2023

Electric Research & Development

Report and Project Status Sheets

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Prepared for the Public Service Commission
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4 Irving Place, New York, NY 10003

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CONTENTS

1. INTRODUCTION

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

The Companies' R&D portfolio supports our commitment to a clean energy future by targeting research and development that facilitates the transition to a net-zero economy by 2050. The R&D portfolio also focuses on obtaining the greatest results for challenges unique to the Companies over various product delivery times, addressing risks as well as longer term strategic value. The Companies' portfolio balances a mix of projects that are short-term and strategic, as well as small and large ones.

2. GOALS AND OBJECTIVES

The electric utility industry delivers electricity in a safe, reliable, economic, environmentally sound, and transparent manner considering sustainability and conserving 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, government, industry, academia, and other electric utilities.

The R&D Department ("the Department") works to provide technologies that support the long-term sustainability of our businesses. The Department does this by identifying, developing, demonstrating and providing advanced equipment, hardware, software methodologies, analytics, etc. for the Companies' operations. The Department's overall role and responsibilities involve formulating and implementing an R&D portfolio which addresses the strategic and near-term needs of the Companies' electric transmission and distribution (T&D) systems, including building on the Department's work on distributed energy resource (DER) technologies and innovations into our operations, planning, and forecasting capabilities.

A relentless focus on safety, operational excellence, customer experience, and clean energy sets the groundwork for our R&D portfolio. The following are guidelines used in establishing the Companies' R&D portfolio:

- Develop and demonstrate advanced technologies and techniques to:
    - Facilitate the transition to a clean energy future.
    - Improve the safety, efficiency, cost-effectiveness, reliability, resiliency, use, and maintainability of the energy delivery system.
    - Extend the useful life of existing company equipment.
    - Increase worker and public safety and improve productivity.
    - Improve cyber and physical security.
    - Improve load and weather forecasting.
    - Enable our customers to better manage and reduce their energy costs, while also reducing adverse environmental impact.

- Support clean energy and environmental research to operate and plan the electric systems in a cost-effective and environmentally excellent manner.
- 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.
- Research and evaluate technologies that promote a healthy and safe workplace in response to current or future pandemic.

3. ORGANIZATION

Since its formation in 1970, the Department has kept pace with the changing electric utility industry so that continued progress is made in identifying research projects that will improve service, reducing cost to the consumer and minimizing the environmental impact of supplying adequate amounts of electric power. The Department has aggressively pursued new emerging technologies that improve the Companies' operations, serve our customers, and help facilitate the transition to a clean energy future.

The Department 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, and inclusive:
    - Relying on and encouraging the talents of others within the Companies
    - Conducting open discussions 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 our business, we engage with customers and external stakeholders in every aspect of our business:
    - Continually learning about technological innovations
    - Benchmarking against utility and non-utility industry leaders

  - Seeking out new ideas across a broad spectrum of different industries, academia, policymakers, governmental agencies, national laboratories, research consortia, and incubators

- With a cost-conscious mindset, employees act like business owners:
  - Identifying the Companies' short and long term needs that may have R&D solutions
  - Developing and deploying advanced technologies and analytical techniques to meet those needs
  - Developing and deploying advanced technologies to improve:
    - worker and public safety
    - operational efficiency
  - Working to increase value and leveraging expenditures

3.1. STAFFING AND DEPARTMENTAL ORGANIZATION

The Department is comprised of two major sections: "Electric" and "Gas & Steam" R&D. Personnel in the department typically come from the Companies' operating areas with external technology experience, and with many years of experience in the company or in other industries or academia, providing the department with a R&D staff with broad experiences. Each of our staff seeks to develop extensive internal contacts and a detailed understanding of our business needs and R&D best practices. Working collaboratively within the Companies, R&D staff establish and implement R&D projects. The support of our internal customers, with their professional staff and labor forces, helps keep the R&D projects address their needs and ensures that solutions get implemented. Also, many of the Companies' staffing and labor hours on R&D projects are provided by company organizations outside the Department. This approach achieves cost savings, provides a customer focus, and maintains program flexibly.

Electric R&D projects implement new technologies to improve safety, efficiency, reliability and operating performance, extend the useful life of electrical equipment, mitigate environmental impacts, and facilitate the clean energy transition. These projects also support the Companies' Customer Energy Solutions organization 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, computing applications, and cybersecurity.

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

3.2. PROGRAM DEVELOPMENT AND MANAGEMENT

The 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 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 Department monitors initial implementation of new technology to confirm that expected benefits are achieved and potential implementation problems are addressed. It also monitors for developments of new technologies that might be of future benefit to the Companies and customers.

The Department 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.

3.3. 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 planning 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 Energy

Solutions, 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.

3.4. TECHNOLOGY TRANSFER

The Companies continue to stress the importance of maximizing return on its investment in R&D. Seminars, workshops, status reports, technical publications and research databases keep employees informed and engaged with new and emerging technologies. Employees participate 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 R&D program has matured, more individuals throughout the Companies have become aware of R&D information and products that are of value to them in achieving corporate goals and objectives.

4. 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. The Department 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 R&D program strives to provide proactive problem-solving opportunities that have the potential for making incremental or even transformational changes 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 are needed but 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, and 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 R&D projects

The Department pursues these goals and initiatives through a wide variety of external and internal programs and activities.

4.1. COLLABORATIVE R&D

The Companies continue the commitment to industry-group R&D programs and actively participate in the decision-making process of national organizations such as EPRI; the National Electric Energy Testing, Research & Applications Center (NEETRAC); and the Centre for Energy Advancement through Technological Innovation (CEATI), which are effective venues for collaboration on research, development, prototyping and testing the widening range of technologies and equipment that are becoming possible or being developed by vendors. Using industry-group R&D programs 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 projects tailored to its needs.

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 utilities, industry, government and private organizations located throughout New York State and the nation for further development. 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 forms 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 multimillion-dollar demonstrations.

The Companies have budgeted $5.0 million in 2023 in support of electric industry group research. Form E-1 identify the estimated expenditures for industry group R&D programs, as well as the Companies' total expenditures for internal and contractor programs.

4.2. 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 $3.4 million in 2023 for general and administrative support of the electric R&D program.

4.3. 2022 R&D SUCCESSES

In 2022, R&D's notable successes include:

- Completed a study of a direct current (DC) coupled solar, energy storage, and electric vehicle charging solution at Con Edison's Cedar Street substation, which also include system simulation to understand transient and steady-state behavior and system optimization analysis on the DC system.
- Developed and built a prototype of a bi-reel cable system that can be used to collect legacy paper insulation lead cable (PILC) and non-PILC cable separately on their own portion of the bi-reel, thus avoiding comingling PILC and non-PILC cables which would reduce the recycling value of the entire reel's contents.
- Developed an artificial intelligence (AI) dielectric oil leak detection system proof of concept for high pressure fluid filled (HPFF) cable systems.
- Performed a cable splicing machine feasibility study jointly with our external partners before moving ahead with developing the one-way one-way cable splicing machine.
- Developed a Digital Twin Framework to provide value and benefits in areas that include: helping to explore requirements for digital twins of electric distribution systems; educating stakeholders on key concepts, use cases and strategies related to the digital twin concept; evaluating how other electric utilities and other industry verticals are leveraging digital twins; and evaluating the evolution of existing and new workforce roles to support digital twin assets and processes.
- Developed and demonstrated a substation inspection robot, testing that it can move on pre-determined path autonomously, recognize switchgear cubicles with equipment, and carry visual and infrared cameras, as well as partial discharge (PD) detection portable tool for equipment condition and health assessment.
- Completed a study that explored the ability of smart inverter settings to help solve voltage issues that may occur in future-looking high inverter based resources penetration scenarios by evaluating these settings over a simulated year of weather and load conditions, as well as any unintended consequences, such as curtailment or increased regulator operations as result of implementing these settings.

Awards

- 2022 saw R&D Champion Award to 3 company employees who furthered the work of R&D.

4.4. 2023 PROGRAM

The 2023 R&D program is segregated into four (4) sub programs: transmission, distribution, substations, and customer engagement. 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
- Improve safety
- Maximize use of existing facilities

The Transmission R&D 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 transmission area include developing and testing technologies for:

- Replacing current underground transmission cable technologies
- Expediting detection and location of dielectric leaks in underground transmission pipes and structures
- Locating disbonded coatings on underground transmission pipes
- Expediting detection and location of faults in transmission feeders
- Reducing the impacts of geo- and electromagnetic and intentional electromagnetic events

Distribution Program

Goals and Objectives

- Improve worker health and safety
- Improve public safety
- Improve operational efficiency
- Improve asset management
- Enhance system reliability and resiliency
- Enhance the customer experience
- 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, extend equipment life, and reduce costs of construction, maintenance and operation of the distribution systems. R&D activities in the distribution area include developing and testing technologies for: 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

Substations Program

Goals and Objectives

- Improve operational efficiency
- Maximize use of existing facilities
- Improve safety and security
- Develop lower-cost, smaller-size, and more efficient, reliable, and environmentally acceptable equipment

The Substation R&D program focuses on improving the operational efficiency and security of substation equipment and extending the useful life of installed equipment. R&D activities in the substations area include developing and testing technologies for:

- Monitoring and assessing, both on-line and in real time, the condition (including the operating status) of power transformers, load tap changers and circuit breakers
- Fault current mitigation, as utilities in dense urban environment are experiencing increased fault current levels due to additional distributed energy resources as well as systems being operated at higher power levels than in the past
- Arc flash protection
- Sulfur hexafluoride ("SF6") management
- Advanced inspection tools and systems

Customer Engagement Program

Goals and Objectives

- Improve the customer experience
- Maintain competitiveness
- Integration of data collection

Customer Engagement projects focus on efforts to enhance the customer experience and lower costs, which include assessments and demonstrations of new technologies that offer:

- Improved demand management and energy efficiency
- Non-intrusive analysis of customer end uses
- Improved interconnection practices
- 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

FORM E-1
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2022 - 2026 (000)

CSN	Project	Task	TITLE	2022	2023	2024	2025	2026
			Administration (Common Distribution 77.60% to Electric)	Actual	Estimate	Estimate	Estimate	Estimate
92032	10064342	0024	SALARIES AND WAGES	$2,078	$2,199	$2,265	$2,333	$2,403
92034	10064342	0025	OTHER EXPENSES	$188	$310	$310	$310	$310
92649	10064342	0372	PATENT SEARCHES IN CONNECTION WITH COMPANY R&D TECHNOLOGY APPLICATIONS	$140	$155	$155	$155	$155
			Subtotal Administration	$2,406	$2,665	$2,731	$2,799	$2,869
			Industry					
N/A	26721718	0001	CURENT Industrial Partner 3-year agreement - 292	$140				
91013	23620852	0001	EPRI- 5 YEAR ELECTRIC DISTRIBUTION BASE PORTFOLIO	$2,342	$2,607	$2,607	$2,607	$2,607
91014	23620853	0001	EPRI- 5 YEAR ELECTRIC TRANSMISSION BASE PORTFOLIO	$1,481	$1,716	$1,716	$1,716	$1,716
92394	10064342	0279	EPRI/NYSERDA/DOE TRAVEL BY ALL OTHER NON-R&D PERSONNEL	$93	$75	$75	$75	$75
92439	10064342	0313	INTERNATIONAL UTILITY WORK GROUP PARTICIPATION	$15				
14106	20829413	0001	CIGRE Membership - 123	$3	$3	$3	$3	$3
N/A	26448975	0001	EPRI Energy Sustainability Interest Group (ESIG)	$24				
91577	25922514	0001	Applications Research Program - CEATI – 2022 - 236	$294				
91328	24343865	0001	Applications Research Program - CEATI – 2020 - 91	$0.30				
N/A	26637217	0001	EPRI Project - National Demonstration and Monitoring of Indoor Food Production (IFP) Facilities -278	$300				
			Subtotal Industry Groups	$4,692	$4,401	$4,401	$4,401	$4,401
			In-House Projects					
			General Common Projects (Common Distribution 77.60% to Electric)					
91370	24577223	0001	Evaluation of Temperature Screening Technologies for Facility Entrances (CoVid 19 Response) - 114	$5				
90915	23235806	0001	EPRI Collaborative Research on Industrial Control Systems (ICS)-Penetration Testing (PT)	($0)				
N/A	26738793	0001	Spigit Innovation Software - 316	$54				
91153	24077834	0001	NYSERDA ICS Forensics Harvester - 49	$8				
90905	23186497	0001	Development of Unmanned Aerial Vehicle (UAV) Corporate Response	$1				
91516	25258817	0001	Eyes in the Field - Wearables with AR (Gas & Steam)	$136				
91353	24520563	0001	Evaluation of Heat Mitigating Flame Retardant (FR) Clothing-104	($3)				
91354	24525691	0001	Assess Fluorine Free Foam for Fire Suppression - 106	$0				
91361	24566820	0001	EPRI Study on Exploring Climate Impacts in Utility Operations & Planning Interest Group SPN# 3002019431 - 113	$3				
91518	25285422	0001	Automation for Regulation Management via NYU Proof of Concept AI Model Development - 155	$49				
91622	26203341	0001	EPRI Climate READi (REsilience and ADaptation initiative): Power	$116				
N/A	26568573	0001	Conceptual Evaluation of CO2 Transport from Manhattan (EPRI)	$78				
91569	25883507	0001	Phase 0 - Optimization Study for the Con Edison Steam System	$54				
91583	26053991	0001	Evaluation of Innovative Work Area Protection Devices - 242	$13				
91561	25814873	0001	Evaluation of the Echo Barrier System - Modular Noise Reduction Panels - 219	$2				
			Subtotal Common	$514	$530	$546	$546	$546

FORM E-1
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2022 - 2026 (000)

			Transmission					
91567	25875141	0001	EHV Overhead feeders Autonomous Drone Configuration Assessment - 226	$5				
90994	23581395	0001	138 kV XLPE Feeders Sharing Manhole Study	$59				
91399	24818455	0001	Overhead Transmission Autonomous UAV Inspection - 126	$51				
N/A	26627978	0001	Mitigating Vibration on Steel Pole Davit-arms Phase II - 266	$55				
N/A	26581135	0001	A Bulk Power System Dark Sky Recovery Demo Using the Disturbance Monitoring Equipment (DME) - 291	$54				
91559	25807725	0001	Laser Ultrasonic Inspection of CFRP (Carbon Fibre Reinforced Polymer)	$17				
91626	26248431	0001	Demonstrate Pulsed Eddy Current (PEC) Robot for High Voltage Feeder Pipe Assessment	$113				
91560	25814660	0001	Manual Carbon Fiber Wrap (CFR) Defect Acceptance Criteria - 212	$123				
90222	20946547	0001	Next Generation for Perfluorocarbon Tracer (PFT)	$9				
91565	25845223	0001	Post-Leak Detection of Minor Leaks for High Pressure Fluid-Filled (HPFF) System - 220	$54				
91580	25977002	0001	Transmission Line Structure Physical Security Sensor Demonstration	$19				
			Subtotal Transmission	$559	$631	$631	$631	$631
			Substation					
91515	25258659	0001	Substation Inspection Robot Development - 181	$77				
90604	22270906	0001	Next Generation Substation Battery Demonstration	$71				
91630	26279665	0001	Fire Characteristics of Midel 7131 Synthetic Ester -265	$43				
00002	26362257	0001	Bulk Power System Physical Security (EPRI) - 264	$20				
N/A	26559746	0001	Evaluation of Substation Robotic Analytical Tools-288	$50				
91411	24869473	0001	EPRI Midel 7131 Study - Evaluation of Spill Control Devices - 138	$8				
90972	23489778	0001	Demonstration of Cubicle Inspection & Repair Safety Device	$27				
			Projects Under $5K	$2				
			Subtotal Transmission	$298	$413	$413	$413	$413
			Transmission & Substation	$857	$1,044	$1,044	$1,044	$1,044
			Distribution	$0				
91529	25403559	0001	Live-Streamed Instructor-Led Remote Augmented Reality Training Demonstration - 189	$0				
N/A	26455697	0001	EPRI Emerging Energy Storage Technology Testing and Demonstration Supplemental	$27				
N/A	26702136	0001	NEETRAC Applications Research 2023 - 312	$143				
N/A	26612125	0001	Applications Research Program - CEATI – 2023 - 302	$356				
91602	26185016	0001	Testlamp Development - 248	$32				
N/A	26625976	0001	EPRI Incubate Energy Lab - 2023 Cohort - 306	$60				
N/A	26573374	0001	Electric Grid Field Asset Unique Identification System, Technology, and Use Cases - 285	$113				
N/A	26592909	0001	EPRI Supplemental Project - Evaluation and Economic Feasibility Analysis of Commercial DER Gateways - 296	$80				
N/A	26568567	0001	Cable Splicing Machine - Phase 2 - 284	$58				
91582	26040258	0001	Development and Evaluation of a Two-reel (Bi-Reel) Cable System Prototype	$64				
91584	26055427	0001	Mobile Contact Voltage Multi-Shunt Data Capture - 243	$153				
91566	25856168	0001	Prototype Live-End-Cap Machine Development and Demonstration, Phase 3	$253				
91556	25792542	0001	Feasibility study - Cable Splicing Machine	$38				

FORM E-1

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2022 - 2026 (000)

91386	24705789	0001	Underground Infrared Secondary Through Cover Inspection Field Pilot - 121	$11				
N/A	26444432	0001	Job Briefing Application Enhancement and Field Evaluation - 261	$24				
91347	24509152	0001	Manhole Monitoring System Phase 2 Analytics - 102	$38				
N/A	26691360	0001	EPRI Supplemental - Underground Structure Monitoring Guiding Alarm Settings and Monitor Deployment	$50				
90918	23263256	0001	Development of New Designs for Secondary Electrical Conduits	$24				
			Projects Under $5K	$11				
			Subtotal Distribution	$1,535	$1,289	$1,289	$1,289	$1,289
			Customer					
N/A	26581105	0001	Sharc Piranha Wastewater Heat Pump NYC Building Retrofit Feasilbility Study - 295	$14				
N/A	26737771	0001	Building Energy Smart Technologies (BEST) Center Membership - 315	$50				
			Projects Under $5K	$2				
			Subtotal Customer	$66				
			EH&S					
91593	26157269	0001	Regen Vacuum Hopper Chute Funnel Prototype Development	$50				
			Subtotal EH&S	$50				
			Electric Transportation					
91448	24941527	0001	EV Bucket Truck Prototype - 148	$236	$414			
N/A	26721717	0001	EVs2Scale2030	$500				
N/A	26360260	0001	EV Bucket Truck Prototype II, Dual Battery Design via Terex	$400				
			Subtotal Electric Transportation	$1,136	$414	$0	$0	$0
			TOTAL ELECTRIC PROGRAMS	$3,644	$2,746	$2,332	$2,332	$2,332
			Total CECONY Research & Development Before O&R Proportion for NY Electric/Gas & NJ RECO	$11,256	$10,342	$10,010	$10,078	$10,148
			Total CECONY Research & Development For O&R Proportion for NY Electric/Gas & NJ RECO	($500)	($484)	($489)	($493)	($498)
			Total CECONY Research & Development After O&R Proportion for NY Electric/Gas & NJ RECO	$10,755	$10,826	$10,499	$10,571	$10,646

Orange & Rockland Utilities (ORU)
RESEARCH AND DEVELOPMENT PROGRAM PLAN EXPENDITURES 2022 - 2026 (000)

L3 Project	TASK	TITLE	2022	2023	2024	2025	2026
		Industry Groups	**Actual**	**Estimate**	**Estimate**	**Estimate**	**Estimate**
10104042	0001	Travel	$29	**$73**	$73	$73	$73
26086606	0001	ORU Research & Development	$14				
		Projects Under $5K	**$2**				
			$44	**$73**	**$73**	**$73**	$73
		In-House Projects					
25420526	0001	Participation in ChargEV Coalition 2021-2022	$25				
26690765	0001	L3_DER Commissioning Procedure and Toolkit via EPRI	$90				
25237653	0001	Electric Overhead Distribution DVAR Static VAR Compensator Trial	$214				
25364269	0001	Electric Distribution Volts & Amps Sensors MOAB Enhancement (EDVASME)	$63				
24598434	0001	IEEE 1547 Education & Credentialing Program	$12				
		Projects Under $5K	$0.25				
		Subtotal In-House Projects	**$404**	**$248**	**$248**	**$248**	**$248**
		Total ORU Research & Development Before CECONY Affiliated Billing (IN) & New Jersey RECO (OUT)	**$449**	$321	**$321**	**$321**	$321
		Total ORU Research & Development Allocated to New York Jersey	($112)	**($79)**	($79)	($79)	($79)
		CECONY Affiliated Billing (6.85% of Administration & Industry - Electric Power Research Institute - EPRI)	$486	$484	$489	$493	$498
		Total ORU Research & Development Allocated to New York	**$823**	**$726**	**$731**	**$735**	**$740**

TITLE Prototype Live-End-Cap Machine Development and Demonstration, Phase 3 - 224

CSN 91566 **POET** 25856168 **TASK** 0001

OBJECTIVE

We seek to enhance the safety of employees and improve quality and longevity of splices by developing and deploying a splicing machine that will produce higher quality splices with greater consistency, while significantly reducing the duration splicers spend in manholes. This project iteratively follows-on work of previous projects. In this project, an Underground Field-Demonstrable Prototype Live-End-Cap Splicing Machine will be developed, fabricated, tested and demonstrated incorporating tooling concepts identified under Phase 2.5 as well as enhancements to setup, installation, and machine operation.

BENEFITS

- Underground Field-Demonstrable Prototype Live-End-Cap Splicing Machine
- Field demonstration
- Evaluation and report of technical requirements and costs for design, fabrication, and testing of a manufacture-ready machine which includes the newly developed features.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Preliminary Tooling Testing and Conceptual Design

☐ Detailed Design – In Progress

☐ Prototype Fabrication – In Progress

☐ Functional Testing and Performance Optimization

☐ Performance Validation Testing

☐ Final Report

TITLE Live-Streamed Instructor-Led Remote Augmented Reality Training Demonstration - 189

CSN 91529 **POET** 25403559 **TASK** 0001

OBJECTIVE

Quality management and change management require regular refresher and revision training for employees. Traditional training of field employees is costly, including travel time and expense, as well as time away from work. This project will demonstrate an enhanced training tool for Electric Operations to improve knowledge transfer and retention and improve reliability and safety.

BENEFITS

Familiarization with using Augmented Reality to enhance training leading to improved knowledge transfer and retention, improved task performance and work quality resulting in longer useful life for utility infrastructure and improved reliability and safety.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Instructor training and familiarization with MS HoloLens

☒ Course material and lesson plan for selected lesson subject

☒ Content script and lesson delivery outline

☒ Live stream prototype delivery and video

☒ Instructor-led training event

☒ Evaluation of effectiveness in Con Edison setting

☒ Final Report

This project is complete.

TITLE Mobile Contact Voltage Multi-Shunt Data Capture - 243

CSN 91584 **POET** 26055427 **TASK** 0001

OBJECTIVE

According to New York State PSC 04-M-0159, Con Edison is required to mitigate any publicly accessible energized object with 1 volt and greater when measured with a 500 Ohm shunt resistor. The IEEE Stray and Contact Voltage working group released a guide focused on voltages that exist at publicly and privately accessible locations as a result of the delivery and use of electricity, including testing techniques and mitigation strategies.

The Engineering team seeks to evaluate the public safety benefit of increasing the shunt resistor value during the troubleshooting of stray and contact voltage. The main objective of this pilot is to determine what is the optimal shunt resistor that can be used in Con Edison territory to reduce measurement error in voltage level from a detected stray or contact voltage finding. Contractor crews already engage in voltage scanning and detection will be required to use multiple resistor values in range between 500 ohm to 15 kilo-ohm on all energized object investigations and record the measurements of voltages associated with each shunt resistor.

BENEFITS

The use of multiple shunt resistor to record the voltage detected on an energized object, will provide empirical data specific to our service territory. The shunt(s) that provide the lowest measurement error, will be the value(s) selected as possible replacement for the current resistor value currently in use. Plans will be made to communicate and update methods for system wide implementation.

This project focuses on safely, providing guidance on how to identify hazardous condition masked by current testing and troubleshooting practices. Lessons learned from this project can shape future updates to the New York State Electric Safety Standard - NYS DPS 04-M-0159.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Construct shunt boxes containing four resistors with values of 500W, 3000W, 10,000W, 15000W
- ☒ Train field technicians on the operation and use of the expanded shunt box and data reporting requirements
- ☒ Update data application used in the field to record measurement for the inclusion of the additional readings
- ☒ Build a database system to house the additional readings
- ☒ Report on measurements taken in Con Edison territory for each energized object at the time of initial detection using multiple shunt resistor values.
- ☐ Report on findings and conclusion

TITLE EPRI Supplemental Project - Manhole Monitoring: Guiding Alarm Settings and Monitor Deployment

CSN 00031 **POET** 26691360 **TASK** 0001

OBJECTIVE

As underground cables and components degrade, they can generate a variety of gases from chemical reactions caused by heating / overheating, arcing and general aging. These gases may be combustible and, should the presence of these gases not be identified, can build up and lead to an explosive manhole event which can potentially endanger the public, utility workers, and damage equipment.

This research seeks to understand the expected movement, migration, pocketing, and dissipation characteristics of selected manhole gases to inform detection sensor placement, sensitivities, and alarm settings. In addition, the research will examine the characteristics of elevated (stray) voltages to inform elevated voltage detection sensor placement, sensitivities, and alarm settings.

The objective of the research is to provide 1) guidance for leveraging manhole monitoring sensors including guidance for sensor deployment and placement, 2) guidance for setting alarms for selected gases, and 3) guidance for stray voltage detector placement and alarm setting levels.

BENEFITS

This research seeks to increase industry understanding of combustible gas behavior, including the expected movement, migration, pocketing, and dissipation characteristics, to inform detection sensor placement within the structures, required sensitivities and alarm settings. In addition, the research seeks to increase industry understanding of the characteristics of elevated voltages to inform elevated voltage detection sensor placement, sensitivities, and alarm settings.

TECHNICAL STATUS

EPRI will prepare a report which will summarize the learnings from the practices / literature review, present test results from the gas behavior testing, and provide guidance on both sensor placement within the hole, and alarm levels for selected gases based on the test findings. The report will also include guidance for stray voltage sensing, a summary of learnings from the camera testing, and results from the communications research. The report is expected in the 4th quarter of 2024.

TITLE Transmission Line Structure Physical Security Sensor Demonstration - 239

CSN 91580 **POET** 25977002 **TASK** 0001

OBJECTIVE

EPRI has developed on a separate project a range of wireless Radio Frequency (RF) sensors for transmission line and substation applications. The suite of sensors can measure a range of parameters depending on application, have on-sensor processing to analyze the measurements to provide parameters than can be alarmed on. One potential application of these RF Sensors is to identify a physical security risk on transmission line structure. The approach proposed is to demonstrate a modification of the present EPRI RF sensor technology which has an embedded accelerometer to identify climbing, sawing, bolt removal, impact to the structure and to relay this information back. The funding requested on this RADPAR will be utilized by company personnel to install, monitor, and periodically test these installed sensors for feasibility of wide deployment.

BENEFITS

Transmission towers in our service territories are in remote and unfenced locations. Remote monitoring of these locations can potentially reduce risk by identifying when individuals are potentially climbing an energized structure and identifying when a structure is being vandalized which can result in a dropped energized conductor.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Install and demonstrate these sensors on our transmission structure.

☐ Evaluate the performance of these sensors for at least one year to evaluate feasibility of wider deployment.

☐ Evaluation of accuracy and whether the sensors exhibit excessive false alarms.

TITLE Manhole Monitoring System Phase 2 Analytics - 102

CSN 91347 **POET** 24509119 **TASK** 0001

OBJECTIVE

The Pilot was designed to evaluate a new business innovative process, where a vendor can provide a turnkey project to manage a risk associated with our underground structures. The main objectives of the pilot were:

- Determine the all-in cost to install and operate a sensor unit
- Develop an algorithm for early warning notification of structure risk profile
- Test and evaluate Con Edison response to integrate workflow with third-party vendor
- Establish benchmarks for program roll-out
- Evaluate the performance of the new structure observation system sensors

BENEFITS

The vendor will develop a high-level architecture for data analytics of the Structure Observation System sensors data and other relevant data sets available at Con Edison, such as AMI data sets, asset data, weather data and maintenance and other relevant data. This architecture will serve as the blueprint for larger operational engagement that will move Con Edison from Alarm based dispatch to predictive dispatches and move away from scheduled monitoring and inspection of manholes to a condition-based Inspection. This turnkey exploratory project can also provide a model for transferring risk associated with the deployment of new and emerging technologies to a third party.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Algorithm developed for early warning notification

☒ More than 4,000 units monitored during the pilot

☒ During the pilot, approximately 13,000 alarms were received, 110 field inspections were dispatched, 9 were escalated to Con Edison for remediation with 1 confirmation of true positive

☒ Algorithm developed did not produce early warning accuracy desired

☒ Final report delivered in 2022

TITLE Structure Monitoring System

CSN 99821 **POET** 21852771 **TASK** 0001

OBJECTIVE

The goal of this project was 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 was 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 would result in the detection of certain gases and voltage conditions that are associated with manhole events and stray voltage. This would allow for early intervention before the situation evolves into a problem and thus, resulting in a decrease in the number of incidents of manhole fires, explosions and stray voltage conditions.

TECHNICAL STATUS

Structure Monitoring System was developed and deployed. This project is complete.

TITLE EPRI Supplemental Project - Evaluation and Economic Feasibility Analysis of Commercial DER Gateways

CSN 00021 **POET** 26592909 **TASK** 0001

OBJECTIVE

The project proposes to expand the role and uses of the local DER network gateway, enabling it with critical features tailored for a utility grid with high DER penetration. IEEE 1547-2018, as well as California Common Smart Inverter Profile (CSIP) and other global integration documents recognize the existence of this gateway. Today, they exist by necessity in order to bring DER onto the network of choice. Therefore, this proposal is not adding the gateway (as a new component), but rather leveraging it and developing it to perform new critical features that address the industry's needs. This project will study, design, test and prove specific features to address current DER integration gaps, without adding substantial cost to the gateway. It will develop tools to help utilities articulate their DER gateway related needs in interconnection agreements and RFPs, provide resources to the industry to accelerate adoption of this technology, and provide a core set of capabilities needed, while leaving room for innovation from researchers and vendors. The project will consider the overall cost of the system and evaluate barriers to economic and technical feasibility, so they can be tackled.

The following tasks are proposed to be performed in this EPRI supplemental project.

- Identify several commercial DER gateway vendors and test these systems and their capabilities to meet the documented gateway requirements
- Evaluate the technical and economic feasibility of gateways, security functions, and associated features to inform utilities, vendors, and policy makers.
- Convene and facilitate a working group to document DER integration needs that can be met by DER network gateways.
- Continue documenting the requirements of the gateway for more advanced applications that involves energy storage.

BENEFITS

The project will inform on the technical, performance, and security requirements of DER gateways. Test results from evaluation of commercial gateways will be presented such that an informed decision can be made on selection of commercial gateways to implement on the Con Edison system.

Specific benefits of this project to support selection of DER gateways:

- Improved utility business decision to purchase DER gateways by providing awareness of current gateway technology offerings and their readiness to meet utility needs.
- Help utilities streamline the procurement and specification of PV and storage type DER gateways by creating referenceable specifications of key DER gateway capabilities.
- Develop a list of DER gateway capabilities through a utility working group to give utilities a list of potential features, their associated benefits, and their economic and technical feasibilities.
- Awareness of cybersecurity implementation challenges and associated grid-code recommendations and mitigation techniques to implement on gateways.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☐ Identify several commercial DER gateway vendors and test these systems and their capabilities to meet the documented gateway requirements
- ☐ Evaluate the technical and economic feasibility of gateways, security functions, and associated features to inform utilities, vendors, and policy makers.
- ☐ Convene and facilitate a working group to document DER integration needs that can be met by DER network gateways.
- ☐ Continue documenting the requirements of the gateway for more advanced applications that involves energy storage.

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

CSN 90915 **POET** 23235806 **TASK** 0001

OBJECTIVE

This project will build upon work performed by EPRI, including guidance and tools developed by EPRI and other industry contributors. This project will exercise these available penetration testing tools and techniques on ICS equipment and deployments in order to transfer knowledge from industry experts to individuals and 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 and red teaming operations, respective of their various organizational needs will be developed and shared with the community at large. This guidance will assist Utilities with the execution of penetration testing operations supporting the detection of potential threats and vulnerabilities. Although the focus of the project is guidance and existing technology / technique transfer, it is expected that the unknown presence of existing or new vulnerabilities may be discovered.

BENEFITS

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

TECHNICAL STATUS

This project is complete. This research aided in understanding the complexities of network defense in depth. It provides an understanding of the vulnerabilities of ICSs focused equipment and what those vulnerabilities mean when they are integrated into a substation environment. The testing in EPRI's Cyber Security Research Lab provides documented configurations, results, and lessons learned. A final report was issued.

TITLE Underground Infrared Secondary Through Cover Inspection Field Pilot - 121

CSN 91386 **POET** 24705789 **TASK** 0001

OBJECTIVE

The objective of this project is to procure and implement borescope type infrared cameras that can fit through a vented manhole cover. We plan to inspect and validate this type of inspection is equivalent to an inspection performed by manually entering a structure.

BENEFITS

Inspection of underground electrical equipment is critical to maintain safety and reliability. The current method for underground inspections is performed by Con Edison or contractor employees physically entering the structures and observing defects. This process is time consuming and labor intensive. Additionally, findings from these types of inspections are subjective. There is a need to perform these inspections more efficiently and images captured to allow repeatable classification of defects. A prototype infrared borescope device was recently delivered, which will allow for safer, less time consuming and less labor intensive inspection of underground utility structures. This project seeks to procure a number of these devices to complete a field pilot prior to a wider deployment.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Distribution Engineering completed Procedure EOP-5047 for operation of the device to find underground defects.
- ☒ Borescope piloted for various inspections.
- ☐ Perform analytics and evaluations with images gather.
- ☐ Final report and Conclusion

TITLE NEETRAC Applications Research 2023 - 312

CSN 00033 **POET** 26702136 **TASK** 0001

OBJECTIVE

Continue collaboration in NEETRAC, and thus help drive innovation, sustain technology transfer, participate in important standards development activities, and leverage R&D intellectual and financial resources via other utility and governmental contributions and collaboration.

BENEFITS

Research, Development and Demonstration to better drive innovation, improve safety, transition to Clean Energy, enhance customer experience, advance operational excellence, reduce risk, allocate resources more effectively, appropriately deploy new technologies, and increase operational capability and performance of our workers.

TECHNICAL STATUS

Receiving interim findings of work in progress on eighteen projects under way, including:

- ☐ Assessing Loss of Performance in Mature Field Aged Cables – In progress
- ☐ Underground Cable Drying Assessment and Decision Criteria – In progress
- ☐ Endurance of Outdoor Insulation Under Multifactor Aging – In progress
- ☐ Dielectric Performance of Celebratory Mylar/Foil Balloons – In progress
- ☐ Understanding Human Factors for Operating Separable Connectors – In progress
- ☐ Field Diagnostics for Distribution Transformers – In progress
- ☐ Benchmarking Utility Construction Quality Assurance Practices – In progress

TITLE EPRI Incubate Energy Lab - 2023 Cohort - 306

CSN 00023 **POET** 26625976 **TASK** 0001

OBJECTIVE

Continue collaboration in IncubatEnergy Labs to help drive our innovation, sustain technology transfer, and leverage R&D intellectual and financial resources via diverse utility and developer contributions and collaboration.

BENEFITS

Research, Development and Demonstration to better drive innovation, improve safety, enhance customer experience, advance operational excellence, reduce risk, allocate resources more effectively, appropriately deploy new technologies, and increase operational capability and performance of our workers. Specific deliverables remain to be determined.

TECHNICAL STATUS

One hundred eighty-three startups applied for inclusion in the 2023 IncubatEnergy Cohort. Sponsoring members down selected to a cohort of 24 that pitched capabilities and concepts to sponsoring utilities, including Con Edison. Individual utilities are presently selecting start-ups for paid demonstration projects to be scoped in 6 weeks and executed in 16. While companies generally engage a single utility in a demonstration, all participating utilities are involved in the demonstration scope, progress, and results. Successful candidates will access data, gather insights, scope demonstration trials, and test their products/services in live customer environments. We will actively follow and advise on eight projects.

Tasks (checked boxes are completed):

- ☐ Cohort selection - in progress.
- ☐ 2023 Project Execution
- ☐ Demonstration Day
- ☐ Final Report

TITLE Adaptive Protection Enhancement Development for Low Voltage Distributed Networks - 140

CSN 91439 **POET** 24932760 **TASK** 0001

OBJECTIVE

This project will engage industry collaborative EPRI in a largely DOE-funded collaborative project to develop and demonstrate processes and tools for allowing bi-directional power flow through network protectors to ensure network reliability, maximize smart inverter capabilities and enable higher penetration of PV. Work will include new automated methods for assessment, design, and placement of adaptive protection schemes that support resiliency of critical infrastructure in and for underground distributed low-voltage networks.

BENEFITS

Create opportunities for additional renewable resources and network resiliency during normal and contingency conditions by modeling and demonstrating novel network protector relay protocols and settings that permit 'friendly' reverse power flow while still protecting against fault-induced backfeed.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Network Selection, data Collection and initial analysis – Completed

☐ Define adaptive protection requirements – In Progress

☐ Network protection analysis and visualization – In Progress

☐ Test and verify network models – In Progress

☐ Final report

TITLE Distribution Recloser Life-Cycle Management - 48

CSN 91156 **POET** 24106229 **TASK** 0001

OBJECTIVE

Vacuum reclosers are foundational components for delivering reliable service to non-network customers. Reclosers operate infrequently but must do so reliably and consistently. Manufacturers perform design and production tests according to industry standards, but these tests typically do not include analysis of the long-term performance of the design and materials used to construct the device. In this project, EPRI members, including Con Edison, collaborate and identify recloser degradation modes that will inform recloser fleet specifications and deployment decisions; identify inspection and maintenance practices to extend recloser service life; evaluate accuracy of embedded and external sensors; and develop recloser aging profiles.

BENEFITS

This collaboration provides technical basis for utilities to make informed decisions regarding the life-cycle management of distribution reclosers, including analysis of long-term performance of design and materials used to construct the device via sensor accuracy tests, aging tests, and teardown inspections. The non-proprietary results of this work will also be incorporated into EPRI Distribution Systems R&D program, and made available to the public, for purchase or otherwise.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☐ Sensor Accuracy Testing – In Progress

☐ Recloser Operation Testing – In Progress

☐ Aging Tests - In Progress

☐ Post-Aging Inspection and Teardowns - In Progress

☐ Final Report

TITLE Electric Grid Field Asset Unique Identification System, Technology, and Use Cases - 285

CSN 00016 **POET** 26573374 **TASK** 0001

OBJECTIVE

Tracking electric grid (transmission and distribution) assets, especially field assets across their lifecycle (cradle to grave), has become more important over the past several decades. The electric sector faces several challenges concerning grid assets tracking, including uniqueness of asset identifiers, asset tagging durability, asset information, multiple asset tracking technology options, and globally unique identifier for each electric grid asset.

The working hypothesis is that a QR code coupled with industry consensus catalog ID would form the

necessary asset make/model and unique identifier information system for all electric grid assets.

Working with EPRI and peer utility members, we seek to develop an inventory tracking QR code and catalog ID, that can enable the named value cases:

- Determine what additional value-use cases will be enabled by this solution
- Determine the best mechanism to engage the utility and vendor community
- Demonstrate technique to apply durable asset unique identifier to electric grid assets not previously so tagged
- Determine what technology is required to demonstrate the implementation of these kinds of capabilities, e.g., is QR code coupled with catalog ID, make/model, unique asset identifier as a sustainable solution

BENEFITS

Tracking of electric grid (transmission and distribution) assets, especially field assets across their lifecycle (cradle to grave) has become more important over the past several decades. The use of a globally unique identifier across assets and its components life cycle can enable:

- Better plan timelines for receipt, installation, commissioning, data analytics, supply chain constraints
- Improved inventory prediction
- Failure / maintenance / useful live predictions by asset type make/model
- Utility mutual assistance on compatible assets alternative sourcing in scarcity situations
- Linking to the asset: safety checklists, material breakdowns/maintenance guides, relevant policies, and procedures

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Project Kick-off

☒ Identify stakeholders and high-level concerns

☐ Functional and data requirements for a database that can be used to store globally unique identifiers for each asset and catalog identifiers for asset types

- ☐ Reference Architecture that documents the data flows and functions
- ☐ Provisioning mechanism that can be used to access the QR code database by utilities and vendors, using the EPRI secure API framework
- ☐ An implementation guide that will information users on the data integrations requirements; loading and analysis of data in the system; tracking of assets through the creation, implementation, commissioning lifecycle
- ☐ Documentation of use cases developed, such as restoration, demand forecasting, inventory management, manufacturer tracking
- ☐ Develop test scripts that may be used by implementers to verify their understanding and ability to integrate with the QR code database
- ☐ Tech transfer via white papers, webcasts, and workshops to inform both the member utilities and the industry at large

TITLE Testlamp Development - 248

CSN 91602 POET 26185016 TASK 0001

OBJECTIVE

It is common when field personnel are working on electric circuits, such as secondary splicing operations for example, for a test device to be used to determine the status of the electrical conductors before personnel perform tasks on the conductors. These devices, commonly referred to as test lamps, measure electrical voltage and provide a visual indication of the voltage potential on the conductors. The testlamp uses an incandescent light bulb as electric potential indicator. The intensity of the light emitted by the lightbulb indicates what level of electric potential is present on the conductor, such as 120V or 220V for example.

There are situations, such as operating in the field, when personnel can have difficulty differentiating visual distinctions due to ambient sunlight. Furthermore, it is known that incandescent light bulbs are being phased out globally. Securing replacement lightbulbs are made increasingly difficult from dwindling suppliers.

The objective of this project is to develop a testlamp that does not depend on incandescent lightbulbs and enhance functionality, such as audible indication alongside to light. Our plan is to use a combination of external vendors and internal expertise to develop the testlamp. We anticipate a phased approach where features are introduced gradually to select field personnel where it is evaluated.

BENEFITS

Qualitative benefits are that a redesigned testlamp will help address immediate incandescent light bulb sourcing challenges. In addition, it will help enhance tool usability of field personnel performing maintenance.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Define testlamp requirements
- ☒ Identify technology and approaches
- ☒ Develop prototype for lab and field test
- ☒ Deliver alpha prototype for limited field personnel evaluation
- ☐ Deliver beta prototype for field personnel evaluation
- ☐ Develop manufacturing and scaling plan

TITLE Feasibility study - Cable Splicing Machine - 211

CSN 91556 **POET** 25792542 **TASK** 0001

OBJECTIVE

Con Edison experiences over a thousand underground distribution feeder failures annually, a small portion of which are caused by inconsistent assembly. To repair failures and to make extensions and other changes to the underground medium voltage network feeder system, splicers must spend long periods of time in underground electrical enclosed spaces, called manholes. We have reduced premature failures and improved useful life of splices by improving splice components and splicer training, but more is needed. In addition, we have steadily improved worker safety by engineering and administrative controls and personal protective equipment, but underground electrical enclosed spaces are not zero-risk environments.

We seek to enhance the safety of employees and to improve quality and longevity of splices by developing and deploying a splicing machine that will produce consistent quality products with less variation than those completed by human counterparts, and significantly reduce the amount of time workers must spend in underground electrical enclosed spaces. Prysmian, Con Edison and Exelon will explore the possibility of offering a solution that avoids the time-consuming grounding step of the process by using some autonomous equipment to perform the splice. Work already has been done with ULC Robotics for the development of a prototype autonomous splicing machine. Building on top of these learnings, Prysmian, ConEd and Exelon are exploring other solutions to develop an autonomous splicing machine. This project focuses on the feasibility of such a tool and will:

- Identify the environment and operating requirements
- Ideate – develop a list of candidate technologies, methodologies, and concepts to test
- Plan and scope to test candidate technologies, methodologies, and concepts

BENEFITS

Envisioned benefits are improved safety resulting from reduced worker time in underground electrical enclosed spaces and enhanced reliability resulting from consistent quality of machine-made splices. Successful completion of this phase of the project will be determined by the identification of a technology, methodology and concept that can be feasibly and economically developed and demonstrated.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ A report detailing the list of ranked concepts and down-selected list of concepts to move forward
☒ A prioritized requirements specification for the user, system, environment and process steps
☒ A system architecture document
☒ A plan for phase 2 and updated estimates and timeline for phases 3 and 4

☒ A risk register

☒ Updated value assessment

Encouraged by learnings from this study, Prysmian, ConEd and Exelon will continue to explore development of an autonomous cable splicing machine in the next phase of the project see following writeup “Cable Splicing Machine - Phase 2 – 284".

TITLE Cable Splicing Machine - Phase 2 - 284

CSN 00014 **POET** 26568567 **TASK** 0001

OBJECTIVE

Upon completion of Phase 1 of the project, the feasibility study, we identified:

- Environmental and operating requirements
- List of viable technology
- Methodologies
- Concepts to explore
- Plan and scope to mitigate technology risks

Encouraged by learnings from the feasibility study, Prysmian, ConEd and Exelon are exploring the development of an autonomous cable splicing machine. Phase 2 will involve technically de-risking critical functions of the technological concepts identified in Phase 1.

Phase 2 will involve:

- Designing, procuring, manufacturing and building a series of test rigs
- Using these test rigs to prove out the critical unit operation concepts that were identified in Phase 1
- Report that demonstrates the testing results from each test rig

BENEFITS

Envisioned benefits are improved safety resulting from reduced worker time in underground electrical enclosed spaces and enhanced reliability resulting from consistent quality of machine-made splices. Successful completion of this phase of the project will be determined by the demonstrating each technology component of the splice machine. Deliverables must demonstrate lower risk when incorporated in splice machine.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Define the proposed high-level design of each test rig

☐ Define the proposed operation of each test rig

☐ Define the testing environment

☐ Define the proposed success criteria for each test rig

☐ Detail the number of splices and cable samples required from Prysmian for testing to be completed

TITLE Collaborative Research to Advance ANSI CTA-2045

CSN 90767 **POET** 22661057 **TASK** 0001

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 multiple tasks within this project: 1) Update Preliminary End-Device Requirements; 2) Develop Preliminary Functional Requirements for New Device; 3) Integrate CTA-2045 Test Tools - including hardware design guides and CTA-2045 application simulator; 4) Develop test plan; 5) Perform industry outreach and gain support; 6) Develop Demand Response Program Support and Guide; and 7) Enable OpenADR and CTA-2045 Mapping and application software libraries. Software libraries will be provided to the open-source community to facilitate the use of the standard.

BENEFITS

This project identifies and documents 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 supports industry efforts to establish cost effective, and standard communications-enabled residential appliances and devices for DR program participation. In addition, a modular interface could provide consumer choices in internet providers and would help prevent appliance obsolescence related to non-standard communication technologies.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Develop test plan
☒ Develop marketing materials
☒ Finalize participant list
☒ Install appliances and/or devices
☒ Test device response
☒ Prepare final report with recommendations

This project has now concluded. The project has informed many aspects of CTA-2045 such as ease of use, availability of supporting vendors, continuation of support from vendors, and potential benefits to implementation of the standard.

TITLE Evaluation of Temperature Screening Technologies for Facility Entrances (CoVid 19 Response) - 114

CSN 91370 **POET** 24577223 **TASK** 0001

OBJECTIVE

The project objective was to evaluate thermal screening solutions for return to work. The solutions shall be non-contact for small and large groups as well as individual scans. We planned to evaluate a minimal of three temperature screening technologies/systems. These systems range in capability, setup, accuracy, scan times, notification, etc. in addition, some offer advanced features like face recognition and techniques to reduce environmental effects. The pilots were carried out in a number of ConEd facilities with the use case scenarios chosen to represent a majority of ConEd sites so that learnings can be applied across the company.

BENEFITS

The expected deliverables of this project were:

- Validate accuracy of claims - temperature and scan times
- Understand the limits of the technology / systems
- Determine best case scenarios
- Gather site requirements and identify suitable temperature screening technologies

TECHNICAL STATUS

As reopening phases advance, it is expected more workers are returning to work, and temperature screening will be required as normal routine. By late 2020, we had tested a few temperature scanning systems and down selected two systems that suit most, if not all, of ConEd's use case scenarios. Plans were to acquire and utilize the down selected scanners to help maintain a safe and healthy workplace.

Tasks (checked boxes are completed):

☒ Scanners installed and tested
☒ Supplemental scanners purchased for future use.

This project is complete.

TITLE Manual Carbon Fiber Wrap (CFR) Defect Acceptance Criteria - 212

CSN 91560 **POET** 25814660 **TASK** 0001

OBJECTIVE

Con Edison is the largest utility in North America that uses an underground High Pressure Fluid-Filled (HPFF) system. Located in a dense urban environment, our piping system is susceptible to stray voltage from nearby facilities generated by subways, trains, streetlights, etc. These stray currents can result in accelerated steel pipe corrosion and subsequent dielectric oil leaks to the environment. Under prior projects, we developed and now use a manual carbon fiber wrap (MCFR) process to form a new secondary pipe barrier over the existing pipes to replace the conventional steel pipe barrel repair method. However, MCFR use can result in defects during the manual wrapping, including foreign materials, air bubble, and debris. This project will develop criteria to validate the types, sizes, depth, and locations of defects that require corrective action, and develop an MCFR acceptance guideline to improve productivity.

BENEFITS

Hydrostatic testing was performed to prove the safety of this method. An acceptance guideline to alleviate the need to bypass repair for MCFR air bubble defects smaller than 2 inches is estimated to reduce by 6% the overall installation costs.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Fabricate defect sample on MCFR 10” pipes smaller than 2”
- ☒ Fabricate defect sample on MCFR 10” pipes greater than 2”
- ☒ Hydrostatic testing with known defect sizes to determine pressure threshold holdup
  - Results of hydrostatic testing on smaller than 2” pipes: completed and accepted
  - Results of hydrostatic testing on greater than 2” pipes: failed and scheduled for retesting in 2023 after redesign of the manual fiber wrap methodology.
- ☐ Finite EA simulation to confirm the result to concur verification for 5” pipe
- ☐ Perform an accelerated moisture corrosion test
- ☐ Develop an acceptance standard and training package

TITLE Advance Dielectric Fluid Leak Locating Gas Chromatography Demo - 131

CSN 91398 **POET** 24802141 **TASK** 0001

OBJECTIVE

The current generation of perfluorocarbon tracer (PFT) dielectric fluid leak locating gas chromatography (GC) was developed in the early 2000s. The existing PFT GC can detect PFT in the air. This is validated by measurement comparison of the normal environmental background PFT, standard injections, and the GC response during leak searches along the feeder route. However, there have been leak searches where the GC failed to detect proper PFT level.

This project intends to develop a GC system capable of providing mobile sampling and automated processing of the collected samples seeking to reduce dielectric fluid leaks releases to the environment through earlier detection. An improved unit will then be pilot tested. If proven effective, the pilot recommendations will be implemented as a permanent part of the dielectric fluid leak detection process.

BENEFITS

Measurement of dielectric fluid leak clamp is a performance metric. An improved GC should reduce the duration of a leak due to earlier detection.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Preparation – optimize the sampling rate and re-evaluate the absorption apparatus
- ☒ Chromatography – evaluate column design and front-end concentrator
- ☒ Detection- increase the sensitivity and output of the electron capture detector (ECD) and reduce the required ambient input air.
- ☐ Analysis – demonstrate the efficiency of multiple bar holes sampler of PFT chromatographic data
- ☐ Software enhancement of the visual effect of the chromatograph.

TITLE Overhead Transmission Autonomous UAV Inspection - 126

CSN 91399 **POET** 24814855 **TASK** 0001

OBJECTIVE

The objective of this project is to evaluate unmanned aerial vehicle system (UAVs) technology capable of improving Transmission Line Maintenance (TLM) operations for both planned and emergency work. This project will demonstrate the benefits and advantages, both operational and economic of using UAS technology for TLM and Engineering when coupled with pre-set waypoints (or flight plan) inspection and recording technologies to enhance safety, both for utility workers and the general public when compared to manned aerial technology. This project will also analyze the cost differentials between the use of manned and unmanned aerial technology. The UAS equipment used in this project will be upfitted 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.

BENEFITS

Project results will produce a set of GPS based trending defects imageries for overhead transmission system assets. The project will also establish a modern standard and maintenance protocol for the Company to setup an overall strategy targeting overhead Transmission Capital projects and provide a low-cost replacement for the mandated lattice tower inspection.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Prepare an UAV autonomous engineering procedure for overhead transmission lines
- ☒ Select a corridor and associated UAV take-off and landing location for line-of-sight UAV inspection
- ☐ Perform UAV inspection to locate defects per tower per feeder
- ☐ Develop a procedure to setup waypoint inspection file per tower per feeder
- ☐ Setup a library for defects' imageries
- ☒ Demo the autonomous UAV flight

TITLE Post-Leak Detection of Minor Leaks for High Pressure Fluid-Filled (HPFF) System - 220

CSN 91565 **POET** 25845223 **TASK** 0001

OBJECTIVE

This project is expected to develop a leak detection model that is based on Artificial Intelligence (AI) and Machine Learning (ML) AI/ML algorithms to identify markers in operational data (temperature, pressure, etc.) that correlate with the physical commencement of the leak phenomenon. We will select a rapid circulation feeder and a pair of slow circulation feeders and perform Exploratory Data Analysis & Develop preliminary AI/ML model and1D Simulation – Digital Twin Modeling

BENEFITS

Con Edison underground transmission system is comprised mainly of HPFF feeders that may be static, slow circulating, or rapidly circulating. Most leaks in HPFF feeders are only detected after a noticeable loss of fluid over time or some other change in system performance is recognized by an experienced operator or the monitoring system (if installed). However, by this point, hundreds and sometimes thousands of gallons of dielectric oil may have already leached into the ground and other environmentally sensitive areas, which increases both the complexity, cost of repairs, and costs associated with subsequent ground-leak remediation. The result of the project will produce a set of preliminary digital twin leak detection models for the selected HPFF feeders and hopefully result in reduction of dielectric fluids release to the environment.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Selected a set of HV Static Feeder
☒ Prepared five years of pumping plan operation data for AI model building
☒ Prepared additional year of pumping plan operation data for AI model blind test.
☒ Vendor built AI leak detection model.
☒ Demonstrate partial success to correlate the known 5 years leak events
☒ Complete the blind year test
- Results were partially successful.

☐ Phase 2 – looking for locations for field installation and testing (2023/2024)

TITLE EHV Overhead feeders Autonomous Drone Configuration Assessment - 226

CSN 91567 **POET** 25875141 **TASK** 0001

OBJECTIVE

The objective of the project will develop an autonomous drone inspection plan and survey criteria per dead-end towers on a pair of EHV feeders. The plan is to build a wave point file to every dead-end tower. The project will also verify tower's configuration using twelve high resolution pictures per tower and six per feeder and use this data to update as-built and Company drawings.

BENEFITS

In conventional overhead feeder design and construction, the system was built with one uniform configuration. Previously, a pair of EHV feeders which were constructed (50 years ago) that used three different configurations and were not being recorded in the system. In preparation of upcoming capital project of feeder replacement for this pair of feeders, we need to survey all dead-end towers to ensure accurate parts procuring. This will ensure construction work meet the tight feeders' outage schedule by avoiding reordering parts and subsequent dispatches. The result of the project will develop an autonomous drone inspection plan for a pair of aging EHV overhead feeders that allows trending and tracking of conditions of all hardwires.

TECHNICAL STATUS

In 4Q2021, we completed the tower configuration survey of 31 dead end towers for a pair of EHV feeders in 3 days. This project is complete.

TITLE Transmission manhole 3-D Digital Scanning Demo - 110

CSN 91357 **POET** 24557241 **TASK** 0001

OBJECTIVE

This work is intended to produce a set of analytical measurement files that provide a 3-D virtual walk through and GPS site data for each manhole to expedite preparation for construction and operational work for pipe type feeders. The plan is to open the manhole cover and using a tripod supported scanner supported by a tripod to scan from the manhole entry to create a 360-degree view of the manhole environment without entering manhole.

BENEFITS

The transmission manhole environment differs from manhole to manhole. The newer XLPE insulated feeder's manhole prohibits any personnel entering the manhole when the feeder is energized. The existing transmission asset management database only contains rendering manhole drawings lacking GPS and precise measurement. In order to prepare working inside XLPE insulated cable manhole, Transmission Operations (TO) is required to access the manhole prior to the scheduled field task to take measurements for fabrication of supported materials such as barrels to address the leaks, valves, bypass pipes etc. The result of the project will produce a set of 3-D GPS sketches and drawings for our transmission underground manholes.

TECHNICAL STATUS

In 1Q2021 a demo of the 3-D rendering of a HV XLPE manhole was held. This project is complete.

TITLE 138 kV XLPE Feeders Sharing Manhole Study

CSN 90994 **POET** 23581395 **TASK** 0001

OBJECTIVE

This project will develop and qualify two straight 138 kV XLPE Feeders joints sharing a single manhole and meet safety requirements to provide worker protection from induced voltage and fault energy dissipation.

BENEFITS

Con Edison owns 450 miles of 138kV class underground transmission lines in steel conduit, half of which are over 45 years old. The eight oldest paper insulated oil filled cable lines on the system are over 60 years of age, and as these circuits are phased out, the Company's replacement methodology is to install solid dielectric lines in new underground Fiberglass Reinforced Epoxy Conduit System (FRE)rather than reusing the already installed 8" steel conduits. The current paper insulated oil filled cable systems require a network of pumping and cooling stations that occupy large amounts of real estate which requires extensive maintenance. By retrofitting our cable systems with XLPE insulated cables, the ancillary system will be eliminated. XLPE systems require minimal maintenance while eliminating the dielectric oil risk.

TECHNICAL STATUS

In 2019, we completed the design of a shared manhole system for two 138 kV XLPE, conventional and triplex, feeders. In 2022, we planned to perform an electrical qualification test to ensure the design meets all safety requirements. This task was not completed in 2022 due to lack of funding. Re-evaluation will be starting in 2023.

Tasks (checked boxes are completed):

- ☒ Investigate all hazardous elements of two XLPE insulated cables joints sharing one single manhole
- ☐ Develop mitigation measures and defining test protocols to meet safety requirements
- ☐ Design and developing prototype joints and manholes
- ☐ Perform electrical qualification test
- ☐ Develop the installation guideline

TITLE Mitigating Vibration on Steel Pole Davit-arms Phase II - 266

CSN 00025 **POET** 26627978 **TASK** 0001

OBJECTIVE

A number of steel pole cross-arm failures have been attributed to resonant vibration induced by moderate winds. In phase I of this project, EPRI completed a software tool (DAV Tool v1.0) to assess the risk from vortex-induced vibration on davit arms, and to re-optimize them if necessary, considering both structural design and resonant vibration.

Exploratory wind tunnel research on a 6-sided section has revealed that the theoretical CFD models to develop this software are largely valid with respect to vortex shedding frequency, but that validation of other shapes would be useful to ensure accuracy of the software. In addition, further validation of natural frequencies is necessary to incorporate the flexibility of the main pole body to which the davit arm is connected.

The objective of the project is to validate theoretical models developed for DAV Tool v1.0 by performing a combination of wind tunnel testing and in-field verification. This will improve our understanding of the type of cross-arms that may be at risk of experiencing resonant failures and identify the risk of resonant vibration occurring on a cross-arm.

BENEFITS

The benefits of this project are to provide us with a real-time vibration model.

TECHNICAL STATUS

Deliverables included: An updated validated model to avoid damage and additional cost associated with VIV damage; validated Strouhal Relationships for all cross-sections, including 4-, 6, 8-, 12-sided, and round sectional shapes structures. Updated/revised software, DAV Tool V1.0 based on wind tunnel test results and field verification. Phase 2 will begin in 2023.

Tasks (checked boxes are completed):

- ☒ Conduct wind tunnel experimentation on typical davit arm cross-sections to determine empirical results for: natural frequency; Vortex shedding frequency; Initiation and cessation wind velocities associated with vortex shedding
- ☒ Update DAV Tool Software to reflect empirical results
- ☒ Repeat experimentation on re-designed, vibration resistant davit arms to validate efficacy of producing vibration resistant arms
- ☒ Validate behavior of wind tunnel testing of davit arms through in-field monitoring
- ☒ Adjust DAV Tool software based on in-field results
- ☐ Complete davit arm designs and fabrication for a series of arms that will be used to define fatigue life curves for the transmission industry. This testing will be done in early 2023.

TITLE Next Generation for Perfluorocarbon Tracer (PFT)

CSN 90222 **POET** 20946547 **TASK** 0001

OBJECTIVE

The current generation of perfluorocarbon tracer (PFT) leak detection equipment was developed in the early 2000s. The existing PFT instrumentation 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 incidents where the PFT vehicle passed directly over a subsurface structure containing quantities of PFT tagged oil without detecting a PFT concentration As such the objective of this project is to study and optimize the current sampling and analysis techniques.

BENEFITS

Enhanced leak detection and analysis will result in the following:

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

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Preparation - Optimize the sampling rate and re-evaluate the absorption apparatus.
☒ Chromatography - Evaluate column design.
☒ Detection- Increase the sensitivity and output of the electron capture detector (ECO).
☒ 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.
☐ Issue project closeout.

This project is completed. A second generation PFT GC was developed and is in use.

TITLE A Bulk Power System Dark Sky Recovery Demo Using the Disturbance Monitoring Equipment (DME)

CSN 00018 **POET** 26581135 **TASK** 0001

OBJECTIVE

A dark sky event has the potential to impact the Energy Management System (EMS). Such an event requires the Energy Control Center (ECC) and Electric Transmission groups to have an alternate solution to maintain the operation of the electric transmission power grid. The objective of this project is to demonstrate a Loss of Energy Management System (EMS) and transition to the Dark Sky recovery solution using the bulk power substation's DME information via the Transmission Network Visualization System (TNVS).

This project will involve installation of new hardware and software updates. The DME servers will be automated to push EMS data to Cloud. This data will be combined with field data entered by Substation Operators using an iPhone app. The TNVS application will be updated to retrieve the new DME data from the cloud and display it in a station map. This project will include several new station maps and newly developed transmission voltage and capacitor bank displays.

BENEFITS

A successful means to recover from a "dark sky" using TNVS to access substation DME information during loss of EMS provides a contingency path to operate the system.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Successful lab demo based on Rainey substation data architecture. Under current "Dark Sky" scenario when the EMS SCADA system had failed, we relied on substation operators using their smart phones to manually transmit information.

☒ Successful demo of the automation of data transfer from substation DME via the cloud to control center.

☐ Project closeout in 2023.

TITLE Laser Ultrasonic Inspection of CFRP (Carbon Fibre Reinforced Polymer) - 213

CSN 91559 **POET** 25807725 **TASK** 0001

OBJECTIVE

The objective is to develop and qualify a laser ultrasonic inspection technique to detect subsurface CFRP defects in the pipe area outside the adhesion zone where CFRP is not bonded to the steel. The laser induces ultrasound in the CFRP which interacts with defects and is detected by a sensitive ultrasonic receiver. The laser and receiver are mounted in an automated scanner which travels across the surface of the CFRP. The plan is to fabricate defects sample on MCFR 10" pipes and perform scan test to validate defect type, size, location, and depth within CFRP layers.

BENEFITS

The CFRP is installed in 100-ft sections with an adhesion zone at the start and end of the 100-ft section. The adhesion zone is a three (3) foot section where CFRP is directly adhered to existing pipe steel surface, any coatings in this section are abated. The Company uses conventional guided wave inspection technique to locate defects in the CFRP in the Adhesion Zones. The remaining 94-ft between each adhesion zone is manually inspected by the National Association of Corrosion Engineers (NACE) Level 3 Inspector using manual tapping quality assessment technique. This is a tedious and time-consuming inspection, that is totally dependent on sound. A quality control and inspection assessment for CFRP non-adhesion area will enhance this process.

TECHNICAL STATUS

Starting from 2017 to present, we developed and now use manual CFRP to form a new secondary pipe barrier over the existing pipes as a secondary pressure boundary to mitigate corrosion and stray voltage issue for critical areas.

Tasks (checked boxes are completed):

☒ Complete and field deploy an ultrasonic inspection system for composite repair defects.

☐ Project closeout in 2023.

TITLE Development of Unmanned Aerial Vehicle (UAV) Corporate Response

CSN 90905 **POET** 23186497 **TASK** 0001

OBJECTIVE

UAVs are helping electric utilities maintain and inspect critical infrastructure safely and quickly. UAV technology is recognized as a potential tool to improve safety, reliability, and advance operational excellence. Con Edison requires aviation expertise and services of a 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 by 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.

The deliverables will include the following:

- UAV Safety Procedures for safe, efficient, and lawful operation of UAV within Con Edison system.
- Detailed Flight Operations Manual and Standard Procedures outlining the entire UAV operational workflow from initial planning of field activities through extracting data.
- Guidance document for vendor selection; equipment purchase; insurance requirements, qualifications for the contractor pilots.
- 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

Establishing standardized procedures and protocols governing the use of UAV for safety and compliance with the government regulations benefits the Company by providing a means for rapid response with drones as a damage assessment tool.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Complete development of drone safety procedure.

☒ Complete RFP and vendor evaluation for emergency response for drone dispatch

☒ Complete the development and selection of drone vendor procedure.

☒ Complete the documentation of safe record keeping for drone flight for Corporate

☐ Project closeout in 2023.

TITLE Sharc Piranha Wastewater Heat Pump NYC Building Retrofit Feasibility Study - 295

CSN 00017 **POET** 26581105 **TASK** 0001

OBJECTIVE

The objective of this project is to perform a Proof-of-Concept Study to install PIRANHA equipment made by SHARC Energy (SHARC), as a Wastewater Energy Recovery System at a Con Edison customer location. PIRANHA, the first of its kind in the HVAC heat pump market, extracts thermal energy from a building's wastewater stream before it exits the building to pre-heat domestic hot water that can provide for both heating and cooling needs.

The project plan is to work with a third-party installation contractor to perform a feasibility assessment at a selected customer demonstration location in Manhattan. The contractor will act as a liaison between the customer, Con Edison, and the equipment provider (SHARC) to facilitate necessary site assessments in planning for the retrofit of the wastewater heat pump system; heat pump PIRANHA unit, wastewater holding tank, domestic hot water storage tank(s), piping and auxiliary pump system. The contractor will also perform the conceptual design, develop a construction estimate of the system for optimal PIRANHA equipment sizing based on OEM's available three sizes (T5, T10, T15), develop conceptual floor plans and savings calculations based on the established baseline and anticipated performance of the proposed system as well as issue a process diagram and 30% engineering installation drawings specific to the demonstration site. Upon review by the Con Edison team, the contractor will generate a complete Scope of Work including turn-key project installation costs.

BENEFITS

This project will demonstrate Proof of Concept for PIRANHA technology, a leading technology in the new market of wastewater heat pumps, to support full-scale market adoption in New York and its effectiveness to scale up as a customer end-use efficiency measure.

A successful project will result in a feasibility study with viable solutions for Piranha unit installation at the customer location that will serve as a basis for a possible project site demonstration. The study will quantify costs and benefits and evaluate feasibility of the Piranha technology for the NYC building retrofits. PIRANHA heat pump can off-sets up to 100% energy usage and associated carbon emissions, otherwise used for domestic hot water. The technology is applicable to many of the Company's customers with good hot water load profiles. PIRANHA is expected to have a favorable Coefficient of Performance (COP) of 3.5 and above, independent from the outdoor air temperature and can effectively replace or downsize traditional combustion-based fossil fuel-fired equipment and/or AC units. The results from the first installation at a multifamily site in Vancouver, CA in 2020, demonstrated that the PIRANHA unit can supply 100% of domestic hot water at 140 deg. Other benefits include: an ability to perform peak load shifting using hot water storage, high expected useful life of estimated 25 years, lower expected maintenance due to fewer rotating parts, and societal and climate benefits of thermal ocean pollution reduction.

TECHNICAL STATUS

Construction contractor partnered with SHARC equipment manufacturer to evaluate the feasibility of a building retrofit with the wastewater heat recovery system for the selected hotel in midtown Manhattan. The contractor prepared conceptual architectural plans with two viable size and space layout configurations, located at the customer basement level and is in the process of resolving logistical challenges and preparing cost benefit analysis.

Drawing for each viable unit size and space layout configuration, including:

☒ Conceptual architectural plans
☒ Electrical plans
☒ Plumbing riser diagram and plans
☐ 30% design drawings for the selected option

Report will include:

☐ Comparative energy analysis of all options
☐ Turnkey project conceptual cost
☐ Feasibility and space requirement

TITLE Building Energy Smart Technologies (BEST) Center Membership - 315

CSN 00039 **POET** 26737771 **TASK** 0001

OBJECTIVE

The objective of this project is to become a member of the Building Energy Smart Technologies (BEST) Center. Membership will position the company to potentially achieve advancement of the state-of-art technologies and tools for environmentally sustainable buildings and cities. BEST Center develops tools and technologies to improve the building's energy efficiency and supports intelligent integration of buildings with the distribution grid by leveraging advances in storage, sensors and machine learning technologies.

BEST was formed in 2021 and started operation in 2022 under a model that's member-driven academia-industry-government collaboration. The program's administration and operation expenses are covered by the National Science Foundation (NSF), an independent federal agency that supports fundamental research and education in science and engineering. BEST partners with City College of New York (CCNY) and University of Colorado at Boulder (CUB) and focuses on four key research areas: 1) Smart Building Materials and Systems, 2) Smart Building Energy Systems, 3) Integrated Energy Generation Systems and 4) Smart Cities Building Energy Smart Technologies Center.

Membership will provide the Company with representation on the Industry Advisory Board (IAB) of the BEST Center to position the Company to be able to identify knowledge gaps, development topics, or required demonstration projects. IAB members collectively determine research topics in annual funding cycle and have an option to become project advisors. Individual project funding is leveraged by cost sharing among interested members. The scope of work for each selected research topic is in the form of faculty members proposals and project are performed by faculty along with graduate and undergraduate research assistants.

BENEFITS

Membership will give the Company two seats on the Board and decision making power about future funded projects. While individual projects may have project-specific deliverables, at a minimum, each project will provide a final report, webcasts and presentation. Furthermore, industry events such as conferences and meetings, with complimentary registrations for participants, will be offered. As a Membership, success is generalized as new knowledge and insights generated by project work that may be used to make informed and improved decarbonization decisions.

TECHNICAL STATUS

The Company joined the Industry Advisory Board (IAB) of the BEST center in Q4 2022 providing two seats with voting representation. The seats are filled by staff from the R&D and Distribution Planning departments. Since joining, Con Edison presented to students and staff and other IAB Board Members at City College of New York (CCNY). In future IAB members will be meeting twice a year to review proposed concept papers and collectively identify about 10 funded projects to advance energy systems for buildings, cities, and grids to be intelligent, resilient, and efficient. Furthermore, Con Edison will be seeking in the future means to decarbonize buildings through Building Envelope measures.

TITLE DER Systems of Record to Support Enterprise-Wide Applications via EPRI SPN -201

CSN 91543 **POET** 25572160 **TASK** 0001

OBJECTIVE

This project aims to bring together utilities that are interested in the intake, storage, and dissemination of DER data across the utility enterprise. Project participants will form a technical working group that meets regularly throughout the project, developing utility needs and translating those needs into the technical database requirements to support various DER systems of record use cases. Consultants may also be engaged to provide expert guidance on DER modeling (standards assessments and advancement), database architectures and types, and application integration. With member interest and support, reference implementations could be produced to provide a means to evaluate commercial offerings and test integration. This effort follows EPRI's recent investigation of inverter onboard island detection methods. In that study, we found a wide range of active and passive inverter on-board island detection methods in current use. These methods may pass the UL island certification test, however, their behavior is typically not captured or documented. The expected output is a comprehensive technical specification for DER database design, including interfaces to other systems and standardized information models for building a DER Systems of Record.

BENEFITS

Project benefits are expected to include: 1) Awareness of what DER attributes are needed to support each utility and customer application; 2) Quantifying the scale and performance required of DER databases to meet evolving utility needs; 3) Available technical requirements for specifying DER databases; 4) Gaining architectural insights regarding placement of DER information databases for overall customer, planning, operations and field uses; 5) Acceleration of standards for DER information modeling; and 6) Avoiding lost opportunities to capture DER information that will be needed in the future.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Recurring technical team meetings and collaboration via webcasts

☒ Generating a common file format for 'results reporting' of DER settings for DER tests

☒ Establish format for 'applied' and 'specified' settings and produce a new version of specification

☒ Technical report issued: Standard File Format for Type Test Results Reporting of DER Settings

☐ Technical report: Utility Use Cases and Requirements for DER Data

☐ Technical Report: DER Database Technical Requirements and Design Document

☐ Technical Report: Mapping to DER Information Models and Standards fit/gap assessment.

☐ Technology Transfer workshop

TITLE Automation for Regulation Management via NYU Proof of Concept AI Model Development – 155

CSN 91518 **POET** 25285422 **TASK** 0001

OBJECTIVE

A core compliance objective is to maintain a complete inventory of applicable obligations along with their authoritative sources as well as address any emerging regulatory changes. To that end, this project aims to automate the obligation inventory using machine learning technology and natural language processing to monitor publications from the Public Service Commission (PSC) and determine applicability. The machine learning model for this pilot would be built using the existing library of over 10,000 Company obligations. Prior attempts to build such a tool were not viable due to limited scalability whereby each regulatory source being monitored required specific configuration at additional cost. Machine learning and natural language processing technology can model the published regulatory content and identity potentially applicable company obligations.

BENEFITS

The deliverable is a system which can monitor PSC filing and postings on 2-3 public web-sites and determine if each of those is 1) applicable to the Company 2) applicable to a specific business unit selected for this pilot and 3) relevant controls may exist in the Company to satisfy the new/changed regulation. The expectation is that this system will be scalable to all Company business units with documented obligations and to additional regulators. Also, we would expect the match rate to improve over time as we grow the list of our documented obligations.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Task 1: Developing the baseline approaches for solving the binary classification task (identify what is important to Con Edison versus not important, based on the pre-processed data set).

☒ Task 2: Developing the baseline approaches for solving the multi-class/multi-label classification task (not important to Con Edison versus important to a specific sector within Con Edison) on the pre-processed data corpora.

☒ Task 3: Building automatic extractor of relevant passages from the original text documents in the context of binary classification.

☒ Task 4: Building automatic extractor of relevant passages from the original text documents in the context of multi-class/multi-label classification.

This project is complete.

TITLE EPRI Study on Exploring Climate Impacts in Utility Operations & Planning Interest Group SPN#

CSN 91361 **POET** 24566820 **TASK** 0001

OBJECTIVE

With its integrated, multi-disciplinary team of subject matter experts (SMEs) across the power sector, EPRI will convene a robust collaborative designed to help participants improve their understanding of the potential impacts of projected temperature trends and increased extreme weather events on utility planning and operations. By engaging with EPRI strategic planning SMEs to identify how climate is being considered in existing planning frameworks, this interest group will share insights with participants on the potential impacts of climate and extreme events across generation and related load projections, asset performance and operations, resource adequacy and system balancing, transmission and distribution reliability and resiliency, and how these changes could impact customers and communities. Leading practices, experiences, and research related to resiliency, damage prevention, and system recovery, as it relates to climate impacts, will be shared. Gaps in current processes, tools, and methodologies will be synthesized to shape future research.

BENEFITS

To support proactive risk management approaches in the power sector, this effort intends to:

1. Identify potential regional climate impacts (e.g., 4th National Climate Assessment) that can affect future long-term system planning and operations;
2. Outline mitigation and adaptation strategies from an operations and planning perspective;
3. Synthesize gaps in analysis and identified research necessary to plan for potential future climate impacts; and
4. Prioritize methods to link energy system climate impacts to electric sector planning tools (e.g., resource and delivery planning models) and processes. This interest group project offers a unique forum focusing on the nexus of projected climate change implications and electric sector mitigation and adaptation efforts to identify and inform planning and operational processes.

Additional project benefits include:

1. Exposure to, interaction with, and technical transfer of climate impacts and resiliency research;
2. Improved understanding from multi-disciplinary discussions with EPRI experts and member companies on energy and climate policy analysis, integrated resource planning, grid operations, enterprise risk management, and customer, community, and ecosystem resilience; and
3. Opportunity to shape future research priorities and directions.
4. Deliverables include collaborative interactions designed to inform participants and member-identified stakeholders as well as written products. The non-proprietary results of this work will be incorporated into EPRI's R&D programs and made available to the public for purchase or otherwise.

TECHNICAL STATUS

Task below (checked boxes are completed) include:

☒ Project Kickoff; host State of Climate Science Webcast series

☒ Host Climate Resilience in Practice Webcast Series

☒ Published report: Library of potential types of climate-related impacts and response options for the electric power system (3002025650)

☒ Published report: Synthesis of Insights from the Exploring Climate Impacts in Utility Operations and Planning Interest Group Climate Resilience in Practice Webcast Series (3002025651)

☐ Webcasts: Annual “State of Climate Science” external expert webcast, followed by series of technical webcasts exploring intersections between climate impacts in adjacent sectors, supply chains, and the power sector.

☐ Updated ECI IG Library: Updated version of the ECI IG Library (PPT format) that incorporates new learnings from Year 3.

☐ Priority Research Activity: One research activity of strategic importance to participants; topic selected during Year 3 Planning Webcast.

☐ Expert Forum: An expert forum where participants can discuss climate impacts and adaptation strategies with their peers and collaborate to evaluate opportunities and challenges related to physical climate risk.

TITLE Pad Mount Transformer Switching Tool Prototype – 197

CSN 91539 **POET** 25531212 **TASK** 0001

OBJECTIVE

This project will enhance the in-use ergonomic design of the existing pad mount switching stick, reducing soft tissue injuries during switching operations helping to promote employee and public safety. The underground Field Operations Department (FOD), and Emergency Operations/Troubleshooters are operating groups use the pad mount switching stick tool for switching of pad mount transformers. This tool can be cumbersome to operate. In the Underground Residential Distribution (URD) system, switch sticks are used to make switch moves on pad mount and submersible transformers to isolate portions of feeders to perform work safely. New pad mount transformers manufactured by Prolec have higher tension when switching compared to the older pad mount units; older types have two switch positions while new units have four switch positions. The existing switch stick used by crews requires more force to operate the switch positions safely and ergonomically. Currently, a prototype model of an ergonomically enhanced switching stick has been built and is being tested and field evaluated.

BENEFITS

This project is intended to reduce employee injuries during switching operations. There may also be improved switching efficiency. The switching stick is being modified with a handle that will allow the operator to have more control and leverage while operating the new pad mount transformers. It will also allow the crew to stand more upright when switching submersible transformers as opposed to leaning over the transformer and unfavorably extending their back. Modifying the switch stick will also result in the employee spending less time in front of the pad mount transformer or on top of the submersible transformer, reducing exposure to any further hazard while switching.

TECHNICAL STATUS

Task below (checked boxes are completed) include:

☒ A prototype was made in-house at our Van Nest machine shop

☒ Prototype was shared with various field SMEs in the different operating regions for feedback

☒ Final field evaluation complete; prototype is currently in vendor manufacturing stage (post project)

TITLE EV Bucket Truck Prototype - 148

CSN 91448 **POET** 24941527 **TASK** 0001

OBJECTIVE

The project will work to develop an all-electric bucket truck solution using a Lion Electric chassis and Posi-Plus Material Handling Aerial Device and evaluate its performance over 3 years once placed into service. Con Edison Transportation has worked with Lion/Posi-Plus to review the operational requirements compared to a standard material handling bucket truck used by CECONY Electric Ops Overhead crews. The proposed truck was scheduled to be finalized in Q1 2021, built throughout CY 2021 with final delivery to Con Edison end of Q1 2022. Once placed in service, the truck shall be used by Brooklyn and Queens Overhead crews for 3 years to evaluate its overall performance.

BENEFITS

With field evaluation of an all-electric bucket truck, Con Edison will be able to make informed decisions regarding the future of its medium and heavy-duty work truck fleet and the feasibility of future fleet electrification in line with the Company's commitment.

TECHNICAL STATUS

Significant delays occurred due to supply chain issues. Task below (checked boxes are completed) include:

☐ Vendor in process of assembling chassis and articulating boom arm (final stage of production)

☐ Prototype EV Bucket Truck to be delivered by mid-2023

☒ Developed scorecard to assist field operating groups to properly assess performance of prototype

☐ Fleet Operations to make minor aesthetic modifications to vehicle with ConEd decal and customary fleet requirements

☐ On-site training to be done by vendor with Fleet Ops and field (user) groups

☐ 3-year trial period with EV bucket truck in all operating regions to assess performance and determine viability of prototype design

TITLE EV Bucket Truck Prototype II, Dual Battery Design via Terex - 259

CSN 00000 **POET** 26360260 **TASK** 0001

OBJECTIVE

The project will work to evaluate a class 7 all-electric bucket truck solution using an International eMV-607 Electric Chassis and Terex HR-55 Material Handling Aerial Device. This combination is very similar to our existing fleet units as it has a traditional cab-chassis design. The aerial components of this truck are powered by Terex's "HyPower" electric PTO and standalone battery solution. This truck will be evaluated over 3 years once placed into service. . Once placed in service, the truck will be used by various overhead crews for a 3 year period to evaluate its overall performance.

BENEFITS

The truck design will consist of a Model Year 2023 International eMV-607 regular cab, 33,000 lbs. GVWR chassis with a 210 kWh lithium ion battery capacity and a Terex HR-55 material handling aerial device. The truck will have an estimated 135 mile range which will not be effected by aerial equipment operation as the aerial device has its own battery. Since this is a very similar design to our existing fleet units, this truck will have similar operating characteristics. Project deliverables include evaluating actual range, vehicle operating characteristics (braking, accelerating and steering), charge times for both the chassis as well as the aerial device, reliability and aerial device operating characteristics. Con Edison has committed to fleet electrification, setting a goal of a 100% electric light-duty fleet by 2035. In addition, Con Edison has committed to evaluating electric solutions for medium and heavy-duty fleet vehicles by means of R&D to test the viability of such vehicles in the most critical utility applications. Transportation has been investigating all electric truck chassis coming to market along with electrified back end utility equipment in order to propose an all-electric work truck solution and evaluate their performance over several years in the field.

TECHNICAL STATUS

Task below (checked boxes are completed) include:

☒ Prototype EV Bucket Truck was delivered November 2022

☒ Developed scorecard to assist field operating groups to properly assess performance of prototype

☒ Fleet Operations currently making minor aesthetic modifications to vehicle with ConEd decal and customary fleet requirements

☐ On-site training to be done by vendor with Fleet Ops and field (user) groups

☐ 3-year trial period with EV bucket truck in all operating regions to assess performance and determine viability of prototype design

TITLE Identifying Smart Inverter Settings for DERs in ConEd Service Territory Study via EPRI – 223

CSN 91563 **POET** 25826471 **TASK** 0001

OBJECTIVE

The objective of the proposed research is to understand the potential benefits and challenges (in the form of curtailment) of attempting to optimize smart inverter settings on a variety of timescales, including "set-and-forget" techniques. Functions compared will include reactive power functions, such as volt-var and constant power factor, as well as active power functions, such as volt-watt and active power curtailment (also referred to as flexible interconnection). The project focused on a specific network section in Con Edison's service territory (White Plains) to study the influence of various approaches to function selection, operating modes (autonomous or centralized), as well as retrofit plans.

BENEFITS

Today, there are several circuits such that adding new DERs would be cost prohibitive, specifically in areas where DER penetration has progressed more quickly (e.g., in Staten Island and Westchester), because circuits are at calculated hosting capacity limits. Better tools for both planning and operating DER could unlock capacity, allowing more customers to interconnect in these areas. With the increase in the DER resources, the distribution grid needs to handle an increasingly variable power supply profile, which adds complexity to safety, grid stability, asset condition, reliability, and resilience.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Investigated the value in being able to periodically update autonomous settings via time-series simulation of sample network and analysis of results
- ☒ Estimated potential curtailment due to smart inverter reactive power functions via probability assessment of curtailment and worst-case curtailment assessment
- ☒ Characterized the benefits and challenges of flexible interconnection via benefit and curtailment analyses
- ☒ Investigated the benefit to retrofitting aging inverters with IEEE 1547 compliant inverters via simulating portions of distribution circuit to understand the ability for smart inverters to compensate for inverters operating at unity.
- ☒ Published final technical report; results identified optimal inverter settings per location in sample network which are in alignment with current DG interconnection requirements.

TITLE EVs2Scale2030 via EPRI - 307

CSN 00037 **POET** 26721717 **TASK** 0001

OBJECTIVE

EVs2Scale2030 is a three-year collaboration that seeks to:

- Enable the utility industry and its regulators to be in lock step with vehicle manufacturers, fleet operators, and consumers to build confidence in achieving 2030 goals
- Enact systems and processes that support the pace of activity and investment required
- Develop and optimize the tools and technologies required to enable EVs at scale and capture the grid benefits of this large and flexible load

In addition, there are 3 pillars to the project plan/strategy:

1) Coalitions & Roadmaps – frame the 2030 problem, establish a year-over-year roadmap to enable EVs at scale on the path to 2030, and provide forums that enable utilities to coordinate with automakers, truck makers, and fleet operators through regular convenings.
2) Structural System Reforms – strengthen the standards and processes used to deploy, operate and maintain EV charging infrastructure and establish or streamline processes that enable the pace of action required to achieve 2030 goals – e.g., grid interconnections, standardized interfaces, EV/Electric Vehicle Supply Equipment (EVSE) compatibility, cost-benefit methodologies, and the workforce to execute these efforts.
3) Unifying Tools & Pilots – develop the tools, technologies, and pilots required to accelerate and validate utility and EV stakeholder interactions, with the goal of increased transparency and collaboration.

EPRI aims to implement this strategy by stepping up convening and stakeholder engagement efforts. The initiative endeavors to leverage the widest possible swath of the utility industry, vehicle manufacturers, fleet operators, consumer groups, and civil society and standards organizations – and to coordinate with federal and state agencies and national labs to provide their concurrence on the path to the 2030 goals.

BENEFITS

A multi-stakeholder, year-over-year national roadmap outlining EV loads, grid impacts, lead times, and costs through 2030.

- Quarterly OEM-Utility and Fleet-Utility convenings
- A Stakeholder Task Force and report assessing cost-benefit methodologies and options for achieving 2030 electrification goals.
- A National Electric Transportation Equity Blueprint
- A National Electric Transportation Workforce Development Blueprint
- A National EV Driver Research Board and ongoing documentation of consumer market research (EV and non-EV drivers).

- An on-line Approved Product List (APL) for EVSE that verifies system consistency with SAE open standards and NEVI's Made-in-America provisions.
- A reliability benchmarking analysis and facilitated industry forums to indicate how updated and improved industry standards can address EVSE interoperability and streamlined EVSE interconnect processes.
- An online grid-interconnect platform and data sharing exchange between fleet operators, utilities, and others.
- A lower-cost charging solutions whitepaper
- A managed charging roadmap
- A roadmap for NEHC/NEVI collaboration
- A report on leading practices for evacuation/resilience plans for EV charging at-scale during widespread power outages.

TECHNICAL STATUS

☒ EPRI launch (2022)

☐ 1.1. 2030 Roadmap - 2023 Q1-Q2

☐ 1.2. Bilateral Convening Series (ongoing)

☐ 1.3. Stakeholder Task Force (2023 - ongoing)

☐ 1.4. National EV Driver Research Board (2022 - ongoing)

☐ 1.5. ET Equity Council and National Equity Blueprint (2023 - 2024)

☐ 2.1. Streamlined Grid Interconnect (2024)

☐ 2.2. Improved Charging Reliability (2024)

☐ 2.3. Affordability Whitepaper (2024)

☐ 2.4. Managed Charging Roadmap (2025)

☐ 2.5. Assessing Cost-benefit Methodologies (2023 - ongoing)

☐ 2.6. Workforce Development for Utility and ET Jobs (2025)

☐ 3.1. Grid Interconnect Platform and Data Exchange (2023 - ongoing)

☐ 3.2. Approved Product List - APL (2022 - ongoing)

☐ 3.3. NEVI/NEHC Coordination with EEI (2023)

☐ 3.4. EV Evacuation and Resilience Best Practices (2025)

TITLE Evaluation of Heat Mitigating Flame Retardant (FR) Clothing-104

CSN 91353 **POET** 24525653 **TASK** 0001

OBJECTIVE

Flame Retardant (FR) Clothing is required to be worn for some field functions performed by Electric, Gas and Steam Operations. Wearing FR clothing and working in an environment that is hot increases the risk for heat related illnesses. While there are mitigating efforts, like drinking fluids and frequent breaks, the human body's capacity to dissipate heat varies from person so identifying FR clothing that doesn't retain heat is an operational need to enhance use of FR clothing.

The objective of this project was to identify manufacturers and models of heat mitigating FR clothing for demonstration. The plan was to select a minimum of 3 different types and to pilot the FR clothing with specific pilot participants in various operating groups and obtain feedback over a several week period per type of FR clothing. Each pilot participant exchanged the FR clothing for the next set and continued until all the FR clothing types were circulated. Each pilot participant provided feedback after each model and at the end of the pilot provided a scoring form to rank the units.

BENEFITS

The expected benefit was to identify types of heat mitigating FR clothing for field use, that would also be comfortable and durable.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Distribute Pilot FR Clothing to participating groups.

☒ Gather and analyze feedback from Pilot participants.

☒ Use feedback to determine recommendation of new clothing for approval.

- Pilot identified one pair of FR pants based on the feedback from the participants. The plan is to test additional garments in a 2023 pilot.

TITLE Development and Evaluation of a Two-reel (Bi-Reel) Cable System Prototype) - 235

CSN 91582 **POET** 26040258 **TASK** 0001

OBJECTIVE

The Company has in service in the electric distribution system legacy paper insulated lead cable (PILC) that when it fails, it requires disposal as a hazardous material. Failed electric cable is removed from the system using vehicles that contain a single reel where multiple failure sites are aggregated onto a single reel for recycling. When a segment of PILC cable is removed and comingled with non PILC cable on the reel, the whole reel's contents is treated as lead contaminated, reducing the recycling value of the entire reel's contents.

The objective of this project is to develop, build and evaluate prototypes of a bi-reel cable system that is suitable for the Company's fleet of single reel cable trucks that can be used to collect PILC on its own cable reel. This bi-reel cable system will consist of two independent reels that interlock together but can function separately upon loading and unloading of cable. The plan is to design multiple versions of the bi-reel concept and identify vendors who can build the custom prototype reels. The reels will be field evaluated to determine which design works best on the current fleet of cable trucks and to provide feedback regarding the process to collect cable with the new design.

BENEFITS

The expected benefit is a cable bi-reel that is suitable for the current fleet of cable pulling vehicles and a procedure as to how to operate this new reel. The pilot will be deemed successful if the prototype bi-reel design meets the following criteria: (1) Easily and securely mounts on the cable truck set up; (2) the reel operation remains similar to current functions (excluding the bi-reel function); (3) is safe and easy to activate and deactivate the bi-reel function when mounted on the truck; and (4) is easy and safe to attach and separate the individual reels once placed on the ground.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Identify vendor to manufacture bi-reel.
- ☒ Review/evaluate design criteria.
- ☒ Receive bi-reel prototype for field testing
- ☒ Conduct field testing on Prototype 1.
- ☒ Provide feedback to manufacturing partner for analysis and revisions
- ☐ Approve revised designs of Prototype 1 for manufacture
- ☐ Approve design of Prototype 2 for manufacture
- ☐ Receive revised bi-reel(s) for field testing

TITLE Job Briefing Application Enhancement and Field Evaluation - 261

CSN 00005 **POET** 26444432 **TASK** 0001

OBJECTIVE

Job briefings are required by Company procedures. Presently, job briefings are documented on a paper form by an employee who handwrites or checks off the information and writes a synopsis of the verbal communication of the briefing. The form is then hand signed by the briefing recipients and the paper forms are then filed. Electric Operations performs over 250,000 job briefings per year resulting in an administrative burden to manage the physical forms. The physical form also does not permit easy analysis of job briefing specifics nor easy retrieval for post job review as may be deemed necessary.

The objective of the project is to build on the success of Phase 1 (Ref. Project: #245632170001 / 91359 - Development of Electronic Job Briefing Application - Phase 1 - Field Evaluation and Optimization). Phase 1 developed a prototype that is dynamic/usable and auto populates the various job briefing categories based on the job type selected, connects to our data systems, and saves and retrieves the data entered. The plan is to add additional functions to the app including selection of job briefing types, increased data storage such as pictures and/or reference materials.

BENEFITS

The project will be deemed successful if the application enhancements meet the use goals of Electric Operations and is approved by EH&S. If successful, the plan will be to implement use of the app by Electric Operations and seek modified versions for additional organizations.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☐ Obtain approval from EH&S for use as an official job briefing.
- ☐ Complete enhancements Q2/2023
- ☐ Conduct field pilot to obtain feedback from participating crews.
- ☐ Review feedback and determine next steps for future deployment.

TITLE Evaluation of Utility Locating Devices - 274

CSN 91633 **POET** 26422674 **TASK** 0001

OBJECTIVE

The objective of the project is to evaluate the UTTO and Eastcom Associates (representing Radiodetection) locating technology. The plan is to have each manufacturer provide pipe and cable locating transmitters and receivers equipped with Locator Assurance modules or equivalent. The Locator Assurance pilot program will consist of trained supervisors and Line Locators utilizing the devices in both pre-construction and post-construction applications. The pilot program will test to validate the utility mark out processes/device and if a Line Locator is using best practices when performing locate operations.

BENEFITS

The deliverables from this pilot will be to identify what device(s) and functions provide the Company with a solution that provides real time transparency to the Company about Line Locator activities. This will enable us to develop a Line Locator database that identifies compliant vs. non-compliant Locator work practices. This data will be used to develop a matrix to gauge individual Locator performance. The data obtained from the pilot program will be summarized in a report that offers program insights means to improve internal damage prevention programs.

Success will be determined by reviewing the data collected by the Locating devices for accuracy of mark outs and noting vendor work quality practices by reviewing various data points such as: centering, swing motion, depth, compass, left, peak, frequency selection and gain. The implementation plan is to recommend the device(s) to our contracted Locating vendor(s) and have the capability to audit vendor mark out practices via a dashboard. Also, use the device(s) to perform our own QA audits on the Locating vendor practices in the field.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Delivery of units scheduled for Q3/2022
- ☒ Training sessions scheduled & conducted for crews.
- ☐ Conduct field pilot to obtain feedback from participating crews.
- ☐ Review data collected.
- ☐ Review feedback and determine next steps.
- ☐ Identify improvements to existing Locating program.

TITLE EPRI Project - National Demonstration and Monitoring of Indoor Food Production (IFP) Facilities -278

CSN 00026 **POET** 26637217 **TASK** 0001

OBJECTIVE

As the world's population increases and the climate changes, it creates challenges for growing food on the entire planet. This has led to world hunger and food security issues for today's society. With a diminishing amount of farmable land and an increase in global population, indoor agriculture can help with these current and future challenges. Indoor agriculture will play a key role in meeting the needs for increased food production. Also, the technologies these facilities adopt will open up a wealth of capabilities, jobs, and alternative investment opportunities that redesign both urban and agricultural landscapes. Indoor farming creates efficiencies in use of energy and water resources and expedites the growth cycle. It also reduces risk of environmental factors that can ruin crop due to weather or pests as well as reduce the need to transport crops over long distances, which helps in reducing the emissions from their refrigeration and trucking.

The objective of the project is to expand utility knowledge of IFP production, process technologies and the feasibility and resources needed for indoor food production. The plan is to select a site that meets the installation requirements of a level surface and install a Pod Farm on that location which has access to operating resources such as power, water, telecom and expansion capability to add a solar array, energy storage and a rainwater harvesting system.

BENEFITS

The project deliverables are regular project updates, interim reports and a comprehensive technical report and presentation when the project is completed in approximately 24 months from the IFP install/start date.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Identify installation site
- ☒ Coordinate resources and utilities for installation
- ☐ Container installation operational
- ☐ Conduct training for participants
- ☐ Conduct remote monitoring of container resources (electric, water, time, etc.)

TITLE Spigit Innovation Software - 316

CSN 00040 **POET** 26738793 **TASK** 0001

OBJECTIVE

Historically, the conception of R&D projects debuted from multiple sources. The objective of this project was to leverage the already in use Spigit Innovation Platform for a single electronic intake of potential innovation project ideas. Ideas would then be examined for further review and evaluation, and eventually assigned to a Project Manager from either R&D or the Innovation Hub, or a combination of the two. The platform allows for additional enhanced project tracking, including project planning, budgeting and implementation.

BENEFITS

Benefits could include a more streamlined process for project intake.

TECHNICAL STATUS

Benefit/cost analysis for use of the innovation platform in general became cost prohibitive. In addition, other options for streamlining project intake became more readily available. The project was cancelled.

TITLE CURENT Industrial Partner 3-year agreement - 292

CSN 00036 **POET** 26721718 **TASK** 0001

OBJECTIVE

Con Edison faces various operational and environmental challenges and constraints related to the distribution of electric power and the efficient use of electric energy. CURENT is the Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks, a research center that was jointly supported by NSF and the Department of Energy (DoE) for a period of 10 years before becoming self-sustaining. It is a collaboration between academia, industry, and national laboratories, and is led by the University of Tennessee, Knoxville. Con Edison is a founding member. We are continuing our working partnership with CURENT for an additional 3-year agreement.

BENEFITS

Collaboration with CURENT can lead to improved availability, reliability and efficiency of our electric distribution system, more efficient use of electric energy and reduced impact of our operations on the environment.

TECHNICAL STATUS

Projects that have stemmed from our work with CURENT include:

- Supercapacitor System Design for Regenerative Braking Applications
- Machine Learning for Battery State of Health Model Development

TITLE INTERNATIONAL UTILITY WORK GROUP PARTICIPATION

CSN 92439 **POET** 10064342 **TASK** 0313

PROGRAM AREA Industry Group

ENGINEER Sergo Sagareli

OBJECTIVE

The International Utility Working Group (IUWG) meets annually for a one-week conference, including a technical forum and an executive forum. The technical forum is an instrument for utilities to discuss relevant topics, share information through technical surveys and discussions and share best practices. New and emerging issues such as Smart Grid, energy efficiency, renewable energy resources and safety increase the need for this type of collaboration.

BENEFITS

Interaction with and benchmarking of best practices with engineers and managers from utilities worldwide helps to improve existing processes and develop new ones.

TECHNICAL STATUS

Themes covered in recent meetings included:

- Focusing on the customer
- Implementing resiliency focused systems and practices to prepare for extreme weather events
- Changing landscape due to the increased integration of distributed energy resources
- Reviewing Electric Vehicle progress, including current levels of vehicles and future planning

The conference found high alignment between Con Edison's challenges and projects and the work of our IUWG partners. This working group continues to be a place where the company can openly discuss challenges and source new ideas. Con Edison's shared themes were:

- Power Flow Control/Phase Angle Issues
- System Health Index and Load Index
- Machine Learning and Deep Learning
- Utilization of Smart Meter Data
- Regulatory Model, Wheeling Tariff Structure, and New Revenue Streams
- Integrated Asset Management, GIS, and Load Flow Systems
- Numerous project ideas that the Innovation Group is investigating to determine if they meet our system needs.

The next IUWG meeting is scheduled for May 2023.

TITLE Applications Research Program - CEATI – 2022 - 236

CSN 91577 **POET** 25922514 **TASK** 0001

OBJECTIVE

CEATI is the Centre for Energy Advancement through Technical Innovation. This program's objective 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, covering many aspects of distribution, transmission and substations equipment design, asset management, as well as system operation and planning. Each project has assigned monitors/advisors to provide feedback and steer research in the direction that will bring most benefit.

BENEFITS

Engaging with these CEATI projects will allow Con Edison organizations to increase leverage of expenditures and improve technology transfer and complement ongoing work with EPRI and elsewhere. The projects presently underway include a broad array of subjects, and by virtue of our participation, we expect enhanced knowledge development in transmission, substation and distribution domains important to Con Edison.

TECHNICAL STATUS

In 2022, Con Edison engineers participated in nine interest groups and task forces. 48 reports were published.

TITLE Applications Research Program - CEATI – 2023 - 302

CSN 00022 **POET** 26612125 **TASK** 0001

OBJECTIVE

This program's objective is to improve current practices, knowledge and technology used in power transmission and distribution. They cover many aspects of distribution, transmission and substations equipment design, asset management as well as system operation and planning. In 2023, new interest group on health and safety will be added to research portfolio. Each project has assigned monitors/advisors to provide feedback and steer research in the direction that will bring the most benefit. In the research, CEATI conducts industry-wide surveys that provide venue for knowledge and best practices sharing among utilities.

BENEFITS

Engaging with these CEATI projects will allow Con Edison organizations to increase leverage of expenditures and improve technology transfer; it will complement ongoing work with EPRI and elsewhere. The projects presently underway include a broad array of subjects, and by virtue of our participation, we expect enhanced knowledge development in transmission, substation and distribution domains important to Con Edison.

Success is achieved if the new knowledge and insights generated by project work and deliverable is used to inform and improve planning, design, and operations of Con Edison T&D systems and equipment. The implementation plan is to incorporate new knowledge in Company specifications, practices and procedures.

TECHNICAL STATUS

Con Edison engineers will participate in 15 interest groups and task forces in CEATI, up from 9 groups and task forces at the start of 2022.

TITLE Eyes in the Field - Wearables with AR

CSN 91510/915 **POET** 25238750 **TASK** 0001

OBJECTIVE

This project developed a Mobile Subject Matter Expert (SME) system that utilizes wearable technology using Augmented Reality (AR) to allow field personnel to have two-way visual and audio communication with SME personnel 24/7 to assist and guide filed personnel performing work tasks that may require additional or enhanced Job Briefings and instructions. In addition, the system connects to databases, such as drawings, instruction manuals, engineering, and technical specifications. Multiple technical resources of wearable technology were tested including RealWear, HoloLens or similar headsets compatible with standard Company hard hats and Microsoft Teams platform, for use by field personnel to communicate with various SME orgs such as Environmental, Health and Safety; Central Engineering, and Central Operations.

BENEFITS

This project pilot tested multiple platforms for the intended use case and determined technology gaps for a wide scale deployment of a real time mobile SME system. Adoption of technology by user organizations will be used as a metric of success (>50%). If successful, Substation Operations and Central Engineering will explore the feasibility of a capital implementation program in Substations.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Purchase Hololens and Realwear sets and distribute to field

☒ Conduct on-line training sessions with vendor support

☒ Develop scenarios for field use

☒ Present final results

The R&D portion of this project was successful and completed. The operating groups are currently exploring the feasibility of a capital implementation.

TITLE Evaluation of Substation Robotic Analytical Tools-288

CSN 00012 **POET** 26559746 **TASK** 0001

OBJECTIVE

This project's objective is to research and evaluate commercially available analytical platforms that could be deployed on any mobile autonomous robotic solutions. The analytical software packages will be evaluated by integrating them onto mobile robotic solution deployed 24/7 in the EPRI 138 kV research substation in Lenox MA to collect data and then evaluating the data collected. The evaluation will be performed by introducing different asset degradation modes in the 138 kV research substation.

BENEFITS

This research will help in further development of substation inspection robots. Completion of the project deliverables that includes a specification guideline for suitable software solutions deployable with a substation inspection robotic platform is the metric to determine success. The data will be considered for implementation in the future if robotic platforms are deployed in substations.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Development of specification guideline for software solutions
☒ Contract signed Q3/2022
☒ Kick-off meeting February 2023

TITLE Fire Characteristics of Midel 7131 Synthetic Ester -265

CSN 91630 **POET** 26279665 **TASK** 0001

OBJECTIVE

The objective of this project is to identify and describe the fire characteristics of Midel 7131 including the heat emission rate, the radiative flux, and the ignition properties of atomized sprays. These characteristics may inform whether fire suppression systems are necessary for Midel 7131 transformers. The project plan for this phase includes existing literature review, SME interviews, drafting a scope of work and selection of testing lab.

BENEFITS

Results of this research will help in better understanding fire characteristics of Midel 7131 and the need for fire suppression systems when using it in power transformers.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Review and evaluate existing data on fire characteristics of Midel 7131
☒ Develop testing scope
☒ Final technical report under review – covering the lessons learned
☐ Final Report published

TITLE CIGRE Membership - 123

CSN 14106 **POET** 20829413 **TASK** 0001

OBJECTIVE

This project allows the Company's participation with the US National Committee of The International Council on Large Electric Systems (in French: Conseil International des Grands Réseaux Electriques or CIGRÉ), CIGRE 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. CIGRE allows world-wide engineers and specialists to exchange information and enhance their knowledge related to power systems, adds value to the knowledge and information exchanged by synthesizing state-of-the-art world practices, and makes the synthesis of CIGRE's work available to the decision-makers of the industry.

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 papers; CIGRE bi-monthly magazine Electra and monthly newsletter; participation in CIGRE sessions.

TECHNICAL STATUS

The Company maintains its membership, receiving access to the CIGRE technical library.

TITLE Bulk Power System Physical Security (EPRI) - 264

CSN 00002 **POET** 26362257 **TASK** 0001

OBJECTIVE

The objective of this project is to enhance physical security and resilience by reducing the potential impact of disruptions and/or damage to critical infrastructure from physical and IEMI events. The results from this project are seeking a better understanding of physical security and intentional electromagnetic interference (IEMI) related events, and the effectiveness of mitigation and response options for them. More efficient and/or cost-effective methods to assess, prevent, and defend against these threats will be explored.

BENEFITS

Project will improve quality of decisions and processes related to providing bulk power system security. Physical security events in the bulk power system vary in their frequency and consequences. Benefits of this study are not quantifiable due to highly uncertain probabilistic nature of these events.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☐ Test plan for resilient components and materials
- ☐ Test plan for intrusion detection systems
- ☐ Test plant for unmanned vehicles and systems (drones, robotics)
- ☐ Results of test for resilient components and materials
- ☐ Results of test for intrusion detection systems
- ☐ Results of test for unmanned vehicles and systems (drones, robotics)
- ☐ Witness testing report
- ☐ Final Technical Report

This project was delayed in 2022 because EPRI did not have enough program participants and it was moved to the 2023 program.

TITLE Demonstration of Cubicle Inspection & Repair Safety Device

CSN 90972 **POET** 23489778 **TASK** 0001

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 and reliability by eliminating the need for bus section outages as a result of complete inspections and repairs.

TECHNICAL STATUS

This device was manufactured in-house for use by substation personnel. Commercialization of this device is still being explored.

TITLE Demonstration of remote breaker racking systems

CSN 92736 **POET** 20707502 **TASK** 0001

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 personnel 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. The development of robotic remote racking system will also protect workers from the potential for soft tissue injuries while handling circuit breakers and ground-and-test devices weighing up to 800 pounds.

BENEFITS

The 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). Additional benefit of developing robotic system is improvement of ergonomics of substation operations.

TECHNICAL STATUS

In 2020, the working model of robotic remote racking system was developed and demonstrated in lab tests and in Mott Haven substation. The prototype was presented at the industry event DistribuTECH 2020.

Field tests were conducted in October of 2020. The robot completed all tasks as required; however, project team is considering further improvements before the robot is put to daily operations, and hence, may be capitalized.

Substation Operations and Central Engineering are exploring various scenarios and proposals from the vendor to develop commercial units for two different voltages (15kV and 27 kV).

TITLE Voice Assistant for Job Planning-210

CSN 91550 **POET** 25665489 **TASK** 0001

OBJECTIVE

Demonstrate the use of voice recognition technology to record substation job planning details attached to work orders. Additional support will be provided by EPRI Incubatenergy Labs program, working with Datch and Endevor, which is the company supporting Engage, the internal job planning application.

BENEFITS

Entering substation job planning information into Engage platform is currently a manual process, which is inefficient and often duplicative. This process could be efficient through live voice entry, which also allows a hands-free info logging during substation inspections, making it safer and improving ergonomics. User acceptance of the app's ability to capture dictated job plan details, and clear process efficiency (time and ease) gains when compared to the current manual and sometimes duplicative process.

TECHNICAL STATUS

In this project, the team successfully integrated the Datch application with the Company's Engage job planning application and confirmed production system functionality. Initial user acceptance testing was also completed, in which a necessary template function enhancement to the Datch application was identified for future project development.

After further consideration, Substation Operations decided not to proceed with company-wide implementation of this technology as the technology was found to have accuracy and precision issues.

TITLE EPRI Midel 7131 Study - Evaluation of Spill Control Devices - 138

CSN 91411 **POET** 24869473 **TASK** 0001

OBJECTIVE

The objective of this project is to identify and/or develop and then test spill containment and control devices and products that are most effective for synthetic dielectric fluids including Midel 7131.

The plan is to:

- Identify and describe the capabilities of available equipment, materials and/or structures to contain and prevent fluid releases
- Identify and test the effectiveness of available controls to contain Midel 7131 while allowing for the discharge of stormwater
- Determine the operating limits of an oil water separator (OWS) unit for separating Midel 7131 from water under varied inflow and influent concentration conditions
- Determine, test, and verify the effectiveness of enhancements for improving the performance and increasing operating limits of the unit

BENEFITS

This project will generate new learnings in area of environment-friendly technologies and may be critical in determining if Midel 7131 is a suitable replacement for mineral oil in transformers. R&D department monitors all relevant research efforts in power industry, which include work by EPRI, CEATI, CIGRE and other research institutions

TECHNICAL STATUS

Attained Experimental confirmation of various spill control devices' functions. This project has been completed and was awarded a Technology Transfer Award by EPRI. An implementation plan is under development.

TITLE Substation Inspection Robot Development - 181

CSN 91515 **POET** 25258659 **TASK** 0001

OBJECTIVE

This research project will investigate the suitability of Unmanned Ground Vehicles (UGVs) to perform some inspection and monitoring tasks of indoor electric distribution substations. UGV present the potential to perform a variety of critical inspection tasks on demand, allowing for more frequent inspections, more comprehensive and persistent searching for anomalies, and a telepresence solution that allows engineers and technicians to view and process valuable data remotely without the need to be on site at a specific substation. The plan is to develop and test a prototype indoor substation inspection robot that is equipped with the appropriate technology and sensors to operate autonomously in the substation and automatically transmit inspection data to a server.

BENEFITS

The autonomous mobile robot for indoor substation inspections will have:

1. Ability to navigate a pre-defined route, employing collision avoidance and re-planning as needed.
2. Successful integration of a gimble-mounted camera with visual imagery collected and retrievable along an inspection route
3. Identify breaker and switchgear cubicle matchups.
4. Successfully demonstrate the ability to check switchgear pothead compartments for changes in partial discharge profiles
5. Successful demonstration of intelligent and autonomous power management, data management and communications.
6. Successful demonstration of semi-autonomous navigation to support teleoperation by engineers, operations personnel, and technicians.

If project is successful, the prototype will be used for development of commercial substation robot.

TECHNICAL STATUS

Project was kicked off in August of 2021, in collaboration with Stevens Institute of Technology. Stevens team conducted a review of existing technology in the field and commenced design of robot's hardware and software. In 2022, completed design and development of algorithms for robot functionality as an inspection robot and demonstration of its capabilities in substation. Next steps are to develop analytics for collected inspection data.

TITLE Conceptual Evaluation of CO2 Transport from Manhattan (EPRI) - 290

CSN 00015 **POET** 26568573 **TASK** 0001

OBJECTIVE

The goal of this EPRI project is to explore the development of conceptual carbon transport plans that can be evaluated and optimized to find the most cost-effective process as it pertains to the steam system. The plan will use the Company's membership in EPRI's Generation program, 222 for Carbon Capture, Transport and Storage as well as its membership in the Low Carbon Resource Initiative (LCRI) as resources to seek additional funding for carbon transport research. This project's specific research plan will focus its work toward examining the scale of CO2 transport from Manhattan and potential impacts to the Northeastern coast of the United States. As a result, the breadth of the study will provide a true sense of the feasibility of this concept. Results of this study will also be used to prepare a Department of Energy Funding Opportunity Announcement application to fund a detailed front-end engineering and design (FEED) work to be collaborated on with the Electric Power Research Institute (EPRI) and potentially through LCRI.

BENEFITS

The deliverable from the FEED study will include a report and conceptual designs for potential options to successfully transport CO2 from Manhattan.

TECHNICAL STATUS

The emission of carbon into the earth's atmosphere has significant negative impacts to the environment such as contributing toward the greenhouse effect, urban pollution, acid rain, and other climate change factors. Con Edison has environmental goals to achieve electrification by 2030 and reduce greenhouse emissions by 2050 as per the Climate Leadership and Community Protection Act of New York State. One path to achieve these goals would be for the Company to rely on post combustion carbon dioxide (CO2) capture technologies to reduce the carbon footprint of the Steam system.

The largest hurdle and unknown is identifying the best technical solution for transporting CO2 captured in Manhattan to a location where it can be consumed or sequestered.

TITLE Demonstrate Pulsed Eddy Current (PEC) Robot for High Voltage Feeder Pipe Assessment - 260

CSN 91626 **POET** 26248431 **TASK** 0001

OBJECTIVE

In prior R&D phases, Honeybee Robotics fabricated a prototype robot with Eddyfi's PEC-025-G2PEC Pulsed Eddy Current (PEC) sensor system and demonstrated a volumetric metal loss inspection without damaging the wax tape coating. Although field demonstrations showed promise at the 11th Street Conduit in Brooklyn, Honeybee no longer provided services for the utility industry and therefore dropped out of any potential future R&D work for this project.

Arix Technologies, a 2017 Houston based start-up, had independently commercialized a PEC robot for refinery applications for corrosion under insulation and had agreed to take on the next stages of development work for this project. Arix adapted the robot for wax-taped feeder pipe and return line inspection and proved its capability to PEC inspect horizontal, vertical and sweep sections in Astoria and Ravenswood Tunnels while the feeders were energized. Arix also filtered out electromagnetic interference from the cables and related harmonics and enhanced the use of PEC sensor technology. The Arix robot was also successful in climbing approximately 225 feet in the shaft and detected volumetric loss ranging between 5% to 25% for 5-inch and 8-inch diameter pipes with harmonics filters in the presence of electromagnetic fields surrounding the feeder lines.

As a result, due to these promising results, in this next phase, the approach will be to further develop additional compensation algorithms during inspection of energized feeder lines. These include contributing factors such as three-phased conductor mass and orientation within the feeder lines, distance between feeder cables, circumferential location of pipe, variations in material property during the pipe manufacturing process that might have a potential impact in the accuracy of wall thickness readings, as well as the effects of paint coating versus wax tape coating.

Additionally, the design of the robot will explore the reduction of its size and weight to optimize its ability to traverse within the allowed spatial clearance between pipes during an inspection scan.

BENEFITS

The project deliverables will be the robot, associated algorithms for improved detection of wall loss, and a technical report evaluating the robot's performance during field demonstrations.

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Conduct field test
☒ Analyze initial field test results
☐ Develop compensation algorithm for wall loss – in progress
☐ Improve mobility of robot on pipe to overcome friction on wax coated pipe
☐ Prepare final report

TITLE Assess Fluorine Free Foam for Fire Suppression - 106

CSN 91354 **POET** 24525691 **TASK** 0001

OBJECTIVE

Due to environmental concerns around fluorinated compounds (PFAS/PFOS), New York State banned aqueous film forming foams (AFFF) used in Company fire suppressants. As a result, this project sought alternatives to fluorine compound containing foams for suitable replacement. The project worked with a fire protection engineering firm to test the efficacy of several fluorine free foam (FFF) alternatives against on two Company hazards (Midel and #2 Fuel Oil).

BENEFITS

The intent of this effort was to provide performance data (presented in the form of a test report) for decision making authorities to aid in the selection and transition away from legacy aqueous film forming foam (fluorine-based AFFF foam) to more environmentally friendly alternatives.

For Phase 1, data included:

- Agent
- Application Type (Type II (banking) or Type III (plunging))
- Fuel
- Test application density
- Application time
- Burnback time
- Proposed minimum design application rate

TECHNICAL STATUS

Tasks (checked boxes are completed):

☒ Type II (Backboard) and Type III (Plunge) UL 162 tests conducted using 6 different FFFs compared against AFFF baselines

☒ Final report concluding foams work per UL guidelines for typical ConEdison hazards (Midel and Fuel Oil)

The Testing report concluded that the foams worked per UL guidelines for our hazards (Midel and Fuel Oil), with the exception that greater volumes of storage would be needed. UL listing on devices that would pair with the foam are pending. All deliverables have been received and the project has been completed.

TITLE Next Generation Substation Battery Demonstration

CSN 90604 **POET** 22270906 **TASK** 0001

OBJECTIVE

The objective of this project is to demonstrate and document the performance of a new lithium-ion (Li-Ion) battery technology that provides the same or better reliability and design life as a traditional flooded lead acid (FLA) battery, requires is less maintenance, while having comparable cost. New battery technologies and systems have emerged that require less maintenance and allow for continuous monitoring through a battery monitoring and management system. Since this technology has yet to be demonstrated at Con Edison substations, it remains unproven from a reliability perspective. As part of this study, a battery will be installed at a transmission substation and its performance will be monitored and documented.

BENEFITS

With remote monitoring of battery health, there is less need for battery inspection compared to FLA systems. New Li-Ion systems are also less maintenance intensive than FLA systems. An evaluation comparing the differences in installed costs and recurring O&M costs will be conducted upon completion of installation and performance monitoring.

TECHNICAL STATUS

Tasks (checked boxes are completed):

- ☒ Identification of appropriate battery technology and vendor offering product capable of meeting the performance, reliability, and safety requirements for substation applications
- ☒ Development of network data flow scheme to allow continuous transmission and databasing of telemetry data for Asset Management
- ☒ Procurement of equipment and materials for installation and construction
- ☐ Device installation and performance monitoring in 2Q 2023
- ☐ Development of final performance report in 4Q 2023

TITLE EPRI Energy Sustainability Interest Group (ESIG) - 277

CSN 00007 **POET** 26448975 **TASK** 0001

OBJECTIVE

Objectives of the Energy Sustainability Interest Group include:

- Provide a collaborative, fuel agnostic industry forum for electric power companies and experts to engage on sustainability priorities.
- Conduct focused technical research and develops tools to support development and enhancement of sustainability programs.
- Tackle the challenge of identifying and understanding sustainability priorities, metrics, goals, performance benchmarking, and disclosure.
- Provide the opportunity to benchmark sustainability performance against peer companies, track performance over time, and share leading practices.

BENEFITS

Forum engagement, sustainability benchmarking, sustainability metric definition, and sustainability analysis spreadsheets. Success is not determinable through metrics, but can include the following:

- Con Edison engagement in working groups and contributing to benchmarking data to understand sustainability gaps
- Possible development and adoption of new "Sustainability Priorities" for inclusion in a sustainability assessment

TECHNICAL STATUS

R&D supports the development and continuous improvement of Company sustainability programs as a collaborative fuel agnostic forum that allows electric power companies to engage on industry sustainability priorities through focused technical research and peer benchmarking.

TITLE EPRI Emerging Energy Storage Technologies Supplemental - 270

CSN 00008 **POET** 26455697 **TASK** 0001

OBJECTIVE

This supplemental will work with the most promising emerging energy storage technology vendors to study their performance for suitable real-world applications. Each system demonstration will be fully characterized and studied by the EPRI team, and the results of each demonstration will be assembled in annual reports.

BENEFITS

Benefits will include:

1. Demonstration systems are successfully installed with minimal to no external delays.
2. Technology received go-ahead from Fire Departments and other AHJs.
3. Performance is fully characterized and deemed adequate for Con Edison applications (determined through regular reviews and the summary findings reports)

TECHNICAL STATUS

This project is ongoing and is scheduled for completion in 2025. Deliverables will include:

1. Technology-specific Procurement Specification Recommendations: Suggested solicitation requirements for an energy storage RFP that enable its design/implementation to meet the desired performance characteristics
2. Technology Performance Summary Report: Detailed testing methodology descriptions, key performance data and analysis, and documented lessons learned collected from energy storage system evaluation

TITLE Development of New Designs for Secondary Electrical Conduits

CSN 90918 **POET** 23263256 **TASK** 0001

OBJECTIVE

The objective of this project is to research and develop materials that could be used to manufacture conduits for our secondary network system. The materials can be selected from existing repositories,or can be synthesized, tested and evaluated in a lab to meet or exceed the current requirements. The conduit must provide better operational efficiencies and help reduce public safety risk.

BENEFITS

Carbon Monoxide accumulations in buildings, resulting from Manhole events, continues to be a public and employee safety risk. By protecting our cable, keeping Carbon Monoxide out of the ground, we will keep others safe. The project will pursue an enhanced sealed joints between conduits and a lower internal surface friction, to make the ducts system less abrasive for pulling cables and reduce damages during installation. The new conduit system will be evaluated for financial and operational feasibility.

TECHNICAL STATUS

The vendor completed the project in June 2021. Suitable materials were researched and selected. Their properties were investigated under three main performance areas: Environmental, Engineering and Cost impacts. A list of seven materials were identified and empirically evaluated to determine if they will satisfy the proposed conduit attributes as required in the project proposal. While an enhanced concrete and the flame shield materials showed great promise, they did not fully meet all the requirements. Further evaluations were conducted, and the HDPE /Foam Cement hybrid materials was considered promising to meet the criteria set out in the project specification. A vendor was selected to develop a specimen of the prototype conduit, and mechanical and thermal tests were conducted. The coefficient of friction was found to be lower than current materials used in secondary construction. However, the thermal and mechanical attribute did not meet the required threshold, and this project was completed in 2022.

TITLE NYSERDA ICS Forensics Harvester - 49

CSN 91153 **POET** 24077834 **TASK** 0001

OBJECTIVE

The goal of the NYSERDA ICS Forensics Harvester was to develop a prototype tool to facilitate the automated collection of forensics data from a variety of devices running in a utility's operational technology environment. Forensics analyses usually occur during the post-mortem analysis during the incident response process. The routine and automated collection of forensics evidence, facilitated by a tool such as the Harvester, could potentially help identify issues with a device that would provide value earlier in the incident response process. The project team consisted of representatives from Con Edison, EPRI, MITRE, and GE Digital Energy. The Harvester prototype will be released as an open-source tool to encourage product manufacturers to incorporate and to provide forensics collection capabilities to end users. The team's research defined requirements for tool functionality and capability along with a protocol for being able to securely collect data of interest from a variety of devices. It is the team's hopes that by providing the industry with a standardized and flexible communications protocol, it will provide a foundation that will enable the potential use of automation tools to routinely capture asset health information, forensics artifacts, and to validate supply chain concerns.

BENEFITS

Forensic evidence acquisition can be a challenging and time-consuming process. One must possess the knowledge and skills to thoroughly examine a device to understand what information is important to collect and how to interpret this information to understand why a device may have mis-operated. The Harvester provides the capabilities to query a device in real time and collect information that could potentially be useful in a forensics investigation.

The developed prototype securely communicates with a client using a protocol, which provides a structured messaging format using defined namespaces in which commands can be sent. The protocol's inherent flexibility provides extensibility that promotes adoption by device manufacturers and customization based on a device's capabilities.

The prototype was implemented on a device, on a platform that uniquely uses Docker containers to isolate the device's various applications. Industry trends point to a shift from dedicated embedded platforms to more conventional operating systems environments. This device enabled the team to explore the benefits of automated forensics acquisitions in an environment that uses containers.

TECHNICAL STATUS

The project team successfully developed and demonstrated a working Harvester prototype. With the device used for this project, the tool can automatically collect over 230 pieces of valuable information from the device, including a capture of the device's volatile memory (memory that requires power to maintain the stored information). A draft of the final report was submitted to NYSERDA for review, and the final report will be published to NYSERDA's website. The source code will also be released to the open source community. The team held two demonstration and technology transfer events on December 9, 2021 and January 31, 2022. This project is complete.

TITLE ICS Data Acquisition using Forensic Techniques

CSN 99876 **POET** 21702861 **TASK** 0001

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 involves the O&R Energy Control Center and the CECONY Substation departments identifying the Bulk Electric System (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 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 this project, the Corporate Security Cyber Forensic Investigation team has been part of a project to research and develop techniques that follow forensic best practices which will be utilized in future cyber-investigation involving proprietary critical assets. Our procurement of equipment has 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.

Most recently, we are using our devices to test new methods of extraction with the help of certain vendors, where we can safely test preliminary versions of firmware and provide them recommendations that will continue to enhance our data collection capabilities. This project is complete. We will continue this effort expanding our inventory of devices in a Phase II project.