data capture for 200 underground structures and approximately 100 building services (overhead). After success of the infrared inspection enhancement program, we seek continued ways to extract added value from infrastructure inspections. Through new technology and improved analytic processes and troubleshooting, we will collect information on proactive detection of cable failure. This project will gather information on the types and conditions of structure covers, appraise different facility types, including cover type, gather current and voltage measurements for detection of dangerous open-neutral conditions, install missing fairleaders where feasible, and collect and analyze high speed magnification video to reveal small changes that could diagnose anomalous conditions that are hard or impossible to see with the naked eye.

Benefits

Low voltage distribution equipment failure continues to be a public and employee risk. Con Edison actions have driven reduction in explosions, reduction in CO events, and reduction in energized equipment reports over the last ten years; but more is needed. This project will help determine if new technology and improved analytic processes and troubleshooting can cost effectively predict and prevent equipment failures.

Technical Status

Completed - Load current measurement of services was found feasible and effective to detect broken neutrals and is being deployed as a field tool. When used in conjunction with AMI infrastructure roll out, it can diagnose and detect cable and wire anomalies, and thus predict and allow prevention of equipment failures. However, high-speed video capture found not workable for field use due to lack of robust hardware and stationary fixed mountings. Also, we learned that street view image processing of manhole covers in street pavements was not suitable for determining the geo-position of manholes via machine learning.

TITLE Enhanced Vault Roof & Grating Design Development

CSN 90896 POET 22841618 TASK 0001

PROGRAM AREA Distribution

DURATION 10/23/2017 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Rodji L. Ventura

AUTHORIZED $50,000 EXP. THROUGH 2018 $38,480

Objective

Engage vendors to develop enhanced vault roof, grating and entryway designs that are structurally sound and more ADA compliant, durable and cost effective. The entryway mechanism should provide mechanical assistance when opening and closing, as well as automatic positive latching in the open position.

Benefits

Defective vault gratings continue to be a public safety risk as well as a risk to Con Edison employees. Present gratings may not be fully compliant with ADA requirements after they have been in service for some period. Present methods of dealing with defective gratings are reactive and time-consuming, and a novel design is needed to reduce risk and help assure safety. This project will determine if such an enhanced design is operationally feasible (cost, impact on day- to-day work).

Technical Status

In Progress - The prototype roof and grating has been installed. Initial feedback from engineering and operations has been constructive. The design is not yet ready to be made into a standard and the project will continue in 2019.

TITLE Contact and Stray Voltage Assessment Enhancement - EPRI

CSN 90906 POET 23196143 TASK 0001

PROGRAM AREA Distribution

DURATION 05/10/2018 to 12/2020 ENGINEER Frank Doherty

PROJECT LEAD Stan Lewis

AUTHORIZED $50,000 EXP. THROUGH 2018 $35,000

Objective

Engage with other utilities via EPRI towards advancements in understanding of stray and contact voltage remediation approaches and strategies, evaluation of new detection equipment, and evacuating applicability and effectiveness of those approaches and equipment.

Benefits

Low voltage distribution equipment failure continues to be a public and employee risk. Con Edison has reduced energized equipment reports and shock reports over the last ten years; but more is needed. Utilities and EPRI will develop and test new stray and contact voltage remediation approaches and strategies, evaluate new detection equipment, and evaluate applicability and effectiveness of those approaches and equipment. The knowledge developed via this collaborative work will inform future Con Edison, O&R and other utility practices, procedures and standards. It will also guide national standards changes.

Technical Status

In Progress - Testing of a technology to assess swimming pool bonding integrity was completed, and we demonstrated use and benefit of a water sensor product and worked with that manufacturer to develop a version that is programmable for contact voltage investigations and diagnostics. Documentation is due out mid-2019. The public contact voltage repository developed by EPRI has been updated and revised, and new material posted. More will be available as part of a 2019 EPRI website upgrade. An October 2018 industry workshop trained investigators on the latest equipment and diagnostics approaches. Six new investigation documents are completed and in the information repository. In partnership with EPRI, Con Edison has established a stray and contact voltage test facility in Lenox MA, that will help enhance our understanding of detection technologies performance, energized object fields and waves, troubleshooting and thresholds of detection, leading to enhanced detection, prediction and prevention of shocks and shock hazards.

TITLE Network Transformer MV Bushing Forensic Failure Analysis

CSN 90947 POET 23376242 TASK 0001

PROGRAM AREA Distribution

DURATION 08/27/2018 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Liza Banhalmi Kramer

AUTHORIZED $75,000 EXP. THROUGH 2018 $32,000

Objective

Engage EPRI to conduct forensic analysis of failed bushing and a control sample of a new bushing to identify root cause(s) and failure mode(s) and corresponding degradation mechanisms. The analysis is likely to include electrical testing, material testing, and a systematic teardown of specimens. EPRI will forensically analyze new and failure specimens to identify potential root causes of failure and failure modes, including: Photo documentation, Surface Inspection, Destructive bushing assessment and Materials Analysis; plus partial discharge testing on new bushings prior to teardown.

Benefits

In 2018, we experienced 152 bushing/termination failures, including many early failures. Determination of root cause of failures will allow us to discover, predict and prevent some future failures in the present population, as well as to make improvements in equipment or installation practices that will mitigate failures in future installations.

Technical Status

We have forensically analyzed five failed and two new bushings. The results were informative and expanded our understanding of likely failure modes, but additional autopsies are needed for further evaluation and increased confidence. More failure specimens are being gathered and will be autopsied in 2019, which will inform improvements in equipment and installation practices that will mitigate failures in future installations.

TITLE Underground Splicing Machine Development Phase 2

CSN 90646 POET 22157931 TASK 0001

PROGRAM AREA Distribution

DURATION 07/25/2016 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Maggie Chow

AUTHORIZED $450,000 EXP. THROUGH 2018 $350,468

Objective

A predecessor project demonstrated proof-of-concept for development of an underground splicing machine. This follow-on project will enable a step change in process, i.e., develop machine to live end cap feeder in a manhole, a process step occasionally required to restore network system resiliency when a network is under duress due to multiple feeder outages. Several feeder processing steps otherwise required could be bypassed, since a machine would be doing the work rather than a worker. These include positive feeder identification and placement and removal of additional protective grounds. Construct and demonstrate a field prototype, including: Task 1: Establish Requirements and Conceptual Design; Task 2: Create Detailed Design and Select Components; Task 3: Fabricate Prototype; Task 4: Test, Optimize and Demonstrate at Cable and Splice Center of Excellence; and Task 5: Field Test and Report Results.

Benefits

Potential to enhance operational excellence and safety by automating Live End Cap installation on network feeders; thus, reducing time employees spend in high energy environments; shortening feeder processing durations; decreasing distribution system stress and associated risk of cascading feeder outages and resulting customer outages, and avoiding associated costs.

Technical Status

In Progress – Detailed design was completed, and the demonstration version is undergoing trial.

TITLE Underground Structure Sand Fill Development to Mitigate Manhole Events

CSN 99911 POET 21546250 TASK 0001

PROGRAM AREA Distribution

DURATION 07/8/2015 to 12/2020 ENGINEER Frank Doherty

PROJECT LEAD Michael Donohue

AUTHORIZED $90,000 EXP. THROUGH 2018 $36,471

Objective

This project will evaluate and measure consequences of filling subsurface electrical structures with sand or other material; effectiveness of the fill to decrease the number and severity of manhole events; and patent and latent costs associated with the placement of the fill and its effect on routine operations and maintenance. Procedures and processes will be developed for selecting, filling and emptying candidate structures, approximately 100 secondary boxes will be chosen and filled; and performance of these structures will be tracked over time.

Benefits

Envisioned benefits are to reduce risk and impact of manhole events and to avoid potential harm to the public and Company employees. Quantification of benefit is not practical at this point.

Technical Status

In Progress - After an initial pilot using sand to completely fill structures, the team found the logistics burden of placement and removal of so much sand challenging and uneconomic. The project team transitioned to perlite, a light-weight environmentally-friendly material frequently used to aerate soil. To reduce logistics burden and need for special equipment, they developed and procured bags to contain the perlite. Initial trials of this combination of light weight material and bagging appears to make the solution viable for field use. Bags of pearlite will be installed in 2019, and several structures will be emptied and re-filled on planned and unplanned basis to learn what operational impacts can be expected for response to burnouts and for make-ready for new work and/or maintenance.

TITLE Weather Forecasting and Outage Prediction Platform

CSN 90547 POET 22950294 TASK 0001

PROGRAM AREA Distribution

DURATION 12/19/2017 to 02/2020 ENGINEER Constantine Spanos

PROJECT LEAD Michael Berlinger

AUTHORIZED $200,000 EXP. THROUGH 2018 $25,600

Objective

Con Edison performs numerical/spreadsheet based modeling to predict impacts to the overhead and underground electrical distribution systems using in-house developed models. Development of a more robust weather forecasting and electrical outage modeling platform can support daily operations and provide added levels of predictive capability. This project seeks to develop a web-based platform through collaboration with an external vendor selected through a competitive RFP. The platform will supplement other forecasting efforts, consolidating verified model data (e.g. wind gusts) to best estimate the counts of overhead and underground electrical outages, and produce outputs with associated confidence intervals. Additionally, the platform will summarize spatial and temporal electric outage impact data allowing Company meteorologists to conduct scenario-planning analyses.

Benefits

The model should better inform company emergency response operations, providing company staff with spatiotemporal modeling of weather forecasts and associated outage counts for the distribution system - capabilities that do not presently exist. The use of an improved weather forecasting and outage prediction platform has the potential to improve forecasting capability and communication of weather-related risk in the short and long-term.

Technical Status

Tasks (checked boxes are completed):

- ☒ Release of RFP to assess vendor capabilities and define scope of work.
- ☒ Improve existing modeling capabilities at the company using additional weather data streams.
- ☐ Formalize a forecasting platform development plan with a vendor leveraging determined model data enhancements.
- ☐ Develop web-based forecasting tool hosted within or interfacing via API with the Con Edison C3IoT platform.

TITLE Development of a Testing Plan for Li-Ion Energy Storage Systems

CSN 90208 POET 20915361 TASK 0001

PROGRAM AREA Distribution

DURATION 04/21/2014 to 01/2021 ENGINEER Serena Lee

PROJECT LEAD Manuel Fernandez

AUTHORIZED $145,000 EXP. THROUGH 2018 $107,233

Objective

Energy storage technology has been identified as one of the potential solutions for grid support, improving system utilization factor, infrastructure deferral and improving power quality and reliability to our customers. Lithium ion (Li-ion) is a high energy density battery technology, well-suited for urban applications, due to their small footprint and portability. As the chemistry of choice for plug-in vehicles (PEV), Li-ion Battery storage technology, even with modest penetration by plug-in vehicles, the resulting production scale of large format batteries could drop costs significantly. Considering the potential for significant cost reductions for Li-ion batteries and improved life of Li-ion batteries over the next decade, Li-ion batteries could lend themselves to be viable solution for infrastructure deferral while improving power quality and reliability to our customers. Con Edison is developing a Transportable Energy Storage System (TESS) for use on Con Edison's distribution grid. The device is a first of a kind at Con Edison and prior to installation on the Con Edison system, we need to maintain proper operation and safety performance. A testing plan needs to be developed for Li-ion storage systems using existing standards as well standards specific to our application of the energy storage system. In this project, we seek to engage a third party to assist Con Edison with the review and confirmation of the battery storage system for FDNY requirements. We will evaluate the possible failure modes the energy storage system may experience in the field from low probability, high consequence events to mid-to-high probability, low consequence events.

Benefits

Con Edison has limited experience with grid-scale li-ion energy storage systems. Engaging a third party with experience in evaluating such systems will help us receive proper performance, operation, installation and safety prior to applying the device on our grid. Once proven to be technically and economically viable, it is expected that energy storage can be used to defer infrastructure upgrades while improving customer's reliability and power quality.

Technical Status

We have engaged a third party to complete a hazard risk assessment. The assessment identified testing and related standards that can support appropriate safety protocols. In 2018, additional work was performed to evaluate the system against newly developed requirements and guidelines from the FDNY.

TITLE Impact Study and Modeling of Kinetic Energy Release from Manhole Cover Ejection

CSN 99820 POET 21852773 TASK 0001

PROGRAM AREA Distribution

DURATION 01/21/2016 to 06/2018 ENGINEER Josephine Aromando

PROJECT LEAD Mark Riddle

AUTHORIZED $150,000 EXP. THROUGH 2018 $114,600

Objective

The objective of this R&D effort is to gain subject matter expertise and analysis in the design and safety performance of vented manhole covers. The subject matter expertise and analysis will be developed through a partnership with the City University of New York Mechanical Engineering Department. This project will utilize CUNY to develop and analyze models, review and analyze experimental data, and provide an analysis of the likely health influences, on humans and canines within the zones of the blast. This exercise will create models for two typical Con Edison manholes and for at least four cover designs. The modelling will address various parameters, such as gas type and concentration, cover displacement, and forces horizontally and vertically surrounding the structure. Understanding the energy release that will result from each restraint system will help Distribution Engineering to specify which restraint system will be the most effective in protecting the public against potential manhole cover incidents. The results of the impact study may potentially lead to follow-on R&D work to evaluate the restraint system in a small-scale pilot study with a small sample of trial manhole covers to be used in the field.

Benefits

A restraint system for manhole covers may significantly contain the energy resulting from a sudden cover ejection during a manhole event. Minimizing the impact of the cover ejection helps to reduce the potential risks involved, such as damage to property, roadways, and possible injury to the public and employees. By understanding the effects of an event and containing this impact, safety to the public and protection of the environment could be achieved and associated costs could be greatly reduced.

Technical Status

Electric subsurface structures contain secondary network equipment and electric feeders. There are potential safety hazards related to cable insulation breakdown, salt intrusion from above ground, or other factors that cause a manhole event to occur. Flammable gases enter a structure when cable degradation occurs, and from third party sources, which over time may accumulate and increase in concentration if not adequately vented to the atmosphere. If cables arc, there could be a build-up of gases in the structure which may potentially result in such events.

A final report has been issued and approved by Distribution Engineering in January 2018. The report detailed the environmental impact study based on actual blast tests performed on multiple designs of vented latched covers at a third-party independent lab. The modeling results were consistent with the blast results performed in laboratory settings as detailed in CSN 99904 Performance Evaluation for Vented Restrained Manhole Covers. Conclusions from the modeling indicates that humans and pets that are shorter in height or close to the ground would experience the environmental impacts of a

cover ejection more adversely. Additionally, maximum sound levels at 158 dB were found during the peak of a blast event for short durations lasting 30 seconds and over an area with a 6-meter radius surrounding the manhole structure. Con Edison engaged with other utilities and with lab personnel to evaluate and study manhole event mitigation technologies. Since then, the Company has proceeded with an implementation program to install latched cover designs and utilize manhole fill (as studied in a separate project) that can mitigate the adverse effects of such events. To date, 750 latched covers have been installed throughout the system with plans to begin using manhole fill. This project is scheduled to be closed out in 2019.

TITLE 15kV 40kA Submersible Vacuum Fault Interrupter with Grounding Position

CSN 90595 POET 22285331 TASK 0001

PROGRAM AREA Distribution

DURATION 09/20/2016 to 12/2019 ENGINEER Serena Lee

PROJECT LEAD Leeman Hong

AUTHORIZED $297,000 EXP. THROUGH 2018 $256,705

Objective

The objective of this project is to procure and install two SCADA enabled vacuum fault interrupters with 3 position switches, SCADA control boxes, and handheld control pendants. These will be used as a field test for viability for future use. These interrupters with integrated switches can only be installed on 15kV and below, and will be installed in Westchester/Bronx as that area does not exceed that criteria. Additionally, all operations of the interrupter, opening the visible switch, and grounding can be done electrically remotely, which allows for crews from various regions to perform operations as no special equipment is needed. These interrupters will be used to ground the feeder, leaving a portion of it alive, and allow for gloved work (instead of hot stick only). Once installed, various metrics will be evaluated to determine future use.

Benefits

The use of the interrupter with 3 position switch will reduce feeder processing time, allow for a portion of the feeder to remain in service and improve the NRI (Network Reliability Index). Additionally, this product does fault interruption without SF6 (a greenhouse gas) as an insulation medium.

Technical Status

In 2018, we received the delivery of the SCADA enabled switches. They will be tested prior to pilot demonstration in the field in 2019.

TITLE Vault Sump Pump Real Time Monitoring Development

CSN 90939 POET 23339653 TASK 0001

PROGRAM AREA Distribution

DURATION 8/3/2018 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Marlon Argueta

AUTHORIZED $30,000 EXP. THROUGH 2018 $17,700

Objective

Enhance non-submersible vault drainage systems by developing and demonstrating a Vault Sump Pump Real Time Monitoring system.

Benefits

These new learnings will inform Company policy and practices towards better situational awareness of water conditions and pump system status in Con Edison street vaults, and thus mitigate claims of customer damage due to water intrusion from company infrastructure.

Technical Status

In Progress – a smart sump pump and monitoring system was developed, procured and installed for shakedown trials in a vault in Manhattan. Initial operational analysis revealed that the programming software did not perform as designed. Adjustments are being made and additional trials will be held in 2019 to assure proper performance in the field.

TITLE Secondary Reliability Index Optimization

CSN 90940 POET 23339654 TASK 0001

PROGRAM AREA Distribution

DURATION 08/3/2018 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Mark Riddle

AUTHORIZED $85,000 EXP. THROUGH 2018 $16,000

Objective

Develop an advanced analytic for a Secondary Network Risk Index that better quantifies risks of secondary cable and equipment failure and manhole events and establishes a baseline for measuring risk and understanding and managing mitigation, year-to-year. The plan is to evaluate the existing Secondary Risk Index and develop methods to convert it into a non-relative risk index: one that does not quantify risk primarily via comparisons between grid infrastructure, and therefore one that will assess overall grid risk levels year-over-year. We will also explore inclusion of additional grid data (much of which is regularly collected and readily available without substantial reprocessing) into calculation of the index.

Benefits

Low Voltage Cable failure continues to be a public and employee risk. Con Edison actions have driven reduction in explosions, reduction in CO events, and reduction in ENEs over the last ten years; but more is needed.

Technical Status

In Progress - The original contractor developed an interesting technical proposal but would not agree to appropriate terms. An alternate contractor has been selected, and work has re-started in 2019 towards best metrics and normalizations of asset risk at the network and map grid level.

TITLE Infrared Secondary Inspection ("ISI")

CSN 99874 POET 10046626 TASK 0032

PROGRAM AREA Distribution

DURATION 12/9/2011 to 12/2020 ENGINEER Serena Lee

PROJECT LEAD Alexander Dornhelm

AUTHORIZED $220,000 EXP. THROUGH 2018 $98,407

Objective

The objective of this program is to evaluate whether thermal images of secondary structures, cables, and connection taken as part of an existing manhole inspection program, can be used to predict, prevent, and prioritize system repair and emergency response. It is believed that secondary infrastructure with a substantial differential temperature, to the ambient and surrounding equipment temperatures, is more likely to result in a smoking manhole, fire and/or explosion. If the test base proves successful in identifying these problems, the next step would be to migrate the use of thermal imaging to the entire inspection program.

Benefits

The Infrared Secondary Inspection has the potential to locate and mitigate some of our manhole events, which will decrease number of customer outages.

Technical

In 2018, there were 112 repairs made on hot spot conditions that were found due to thermal imaging. Con Edison Distribution Engineering released a specification in April 2018 that describes in detail procedures for field crews to find, categorize, and repair hot spots. Thermal imaging is also now being used to identify high loaded customer cables. By working with Energy Services, we are better at identifying when customer services need upgrades.

TITLE Technoeconomic Analysis of Electric Rail Regenerative Braking Benefit to Electric Power System

CSN 90464 POET 22097097 TASK 0001

PROGRAM AREA Distribution

DURATION 06/16/2016 to 06/2018 ENGINEER Constantine Spanos

PROJECT LEAD Steven Malena

AUTHORIZED $225,000 EXP. THROUGH 2018 $209,898

Objective

In this project, a research university performed a detailed transient analysis on the New York City Transit (NYCT) DC distribution network. The purpose of this study was to understand/estimate the behavior of the NYCT distribution system when wayside energy storage is deployed for improved utilization of regenerative braking energy. Using transient models and validated simulations, the research university assessed the various technology alternatives available for wayside energy storage including lithium-ion batteries, flywheels and supercapacitors. The impacts of the different storage technologies on the system, e.g. the quantity of the harvested energy and the impact on the third rail voltage, was explored, as well as system configuration and cost.

Benefits

The New York Metropolitan Transportation Authority (MTA) consumes approximately 2150 GWh per year for traction power, while the MTA NYCT alone consumes about 80 % of the total annual MTA energy consumption. Currently, the regenerated energy by MTA trains contributes to supplying only the train auxiliary loads and equipment (e.g. onboard HVAC), or nearby trains simultaneously accelerating. The rest of the energy is dumped through resistors because the regenerated energy injected to the third rail would cause the supplied power to exceed the load demand leading to a transient over-voltage (i.e. the third rail voltage exceeds the maximum allowable voltage to supply the train) that may cause tripping of protection device. There is potential for cost decreases if the regenerated energy is harvested and reused in the MTA system for the following reasons: 1) The regenerated energy is significant 2) High number of passenger stations, and frequent train stops are characteristics of the MTA NYCT system, and urban transportation generally. 3) With better coordination, there is potential for significant reduction in demand with dispatched wayside energy storage.

Technical Status

The project has been completed with the development of a simulation model that will be used for sizing a possible pilot demonstration system in 2019 in collaboration with NYCT and NYSERDA.

Tasks (checked boxes are completed):

- ☒ Data acquisition and literature study
- ☒ Model development for a small passenger station
- ☒ Model development for large/multiple passenger stations
- ☒ Review on economic aspects.
- ☒ Final report & documentation

☒ Release of public whitepaper to inform future NYSERDA solicitations.

TITLE Navigating DER Interconnection Standards and Practices – Innovation Challenge Pilot

CSN 90987 POET 23551032 TASK 0001

PROGRAM AREA Distribution

DURATION 11/20/2018 to 12/2019 ENGINEER Simon Odie

PROJECT LEAD Steven Malena

AUTHORIZED $50,000 EXP. THROUGH 2018 $10,000

Objective

The project has two components with the following objectives: 1) support the Company in applying the new IEEE 1547[1] standard and 2) improve utility DER interconnection practices. Part I of the project will explore issues such as the assignment criteria for IEEE 1547 performance categories, the grid-specific tuning of DER settings within the 1547-specified ranges of adjustability, and the selection of the 1547-referenced communication protocol. Part II will encompass application management efficiency improvements, opportunities to harmonize technical screenings, considerations for grid-supportive DER, and approaches for addressing unique grid design and deployment scenarios, including qualitative risk assessment, and related tools. Joint utility participants will be able to share their experience and learn from each other while also receiving utility specific support.

[1]IEEE 1547: Institute of Electrical and Electronics Engineers; IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

Benefits

This EPRI Supplemental project seeks to develop internal resources ready to apply new IEEE interconnection requirements (IEEE 1547, 1547.1, UL1741(SA), and certifications), and to assess utility opportunities for streamlining interconnection practices and sharpening technical review procedures. The deliverables of this supplemental project will inform future DER interconnection requirements as well as provide a guideline on how the distribution system shall operate under normal conditions given varying PV injection due to smart inverter operation.

Technical Status

Distributed Energy Resource (DER) installations are increasing and, in response, efforts are underway to better manage how they connect to the grid. Initially guided by the FERC Small Generator Interconnection Procedure (SGIP) and IEEE Standard 1547-2003, interconnection procedures and technical requirements have since been adapted to account for technology changes and emerging grid reliability issues, as well as process-oriented bottlenecks. Many utilities are, for example, facing growing connection queues, wide-ranging feeder hosting capacities, and inconsistencies in how and when to apply technical screens to address reliability concerns. The IEEE 1547-2018 standard outlines the technical considerations for the interconnection and interoperability between utility electric power systems (EPSs) and distributed energy resources (DERs). Smart Inverter settings include: voltage and reactive power control (fixed power factor, volt-var); voltage and real power control (volt-watt); frequency-watt; frequency ride thru, etc. These changes will likely require utilities to modify their processes and boilerplate interconnection agreements to meet changing expectations, technologies, and standards.

TITLE Distribution Automation of Network Protectors via DA-Takeout Pilot

CSN 90951 POET 23402597 TASK 0001

PROGRAM AREA Distribution

DURATION 9/10/2018 to 06/2019 ENGINEER Simon Odie

PROJECT LEAD Tony Zhu

AUTHORIZED $36,000 EXP. THROUGH 2018 $9,579

Objective

The objective of the DA-Takeout Pilot is to understand the capability of the Distribution Automation (DA) Access Point (AP)-Takeout model for effective distribution equipment communication and controls via AMI. This includes the capability of the infrastructure to handle high polling Interval frequencies and exception reporting. There will also be newly established routes established through the Company's firewalls, routers, and applications that allow for the traffic from the endpoints to the Con Edison environment. Included in the objectives are requirements for secure tunnels to provide an encrypted network with authentication to prevent malicious attacks. With acceptable multi-layer security, field bridges will be deployed onto two network protectors and connections made through two APs back to Con Edison's SCADA Test environment. Adjusting configurations for increased polling rates and observing failovers to alternate networks (cellular) will provide insight to the reliability of AP-Takeout.

Benefits

This project allows Con Edison to leverage its new AMI infrastructure to understand methods by which distribution equipment can communicate via AMI. The new communication established to Network Protectors in this pilot may allow for further telemetry and remote control. A new functionality may improve operations by possibly being able to identify alive-on-backfeed network protector conditions, and improving recognition of system conditions. These benefits may result in a more reliable distribution system, and a reduction in truck rolls. In addition, project developed controls for network protectors have the potential to be translated to other distribution system equipment such as underground and overhead switches in an effort to better modernize the distribution grid.

Technical Status

Con Edison is planning on a Distribution Automation grid modernization effort that includes control and telemetry of Intelligent Electronic Devices (IED) such as Network Protectors and Recloser Switches. One of the possible solutions to Distribution Automation is AP-Takeout, which leverages the AMI communication network. AP-Takeout is a new solution that uses the existing Advanced Metering Infrastructure (AMI) communication network (access points and relays) with new remote bridge devices at the IEDs to pass network traffic through a cellular backhaul. DA-Takeout presents a viable option for Con Edison, but needs validation of its resiliency to cybersecurity attacks and ability to handle high polling rates from a demanding and dense network. A lab test then field pilot would prove the functionality of AP-Takeout and develop the proper configurations for a future Distribution Automation solution.

TITLE Development of Training Course for Electric Operations in Virtual Reality Environment

CSN 90270 POET 22930662 TASK 0001

PROGRAM AREA Distribution

DURATION 11/13/2017 to 12/2018 ENGINEER Sergo Sagareli

PROJECT LEAD John C. Amato

AUTHORIZED $150,000 EXP. THROUGH 2018 $5,877

Objective

To conduct training in a classroom setup, and at the same time, in a very life-like feeling, project team suggested to develop virtual reality application that will provide new hires with needed set of skills and job hazards awareness. Our goal is to create an interactive Virtual Simulation training for field folks to gain experiences and learn from their mistakes in a controlled computer environment without being injured. For the first simulation pilot, our plan is to have the employee experience being the lead on a job from beginning to end. Steps include the job briefing, driving out to the field location, setting up work area protection around the structure, signing on with the control center, testing equipment dead, performing an Underground job, cleaning up and returning to the yard. If any mistakes are made such as not spearing or testing cable dead, the employee would see the consequences on the screen and learn not to repeat those mistakes when in the field. For example, not testing cable dead would result in a flash on the screen and employee would have to retake the training. Our long-term vision is to create Virtual Simulation training for various tasks for the construction groups Underground, Overhead, URD, Services, Cable, Flush etc.

Benefits

Electric Operations employees will receive on-the-job training in a safe classroom environment, while having complete sense of being present in real life job environment.

Technical Status

With aging workforce, knowledge transfer to newly hired employees is an important task. Training on energized equipment and in the streets with traffic is dangerous for unexperienced workforce. We will start out with the Underground pilot first and incorporate any lessons learned into the future simulations.

Virtual Reality Scope for 1st phase – through the end of 2019:

- OSHA pre-job briefing in the work out location
- Circle of safety to inspect/check vehicle for flat tires, damage
- DOT Vehicle inspection checklist
- Mobilize by obtaining materials for job
- Equipment inspection –fire extinguisher, 1st aid kit
- Driving to the job location – merging, tight street, bicycle, pedestrian (eye check)
- Job briefing at the job location – possible interjections (night/day/rain/snow)
- Setting up the work area protection – air monitoring, voltage tester, working ahead sign, HPI peer check with partner, possible interjections (pedestrians walking into job site, pedestrians asking questions)

- Feeder sign on with control center to obtain proper authority to perform work both electronically and verbally
- Testing Dead - spear primary feeder cable – verification of testing cable dead
- Splicing set of straights – HPI peer check with phases, drop and pick up cable, spear, cut, short and seal
- Feeder Sign off (job complete) –sign off after 2 phases complete with control center both verbally and electronically
- De-mobilizing the work area setup – start to take signs down first then turns into animated clip
- De-Briefing – close out work using Logica
- Returning to work out location – PILC cable bin, lead cable, scrap metal bins

TITLE DOE Development of TRANSENSOR for Distribution Transformers

CSN 90898 POET 22830019 TASK 0001

PROGRAM AREA Distribution

DURATION 10/13/2017 to 06/2019 ENGINEER Serena Lee

PROJECT LEAD Jane Shin

AUTHORIZED DOE Reimbursable EXP. THROUGH 2018 $10,738

Objective

Con Edison is partnering with researchers on the TRANSENSOR (Transformer Real-time Assessment INtelligent System with Embedded Network of Sensors and Optical Readout) project partially funded by the DOE. The project will seek to combine low cost embedded fiber optic sensors to monitor key internal parameters such as internal hotspots, vibration levels, and partial discharge events on our underground distribution transformers. Con Edison is responsible for field testing the underground distribution transformer integrated with the TRANSENSOR on the electric distribution system. A summary report will be developed to describe the field demonstration, data collected, details of the testing and summary of the test results.

Benefits

On-line monitoring sensors can provide advanced warning of impending transformer failures. This can potentially mitigate any catastrophic events that can impact the safety of our employees and the public. If successful, this project is expected to better understand if an underground transformer is about to fail.

Technical

The vendor has developed the sensors and have installed them in two new network transformers at the transformer manufacturer for testing. The results of the test are promising. In 2019, we will install them in the field for field trials.

TITLE Compact Submersible 25kA Primary Fault Interrupting Switch & Control Cabinet

CSN 92426 POET 20642361 TASK 0001

PROGRAM AREA Distribution

DURATION 09/6/2013 to 12/2019 ENGINEER Serena Lee

PROJECT LEAD Peter Day

AUTHORIZED $490,000 EXP. THROUGH 2018 $122,181

Objective

Existing isolation switches require an additional structure, must be locally operated, rely on accessories for grounding, and do not interrupt fault current. The purpose of those switches is to provide a means to isolate faulted portions of feeders so that unfaulted portions can be restored. The more quickly this can be done and the more assets are kept in service, the less stress is exerted on other system components. A three position, remotely operable switch provides a quicker means of processing the faulted portion of the feeder, while adhering to associated operational procedures with the addition of cam-ops. By having a fault interrupting switch, the unfaulted portion of the feeder will not be affected by a feeder event, keeping as many assets in service as possible when an event occurs. Additionally, as part of the proposed initiative to require new 120V/460V customers to own, operate and install their internal distribution equipment, including network protectors and transformers, a method is needed to isolate and ground the customers from the grid for feeder work. The purpose of the second switch installation is to test a new method of isolating customer equipment making it possible to adopt the new initiative for customers to own and operate their own electrical equipment. A three-position submersible medium voltage switch and control cabinet installation is required in a company owned manhole outside the customer premises that allows for isolation from the customers equipment. For this proposed test pilot, the switch will be installed outside a customer location that has been identified with difficult access issues.

Benefits

An enhanced compact, submersible, primary (fault-interrupting or non-fault-interrupting) switch will improve network design resiliency and enhance restoration efficiency, helping to reduce feeder processing time and bottom-line costs.

Technical Status

In 2018, we found water intrusion in the SCADA box for the switch. As a result, we have decided to put the project on hold. A 15 kV 40 kA submersible vacuum fault interrupter was developed in 2018 as part of another R&D project which will be tested and piloted in 2019. If that switch is demonstrated to be successful, this project will be closed out.

TITLE Early Summer Load Forecasting Tool

CSN 99896 POET 21644111 TASK 0001

PROGRAM AREA Distribution

DURATION 9/1/2015 to 1/2018 ENGINEER Constantine Spanos

PROJECT LEAD Sho Ohata

AUTHORIZED $75,000 EXP. THROUGH 2018 $70,000

Objective

This project focused on the exploration of various datasets to improve upon the current network area forecasting process. The overall goal was to identify datasets to allow for upcoming summer load forecasting without the current summer load, as well as determining datasets that provide indications of a growing network in the coming years. These data inputs could improve the accuracy in-house models when used in conjunction with current summer data.

Benefits

The primary benefit from this project is to allow for better planning of distribution system work well in advance of an upcoming summer. This will allow for cost savings, as well as ensuring that system issues in critical networks which may be stressed in an upcoming summer will be addressed.

Technical Status

This project was launched in mid-2016. Many different datasets have been explored to determine their completeness and timely availability as well as their power to predict future load changes (Longitudinal Household Employment data, Taxi and Limousine Commission data, real estate price and occupancy, yearly updated building floor area, number of permits, etc). The predictive model has been built and research findings are detailed in the Final Load Forecasting Report issued in summer of 2017. The most promising datasets identified included NYC Department of Buildings permitting data. Final payment posted in January 2018, and the project is pending closeout.

Tasks (checked boxes are completed):

- ☒ Con Edison worked with a NYC research university to identify the data sources that best capture the predicted load in various networks. The research university specializes in working with large and disparate data sources to glean insights into urban environments and its occupants.
- ☒ The university built a machine learning model to apply to widely varying urban data sets (sales of certain products, subway turnstile activity, or taxi activity) to identify the data sets that best correlate with the load changes in a given network.

TITLE Service Link™ Application for Meter Exchanges

CSN 99803 POET 21900931 TASK 0001

PROGRAM AREA Distribution

DURATION 02/22/2016 to 06/2018 ENGINEER Josephine Aromando

PROJECT LEAD Julie Yong

AUTHORIZED $50,000 EXP. THROUGH 2018 $16,486

Objective

The Service-Link™ software has been proven to work with our existing CIS in both the Field Operations and Customer Operations groups for an estimated ten years. The plan is to use the existing Service-Link™ technology with MAG to streamline the process and automate the meter exchange paperwork in order to save time in data entry and processing and to focus the Company's efforts towards enhancing the customer experience. Thereafter, the Company can work with Service-Link™ vendor to provide more forms for entering test data, subsequently updating both CIS and ADAMS database without error. This approach would focus on purchasing five Service-Link™ hardware units to test in the field. If proven successful after two weeks of field testing, plans to expand this pilot to additional units would then be implemented.

Benefits

An evaluation of Service-Link™ would have determined how effective it would be in streamlining customer information more quickly, eliminating unnecessary paper trails, and avoiding costs associated with archiving records with Iron Mountain. In doing so, labor productivity improvements could have been measured.

Technical Status

A temporary server has been set up to review work orders from another utility and have been used to build upon the workflow for Meter & Test. Customer operations has agreed to the use of their test server to review new workflows built based on the immediate feedback. The iPhones purchased were able to download a working version of the Service Link application and tested with preset work orders from another utility. Once finalized, the meter work orders can be configured to reflect real work scenarios in the service territory. As of December 2018, this project has been terminated due to the use of ProField Manager that provides similar functions and features that ServiceLink would have evaluated. ProField uses a different platform and hardware but is used widely in Electric Operations. Therefore, the decision to terminate this project evaluating ServiceLink was made.

TITLE Structure Monitoring System

CSN 99821 POET 21852771 TASK 0001

PROGRAM AREA Distribution

DURATION 01/20/2016 to 12/2019 ENGINEER Serena Lee

PROJECT LEAD Zhou Zheng

AUTHORIZED $250,000 EXP. THROUGH 2018 $2,243

Objective

The goal of this project is to develop a cost effective manhole monitoring system that will report back conditions in our underground structures that may eventually lead to manhole events.

Benefits

The program's primary objective is to reduce the number of manhole events and energized objects through the use of an early warning gas and stray voltage detection system. If successfully developed and implemented, the system will result in the detection of certain gases and voltage conditions that are associated with manhole events and stray voltage. This will allow for early intervention before the situation evolve into a problem and thus, resulting in a decrease in the number of incidents of manhole fires, explosions and stray voltage conditions.

Technical Status

In 2018, approximately 2,600 generation 1.5 SOS (Structure Observation System) units were installed in secondary rebuild structures throughout the Con Edison service territories. Currently, we have collected around 4.5 million data points from all installed devices. Additionally, several hotspot and stray voltage conditions have been detected and mitigated. Generation 2.0 SOS design was finalized and put into pre-production in December 2018 and will be ready to manufacture/install in early 2019. The new design includes an additional visible camera sensor, LED flash and redundant Carbon Monoxide sensor and will continue to be installed in secondary rebuild structures. The majority of the costs have been reclassified as capital.

TITLE Public Safety Program Cost Benefit Analysis

CSN 99802 POET 21912371 TASK 0001

PROGRAM AREA Distribution

DURATION 2/24/2016 to 04/2018 ENGINEER Serena Lee

PROJECT LEAD `Zhou Zheng/Stan Lewis

AUTHORIZED $350,000 EXP. THROUGH 2018 $337,644

Objective

Con Edison in partnership with a university seeks to analyze a) each Public Safety Programs cost to an effective net benefit, b) each Public Safety Programs cost to individual benefits; and c) optimization of the greater program portfolio to specific benefits. The cost vs benefit curves for five of Con Edison's established public safety programs will be studied as Task 1 and emerging public safety programs as Task 2. Program benefits will be measured around safety and reliability. For purposes of public safety, the benefits will include the risk to the public of experiencing an injury or property damage event from the failure of Con Edison equipment. Some of the risk parameters for safety may include fires, explosions, carbon monoxide evacuations, and electric shocks. For purposes of reliability, the benefits will include equipment damage and loss of service. Some of the risk parameters for reliability may include open mains, no lights, side offs, shunts and bridges.

Benefits

Optimization of public safety programs is expected to yield cost savings and/or safety performance enhancements.

Technical Status

The project is complete. The vendor provided Con Edison with their findings of the cost vs. benefits for our established public safety programs (vented cover replacement, mobile & manual contact voltage scanning, SIP inspection and quality assurance). A final report did not identify any new strong program performance trends or correlations.

TITLE Mobile contact voltage detection development and demonstration

CSN 92681 POET 20705476 TASK 0001

PROGRAM AREA Distribution

DURATION 11/4/2013 to 12/2018 ENGINEER Frank Doherty

PROJECT LEAD A. Dornhelm, R. Li

AUTHORIZED $140,000 EXP. THROUGH 2018 $135,491

Objective

Develop, build and demonstrate an alternate scanning device. Deliverables include a demonstration prototype for feasibility analysis and a field-deployable system for field trial.

Benefits

Development and deployment of a competitive alternate mobile contact voltage detection system will eliminate dependency on a sole source provider while complying with regulatory requirements. Resulting competition is expected to drive down costs and provide incentive for improved quality of performance. Once effectiveness is demonstrated, availability of two systems will allow better benchmarking and quality control, and improved detection of energized objects will reduce the risk of shock to the public.

Technical Status

Completed – Equipment was purchased, and effectiveness and sensitivity tests were performed for multiple arrangements and E-field sources. Work was largely suspended while patent challenges and litigation are resolved. While various litigation matters involving patents in this field have been settled, including the lifting of an injunction, market interest remains very low based on vendor business case assessment. In the near future, AMI and IOT (internet of things) may allow R&D of economical direct measurement and monitoring on potential contact voltage sources. To be closed.

TITLE Underground Conduit Development to Mitigate Manhole Events

CSN 90467 POET 22104253 TASK 0001

PROGRAM AREA Distribution

DURATION 6/27/2016 to 12/2019 ENGINEER Serena Lee

PROJECT LEAD Michael Donohue

AUTHORIZED $90,000 EXP. THROUGH 2018 $93,418

Objective

The objective of this project is to install the Flame Shield conduit between two structures. The plan is to have a contractor install 4" conduit for a relay project in between two structures in Manhattan.

Benefits

Manhole events, electric shocks, and carbon monoxide accumulations in buildings continue to be a public and employee safety risk. By developing improved cable protection, it will keep protecting our cable better, keeping carbon monoxide gas out of the ground. The conduits sealed joints may also make it attractive to house electric cables passing through hazardous environments such as ground gas areas. Flame shield phenolic conduit can potentially achieve these goals. This project will determine if the conduit is technically and operationally feasible.

Technical Status

This project sought to explore the use of new duct types for the low voltage electric distribution system. Early tests of fiberglass ducts went very well in terms of their ability to withstand high temperatures for protracted periods. However, these ducts ability to withstand puncture, from a backhoe or other street tool, was not satisfactory. The team has returned to reviewing current market solutions and more customized options. This project will be closed out in 2019.

TITLE Trial Installation of New Splice Box at TLC

CSN 90273 POET 22946701 TASK 0001

PROGRAM AREA Distribution

DURATION 12/15/2017 to 12/2019 ENGINEER Frank Doherty

PROJECT LEAD Alexander Lin

AUTHORIZED $80,000 EXP. THROUGH 2018 $1,110

Objective

We seek to evaluate splice boxes from Channell Corp which are HDPE, allow for racking, are Tier 22 rated, and have more options for covers of varying loading capabilities. This demonstration and evaluation will be done at The Learning Center.

Benefits

Reducing sole sourcing and increasing flexibility / usability / durability of underground structures are clear benefits worthy of pursuit. This project will help develop data required for better quantifying those benefits.

Technical Status

The new splice box was installed at our Learning Center in Queens in 2018. We were able to arrange installation with a construction management crew, as it would be in the field. The unit's double stack arrangement of large size box appears to have adequate space for a primary URD transformer and will help bring that to fruition. The small box appears sufficient for secondary services; both are heavy duty and have a tier 22 rating (good enough for residential street loading). However, a few pending issues remain before a field trial in 2019.

TITLE JSSE Mobile Application

CSN 99777 POET 22049818 TASK 0001

PROGRAM AREA Distribution

DURATION 5/23/2016 to 02/2018 ENGINEER Steve Labudzinski

PROJECT LEAD Regina Ferrer

AUTHORIZED $50,000 EXP. THROUGH 2018 $21,754

Objective

This project proposes to create a mobile JSSE application that address the problems/challenges by allowing for the following: data entry from a Mobile app that will be integrated and populated to the EH&S SharePoint server, JSSE formats can be loaded according to the individual disciplines of work function to insure relevancy of the JSSE, ease of data entry, and provide for future analysis.

Benefits

The benefit for this project is qualitative and quantitative. The qualitative benefit is the new mobile App. that will improve the data captured on a JSSE by capturing it once at the time it occurred. The time lapse between receiving feedback and then arriving in the office to complete the form on the SharePoint may lessen the accuracy and impact of the coaching session. The quantitative benefit is the mobile App will eliminate about 50% of the effort required to complete a JSSE by eliminating the recording of the event on paper for later input into the SharePoint site.

Technical Status

Electric Operations document safety discussions with crews on forms titled Job Site Safety Exchange (JSSE) that are housed on an intranet Sharepoint site. Employees that complete the Job Site Safety Exchange (JSSE) handwrite notes and a synopsis of the communication while in the field and completes the form once back in the office. The lapse in time between the actual JSSE and the time the form on the SharePoint site is completed can lessen the accuracy and impact of any coaching session that took place as well as the loss of valuable feedback from the actual exchange. The process also requires performing the same task twice, once in the field and again in the office. Finally, the JSSE SharePoint site is not user friendly and currently displays data entry fields in dense single displays which makes it difficult to analyze and to react to information entered. Also, the standard forms cannot be easily optimized by function/department to be more customized/relevant. The program was expanded to include Mobile Job Briefings app. The project showed that a mobile electronic solution to paper documents can be successful and dynamic. Also, the electronic solution has value as it can save pictures, time and GEO stamp the information exchange and would be accepted by users. The project is completed and the feedback/information gained will be used for internal development of similar Apps.

TITLE High Impedance Fault Detection on Distribution Overhead Feeders

CSN 90500 POET 22129397 TASK 0001

PROGRAM AREA Distribution

DURATION 07/15/2016 to 12/2018 ENGINEER Serena Lee

PROJECT LEAD George Hoxworth

AUTHORIZED $85,500 EXP. THROUGH 2018 $132,228

Objective

EPRI conducted a project on High Impedance Fault Detection at their test lab in Lenox, Massachusetts where they are staging high impedance faults and evaluating the performance of the relays with algorithm to detect these faults. In this project, we seek to leverage the work that EPRI is doing by investigating whether data from the Con Edison system would false trip these relays.

Benefits

High impendence faults can have varying levels of financial impact. During high impedance fault conditions, the fault current is not high enough to trip protective devices which can cause unnecessary damage to the distribution system and other infrastructure (such as roads, vehicles, gas mains, etc.) delaying restoration time.

Technical

The EPRI project is complete. More equipment than anticipated was needed to be installed in order to collect data from the system. Project funding will be adjusted. The experiments at EPRI have demonstrated that there are many high-impedance faults that draw currents. Examples include conductors on asphalt and covered conductors. These are undetectable using algorithms that detect arcing currents. These scenarios are the most dangerous to the public because the conductors look de-energized; there is no arcing. EPRI has also identified that pinging automated meters are a promising new approach to detect many downed conductor scenarios. This applicability of this approach for Con Edison needs to be further investigated. This project will be closed out in 2019.

TITLE NYSERDA Optical Sensors Development for Distribution Systems ($200K from NYSERDA)

CSN 90785 POET 22708585 TASK 0001

PROGRAM AREA Distribution

DURATION 08/3/2017 to 06/2019 ENGINEER Serena Lee

PROJECT LEAD Paul Stergiou

AUTHORIZED Funded by NYSERDA EXP. THROUGH 2018 ($80,255)

Objective

In this NYSERDA funded project, Con Edison will partner with a vendor to qualify, pilot and deploy a next generation optics based medium voltage (MV) and medium current (MC) network grid sensor. The scope of work includes developing test criteria for the new sensors, conducting third party laboratory testing, installing the sensors on Con Edison distribution system and collecting data for one year for the field trial.

Benefits

Reliable and highly accurate voltage and current sensors are needed to monitor and troubleshoot the distribution system. To date, we have identified three applications for the optical sensors on the distribution system. They include applying them underground to facilitate rapid and more accurate detection of fault locations, replacing failed capaciformers and voltage neons indicators that are unreliable at unit substations.

Technical Status

The sensors for the three applications have been installed for pilot testing in the field and are currently under evaluation.

TITLE Random Network Protector Auto-Exercise to mitigate Alive on Backfeeds

CSN 99910 POET 21546251 TASK 0001

PROGRAM AREA Distribution

DURATION 07/9/2015 to 12/2018 ENGINEER Serena Lee

PROJECT LEAD Joseph Cultrera

AUTHORIZED $260,000 EXP. THROUGH 2018 $121,057

Objective

The objective of this project is to provide field forces with the ability to identify NWPs (Network Protectors) that would either failed to trip or failed to close when system conditions require it. By devising a scheme to automatically exercise the NWPs periodically, we can potentially identify the problemed NWPs pre-emptively and proactively make repairs. To accomplish this, we plan to upgrade the firmware on the existing non-communicating microprocessor relays at individual street feed locations. At multibank locations, we will install communicating relays, flashed with the auto-exercising algorithm, and associated cables. This algorithm will trip and auto-close the network protector which will be tracked on NetRMS with the use of the “B” and “M” flags indicating a NWP operation.

The project will be performed in stages:

1. Develop the algorithm and obtain one set of the required hardware for laboratory bench testing.
2. Purchase the necessary equipment/firmware and install it at eighty-one (81) locations for the pilot project.
3. Monitor NetRMS and work with field forces to identify and repair failed NWPs.

If this project is deemed as a useful tool, R&D will seek to capitalize the cost of installation for system deployment.

Benefits

- Increase reliability by reducing the possibility of failures by:
- Proactively identifying NWPs that fail to trip prior to feeder outages.
- Reduction in ABF occurrences and help achieve a reduction in feeder restoration times.
- Reduce additional faults on the feeder due to over voltages.
- Proactively identify NWP’s that fail to close allowing us to reduce overload conditions during the peak loads.
- Reduction in O&M expenses by:
- Minimizing search for ABF locations and allowing us to utilize our field forces on scheduled work eliminating periodic inspections for network protectors that successfully confirm auto operation and shift to condition based inspections/repairs.

Technical Status

This project is complete. The goal of this project is to determine if the auto-exercise logic will be helpful in reducing the ABF rate and ensuring NWPs are closed to support the distribution network by identifying NWPs that fail to close or trip. In the last 18 months we identified and repaired 8 defective

NWPs, thus proving the effectiveness of auto-exercise logic. The NWP auto exercise program population has been expanded by the Grid Modernization project and further deployment shall be in accordance with EO-5411 and Distribution Engineering - Equipment Group will continue to audit the NetRMS data to identify defective NWPs. Portions of this project were capitalized in 2018.

TITLE Arcing Fault Detection in Network Protector Relays Field Demonstration

CSN 90227 POET 20956928 TASK 0001

PROGRAM AREA Distribution

DURATION 05/22/2014 to 12/2017 ENGINEER Serena Lee

PROJECT LEAD Michael Donohue

AUTHORIZED $485,000 EXP. THROUGH 2018 Expense recategorized to Capital

Objective

Secondary electrical manhole events can present a significant safety risk to the public and our workers. Many of these events can be attributed to the ignition of combustible gases that are normally generated when an electric arc causes secondary cable insulation to burn. These electric arcing faults normally draw insufficient current to reliably operate conventional protection to isolate the failure. The faults can arc for long periods of time, resulting in heat, smoke, and gasses accumulating and causing smoke, fire, or even explosions at manholes. In previous R&D efforts, we have used real-time arcing fault data collected from Manhattan's Cooper Square network to correlate observed manhole events. Using the data collected, algorithms to detect and characterize arcing faults on the secondary network have been developed and integrated onto the network protector relay. These algorithms were tested in the test lab and determined to be effective at arcing fault detection. Prior to system wide deployment, a small scale field demonstration is needed to complete the technical capability evaluation under field conditions, finalize use cases, obtain operational experiences and develop installation and response procedures for the system. In this project, we seek to complete the field demonstration in two ways. Because our data collection efforts have been limited to Manhattan thus far, we plan to expand the effort to Brooklyn where there are higher concentrations of high risk cable types such as Aluminum, 4/0 and lead cables. We seek to build and install fifteen (15) new Arc Fault cabinets in a selected Brooklyn network. The cabinet will contain network protector relays with the arcing fault detection enhancement and a data collection device to retrieve and store data and oscillography for the purpose of algorithm evaluation and improvement. Additionally, a number of existing in service network protector relays in Manhattan and Brooklyn will be flashed with new firmware which will include arcing fault recognition as well as the normal relay functions. These relays will bring up an alarm flag if an arcing fault is recognized.

Benefits

An underground structure event impacts public safety. Averting these events would result in decrease risk and exposure to our employees and the public.

Technical

The Arc Fault Project seeks to detect low voltage cable failures through the use of network protector relays. We have reprogrammed a number of network protector relays with the arcing algorithm and monitored activity alerts within a network. Thus far, we do not have much evidence that we can successfully correlate the arc fault indications with events on our secondary network system. We are planning to complete the evaluation of the feasibility of this project in 2019. Portions of this project have been capitalized.

TITLE Collaborative Research to Advance ANSI CTA-2045

CSN 90767 POET 22834142 TASK 0001

PROGRAM AREA Customer

DURATION 06/2018 to 06/2021 ENGINEER Steven Go

PROJECT LEAD Zachary Sussman

AUTHORIZED $60,000 EXP. THROUGH 2018 $60,000

Objective

This project is designed to enable continued education about CTA-2045 technologies by furthering research, updating functional requirements, advancing test tools, contributing to consensus test procedures and demonstration with EPRI. There are mutiple tasks within this project, 1) Update Preliminary End-Device Requirements 2) Development of Preliminary Functional Requirements for New Device 3) CTA-2045 Test Tools - including hardware design guides and CTA-2045 application simulator 4) test plan development 5) industry outreach and support 6) Demand Response Program Support and Guide Development, 7) OpenADR and CTA-2045 Mapping and application software libraries where OpenADR 2.0 where field demonstrations can be carried out by EPRI as part of the NYSERDA funded effort. Software libraries will be provided to the open source community to facilitate the use of the standard.

Benefits

This project focuses on identifying and documenting the processes that must be in place to facilitate a wide adoption of a modular communication interface standard for device participation in demand response (DR) programs. This research will support industry efforts to establish cost effective, and standard communications-enabled residential appliances and devices for DR program participation. In addition, a modular interface would provide consumer choices in network providers, and would help prevent appliance obsolescence related to non-standard communication technologies.

Technical Status

After the Consumer Technology Association (CTA) published the CTA-2045 standard in February 2013, a collaboration was formed to learn if technology providers, regardless of their product type, could build products that could communicate with one another through a standardized port that met the requirements defined in the CTA-2045 standard. In order to carry out this project and learn if different products can interoperate with one another, the collaboration required that real products be built and tested in the field. Utilities and technology providers worked together to develop hardware and software tools to build, test and verify that products met specific requirements. By mid-2016, thirteen different product types from twelve vendors were developed and deployed in labs and service territories across the US, Canada and France. However, EPRI research showed that the industry is not equipped with the tools, mechanisms and knowledge to sustain the momentum achieved under the initial collaboration project. This project was kicked off mid-2018, we identified use cases that are relevant to the 5 boroughs of NYC as well as suburbs. Technical requirements gathering, and gap analysis will be conducted year 1. Deployment planning, technology procurement, lab testing, field deployment as year 2 activities. Finally, data analytics and reporting on year 3.

TITLE EPRI Data Center Collaborative

CSN 90658 POET 22164157 TASK 0001

PROGRAM AREA Customer

DURATION 07/28/2016 to 12/2019 ENGINEER Steven Go

PROJECT LEAD Rebecca Weiss

AUTHORIZED $75,000 EXP. THROUGH 2018 $75,000

Objective

EPRI, in partnership with a minimum of five utility collaborators, will conduct a study to determine the energy savings potential of small and embedded data centers for utility energy efficiency programs. EPRI will develop methodologies for identifying small and embedded data centers; assess emerging best practices and technology solutions; provide data and information for utility data center program development; and assist utilities in engaging customers with small and embedded data centers.

Benefits

The findings of this Collaborative will enable Con Edison to identify small and embedded data centers within our service territory and provide the information needed to run programs targeted at customers with small and embedded data centers. Customers participating in these programs are expected to see energy savings of 20-40%, a potentially significant contribution to achieving our Energy Efficiency goals.

Technical Status

Small and embedded data centers currently account for about 50% of total data center energy use, and have 10-50 times the energy intensity of offices. Con Edison currently has limited knowledge of the location of embedded data centers within our service territory. Additionally, the Company offers no programs or incentives to encourage embedded data center energy efficiency, and has a need for additional expertise in this area. Finally, NYSERDA's traditional data center incentives are ending in 2017, leaving a program gap. The implementation of energy efficiency measures in small and embedded data centers typically leads to energy savings of 20-40%, making data centers a very appealing target for our energy efficiency programs. The data center collaborative project was launched end of 2017 working through 2018 with the goal of publishing a best practice guide for embedded data centers. Together with other utility partners we identified key questions we seek answers to this space.

These are:

- What do small data centers (DC) look like?
- How much energy are they consuming?
- How to identify small and embedded DCs?

TITLE PRE-COMMERCIAL SCALE-UP OF A GAS-FIRED ABSORPTION HEAT PUMP (GAHP)

CSN 90893 POET 23137329 TASK 0001

PROGRAM AREA Customers

DURATION 2/22/2018 to 02/2020 ENGINEER Josephine Aromando

PROJECT LEAD William Xi

AUTHORIZED $20,000 EXP. THROUGH 2018 $10,000

Objective

The objective of this pilot study, which resulted from a multi-million dollar Department of Energy (DOE) grant (DE-FOA-0001632), is to collaborate with two third-party vendors to execute the next phase of this study, which is to demonstrate gas-fired absorption heat pump (GAHP) technology at additional selected customer sites to assess their commercial viability. GAHP has been proven in previous studies to show higher energy efficiencies and higher performance ratings. Although earlier prototypes have proven the technology with some test consumers and with the gas utility industry, this next phase moves to the pre-commercialization phase to further examine these units' performance, design criteria finalization, and economic risks with the private sector, especially as this product is still relatively unknown to the general market. The project is being managed by Gas Technology Institute (GTI) who will work closely with the manufacturer to transition working prototypes of their heating and cooling units to be demonstrated at additional test sites, conduct further risk analysis and determine economic feasibility of the technology. This study will run for two years.

Benefits

This technology has the potential to address issues related to distribution planning and reliability while providing energy efficiency benefits. Under the Reforming the Energy Vision (REV), Con Edison is seeking the deployment of customer technologies that can reduce electric load during peak periods and reduce the overall greenhouse gases emitted into the atmosphere. If the GAHP technology was widely adopted, electric load reductions could be achieved, at times during peak periods, and consequently reliability could be improved. If proven out at the commercial scale, GAHP could be a useful enabling technology for the customer's sited electric load, such as those sought in the Brooklyn/Queens Demand Management (BQDM) program.

Technical Status

Direct-fired furnaces, boilers, and water heaters are commonly utilized for providing heating and cooling for customers. Although these conventional gas heating and cooling technologies have been in existence for many years, they emit greenhouse gases into the atmosphere. They also require complex design and construction of their components which require maintenance. Their operation in extreme climate conditions also becomes limited, particularly in areas that experience severe cold weather. The project is now in its second and final year. An intellectual property management plan is now complete for the gas absorption heat pump. The prototype designs are currently underway for the heat pump design and the sealed system (service valve and defrost valve). Other components such as the hydronic loop/fans/motors, controls, air handler and storage tank, solution pump and combustion system were tested through a number of iterations and adjustments made as needed. By 4Q18, four prototype units were constructed and built for testing with two installed at preselected residential houses in Wisconsin. Demonstrations and market research will continue in 1Q19.

TITLE ICS Data Acquisition using Forensic Techniques

CSN 99876 POET 21702861 TASK 0001

PROGRAM AREA Customers

DURATION 9/21/2015 to 12/31/2020 ENGINEER Serena Lee

PROJECT LEAD Richard Alcalde

AUTHORIZED $140,000 EXP. THROUGH 2018 $114,919

Objective

The purpose of this project is to research and develop techniques that follow forensic best practices that can be used as part of a cyber investigation involving proprietary critical assets. The research involve the O&R Energy Control Center and CECONY Substation identifying the BES Cyber Assets within their respective facilities.

Given this list of BES Cyber Assets, the Cyber Action Team will procure these sample test devices and then develop best practices to address at a minimum the following:

- Determine the compatible tools needed to perform a data collection
- If it is possible to perform a data collection without restarting or shutting down the asset.
- If a live collection is possible, then determine the impact of the acquisition on the asset
- If it is possible to perform a logical data collection without physically tampering with the asset
- If it is possible to perform a collection of volatile data
- What tools can be used to analyze the collected information

Of the various BES Cyber Assets to be identified by both groups, the Cyber Action Team proposes to use a phased approach and concentrate on a subset of the BES Cyber Assets.
The first phase will a subset of BES Cyber Assets that are available in both O&R and CECONY substation environments. Additionally, this first phase will be limited to a few select BES Cyber Assets in order to have a manageable asset count.

Benefits

The result of this project will be a guideline for incident handling and response to specific critical BES Cyber Assets within the O&R ECC and CECONY substations. If there is a cyber-investigation involving cyber assets that are in scope of phase 1 of this project, the result of this project will provide a direct guide with tested and repeatable procedures on how to perform a data collection of the device.

Technical Status

Over the course of two years, the Corporate Security Cyber Forensic Investigation team has been part of a project to research and develop techniques that follow forensic best practices that can be used as part of a cyber-investigation involving proprietary critical assets. Our research involved working with the Energy Control Center and CECONY Substations to identify the BES Cyber Assets within their respective facilities. With this inventory, this project allowed us to procure test devices which, in turn, allowed us to develop best practices for data collection in this environment.

Our procurement of equipment included a sample of equipment, which included over a dozen different SCADA (Supervisory Control and Data Acquisition) devices, in addition, we acquired certain network devices, all of which were used within our environment.

This research project allowed us to create new data collection guidelines for equipment that was specific CECONY Electric and also provided us an extra benefit of formalization of these devices, to those who work on ICS Incident Response. This project also helped created toolsets based on commercial and open source security tools that we have found capable of providing our team root cause analysis and time lines of an incident from these devices.

TITLE EPRI Telecommunications Initiative

CSN 99778 POET 22048670 TASK 0001

PROGRAM AREA Customer

DURATION 05/6/2016 to 04/2018 ENGINEER Steven Go

PROJECT LEAD W. Little & A. Kouyoumdjian

AUTHORIZED $225,000 EXP. THROUGH 2018 $214,720

Objective

The Telecommunications Initiative addresses complexity in planning, designing, deploying, and managing networks to support grid operations. Utilities realize that many diverse telecommunications technologies and solutions must be deployed to support grid operational requirements. In addition, the rapid evolution of telecommunication technologies reduces their lifecycle timelines. As existing networks are pressured by obsolescence and new data traffic, there are no simple answers to cost-effective replacements that avoid asset stranding. Evolution of grid operations into the future introduce new IT and OT applications with undefined needs for increased bandwidth and remote coverage.

Benefits

Con Edison will benefit from participation in forums of industry telecom experts to discuss issues, tactics and strategies, and lessons learned, receiving use cases on telecommunications scenarios, lab and field testing results of various telecom technologies for public and private spectrum. These qualitative benefits will support Con Edison with technology evaluations and migration approaches that will aid in developing strategies for future communications infrastructure.

Technical Status

Telecommunications are essential to the operation of today's electricity system and will play an even more critical role in a highly integrated, connected, and interactive power system. The electric sector is facing several challenges with respect to telecommunications. These include:

- Transition from isolated, application specific networks to integrated, unified networks;
- Retirement of analog and TDM leased line services from carriers;
- Transition of applications to packet based systems (typically Internet Protocol or IP);
- Rapidly increasing bandwidth and geographic coverage requirements for intelligent field devices;
- Impending obsolescence and/or insecurity of legacy wireless systems;
- Lack of private spectrum for critical operational links;
- Increasingly crowded unlicensed spectrum, and resulting impacts on reliability;
- For higher reliability and resiliency;
- Increased focus on cyber-security and changing NERC Critical Infrastructure Protection (CIP) standards requirements.

The Telecom Initiative launched in early 2016 and continues through 2017 into early 2018. In 2018, it transformed into a new Project Set within the Information and Communication Technologies program (161G).

The initial utilities that helped shape the scope, deliverables, and timelines of the project helped us winnow down 20 challenges to the top 6 in terms of urgency and strategic value.

These are:

- Serial to packet migration
- Wireless networks – private and public
- Strategic Fiber
- Connectivity Beyond the Meter
- Network Management, Reliability Metrics and assessing emerging technologies like SDN
- Network planning and co-simulation

TITLE ORU Electric Distribution Volts & Amps Sensors Production testing - Phase III EDVAS

CSN N/A POET 23216379 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 05/21/2018 to 12/2020 ENGINEER Serena Lee

PROJECT LEAD John-Paul Laglenne

AUTHORIZED $180,000 EXP. THROUGH 2018 $98,754

Objective

ORU electric overhead distribution system currently uses voltage and current sensors that are required to be pole or frame mounted. In certain applications, such as at a SCADA connected MOAB (motorized operated air break) switch, three phase voltage sensing on both sides of the MOAB is needed for enhanced situational awareness for the feeder status during outages and storm events. With the existing technology, only one set of voltage sensing can be installed due to the frame space constraints on a pole. In addition, the existing sensors use a resistive voltage divider and cables to bring the analogy input to the controller. As a result, inaccuracies are introduced, and correction factors are needed to calibrate the inputs to the controllers. In this project, we seek a cost effective, 13.2kV line suspended, combined voltage and current sensors that can output low energy voltage waveforms into commercially available microprocessor based meters/controllers analog inputs at the pole. A 1% of full scale accuracy is desired, and high reliability for an outdoor installation lasting at least 20 years is required, as is a voltage. Phase 1 and 2 of this R&D work was about developing the sensor technology with the vendor while meeting the stated requirements. Now we must integrate the proven technology into O&Rs distribution automation for deployment in production.

Benefits

The sensors tested in Phase 1 and Phase 2 BETA R&D project (2015-2017) had proven reliable, accurate, and precise based on the bench testing and field testing completed so far in 2017. This BETA testing will continue until we are sufficiently confident in the vendor sensor performance to purchase a large number of distribution pole ready packages to install on select feeders for production use. The first use case will be a solution required by the PSC Joint Utilities DER Monitoring and Control solution. The sensors purchased for this Stage 3 project will also be installed in the Stage I field trial location at Clarkstown PV for a short period of time and have their calibrations verified prior to production installation.

Technical Status

The sensors tested in the phase 1 and 2 project have had some setbacks during testing, using more dynamic events such as current inrush and abrupt, sustained voltage dips. The vendor is working to improve the sensor for all line measuring scenarios, static and dynamic. O&R has provided a series of test scenarios with expected performance accuracy requirements that the vendor is working on meeting. A second vendor has provided voltage only sensors that have performed very well (+/- 0.3% absolute accuracy 99% of the time). The largest deviation to date has been 1.5% for a few hours. This sensor performance will meet O&R's needs for all applications requiring high accuracy voltage sensing; however, we are still attempting to find a current sensing product to perform as required. The 2019 work will focus on this task.

TITLE ORU Participation in ChargEV Coalition

CSN N/A POET 23205405 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 05/10/2018 to 1/2020 ENGINEER Simon Odie

PROJECT LEAD Alexander Bykov

AUTHORIZED $75,000 EXP. THROUGH 2018 $25,000

Objective

This project entails participation in ChargEVC whose mission is to serve as a trusted resource for research and a singular voice for advocacy, leading to advanced EV market development programs and policies in NJ. The coalition works at the local level, with local players, in response to local conditions, to expand EV programs to accelerate electrification of transportation in New Jersey. ChargEVC's focus includes outreach and collaboration with policy makers to develop policies, including incentives that address barriers to EV adoption, and improve accessibility to EV charging infrastructure.

Benefits

Specific benefits will center around information gathered about EV program enhancements and EV adoption rates in both the NJ and NY service territories, which will host greater details as result data becomes available.

Technical Status

Timing plays a key role in effecting change. In New Jersey, the time for expanding and escalating the adoption of Electric Vehicles (EV's) is now. O&R and Rockland Electric is working on developing an EV program that would accelerate EV adoption in the states on New York and New Jersey. ChargEV provides research and legislative support in NJ.

TITLE ORU Driver Risk Management System for Vehicle Fleet Safety

CSN N/A POET 22493082 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 03/3/2017 to 03/2018 ENGINEER Steve Labudzinski

PROJECT LEAD Stephen Prall

AUTHORIZED $55,000 EXP. THROUGH 2018 $ 58,683

Objective

Video based vehicle safety programs have been proven to change driver behavior and reduce collisions. The ability to directly observe driver behavior by way of the event recorders allows leadership to verify that operators are abiding by expectations, and it provides an effective feedback tool when operators deviate. The system will also provide vehicle telemetric data from the Engine Control Unit (ECU), such as idling, high revs, etc. The pilot will also check that a defined number of triggered videos are analyzed by trained operators by the vendor prior to supervisor (coach) distribution and noting such behavior as speeding, no seatbelt, distraction, etc. The system utilizes inward/outward facing cameras, GPS, Immediate video offload, vehicle diagnostics, and vehicle customized triggering. The device installation will be in vehicles used by the 20 worst drivers and then proportionally by section based on the rate of miles per motor vehicle collision in randomly selected vehicles. Sections having a low rate of miles per MVC will have a higher proportion of devices installed. The objective is evaluation and effectiveness of the driver safety system as a vehicle safety program.

Benefits

Implementation of the technology will provide a foundation for specific and actionable driver feedback. Regular feedback and driver expectation of feedback is expected to facilitate improved driver behavior. Reduction in the frequency/severity of risky behaviors is expected to precipitate reduction in collision frequency, mitigating the liability exposure that accompanies fleet operations in O&R's diverse territory. The project will also validate the expectations of fewer motor vehicle infractions and collisions or improved driving habits.

Technical Status

Installation of the video based vehicle safety devices were performed in the month of July and August 2017. 75 vehicles were identified to be installed with the device. The evaluation and use feedback period will last about 6 months. The program was started in the August/September 2017 timeframe. Various risky behaviors were identified and scored depending on relevance to company safety concerns. The higher the score, the risky the behavior. That scoring is used to generate a safety score based on hours of driving and to identify which drivers need coaching. A high safety score relates to more risky driving behavior. The initial safety score for the company was approximately 120 with the final safety score ranging between 40-50. The program so far has seen a decrease in risky driving behavior based on the current safety score. The R&D program funding was completed in March 2018, and the sponsor self funded the program until December 2018. The program created an awareness of driver behavior and reviewed risky behavior through feedback/coaching sessions with the observed driver. The program yielded these collision stats based on 100 vehicle: Recordable MVC’s non-Smartdrive: 13.5 vs. 7.5 Smartdrive (44.0% reduction) and Preventable non-Smartdrive MVC’s 10.9 vs. 4.7 Smartdrive (56.6% reduction). The evaluation showed that this type of safety program will reduce risky driving behavior. The project is completed.

TITLE ORU Electric Distribution VA Sensors Production Testing Phase II ver1

CSN N/A POET 22437737 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 01/25/2017 to 12/2018 ENGINEER Serena Lee

PROJECT LEAD John-Paul Laglenne

AUTHORIZED $90,000 EXP. THROUGH 2018 $98,754

Objective

The sensors tested in the phase 1 project have proven reliable, accurate and precise based on the bench testing and field testing completed so far. In this project, we are installing the sensors on a number of distribution pole ready packages to install on select feeders. This testing will seek to benchmark model data against real measurements.

Benefits

ORU has many overhead electric distribution applications that would benefit from 3 phase voltage and current sensing that is accurate, repeatable, outdoor rated for 20 years or more, and can fit into the pole top device. If the project is successful, the sensors can be applied on SCADA connected capacitor controls, the head end of feeder circuits and any other SCADA connected devices compatible with the transducer signal for accurate reporting of faults, power quality, feeder kW and KVar demands and operational awareness.

Technical Status

In the project, ORU continued to monitor and evaluate the vendor sensor performance. The vendor update the sensor signal processing software and firmware to improve the accuracy and precision performance to support power quality and meter grade applications. ORU has designed, built, and is testing a production power quality enclosure that uses the vendor sensing system. This work is completed. Additional sensor testing will be done in Phase III of this project.

TITLE ORU Montvale Shopping Center Reliability Improvement Plan

CSN N/A POET 23403864 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 09/11/2018 to 04/2019 ENGINEER Serena Lee

PROJECT LEAD Keith Brideweser

AUTHORIZED $48,920 EXP. THROUGH 2018 $ 7,965

Objective

The shopping center in Montvale, NJ has had numerous blown fuses over the course of the past three years, many due to incidental animal contacts. Animal guards have been ineffective in mitigating the issue. The objective of this project is to monitor incoming power quality to the shopping center and reduce the number of blown fuses as a result of transient downstream faults. We are seeking a solution to minimize customer impacts.

Benefits

This technology when implemented can potentially mitigate future outages at the customer location. The shopping center in Montvale, NJ has already been impacted by outages 14 times in the past 5 years. Once this technology is proven on the O&R system and procedures developed on their use and installations, future power quality issues can potentially be solved using this technology.

Technical Status

On November 29, 2018, we installed devices that combine fuse-blowing and fuse-savings methods in Montvale, NJ. To date there have been no customer complaints or notifications of electrical outages at this location. By mid-February 2019, we are expected to schedule an onsite visit to download data from these devices. The data will be reviewed and assessed by Electric Operations and Distribution Engineering personnel, who will be specifically looking for outages, momentary interruptions, and anything else that appears unusual or out of place. The devices will remain in service and will have the data downloaded again in April or if there is an outage event at this location. This field trial will provide information about the effectiveness of the solution.

TITLE ORU Emulation of Reclosers

CSN N/A POET 22606299 TASK 0001

PROGRAM AREA Electric Distribution

DURATION 05/22/2017 to 12/2018 ENGINEER Serena Lee

PROJECT LEAD John-Paul Laglenne

AUTHORIZED $80,000 ` EXP. THROUGH 2018 $79,160

Objective

This project is to develop code that will mimic all of the necessary Reclosing, Loop Scheme, and Safety functions that O&R's Reclosers currently have.

Benefits

Being able to use a device to control Reclosers on the O&R system provides the possibilities for different types of Reclosers being integrated into the distribution system. The plan is to start the integration of this code into the development of an Underground Recloser solution. The main purpose of the Underground Recloser is to give O&R the ability to have protection located at DG sites in between the customer's load and the DG site itself, which might not have any overhead exposure. A later plan is to incorporate this into a 34.5 kV Recloser, which allows for a full Recloser installation on one pole instead of the current installation which requires three poles (one for the Recloser, one for the power, and one for the by-pass GOAB).

Technical Status

This project is complete. In this project, Orange and Rockland worked with the vendor to produce the code on a device that will emulate the existing recloser. Code was produced, and we began testing, but found that the device we were working with ran out of programming memory. However, we have confirmed with a manufacturer that a future device under development can provide the capability.