University of Kentucky Research Foundation

University of Kentucky Center for Applied Energy Research (UK CAER)

Carbon Dioxide Mineralization in Calcium-based Sorbent

A partnership with UK CAER to develop a calcium-based sorbent to capture carbon dioxide for storage in cement. The goals are to develop a sorbent from aluminum dross, red mud, or spent combustion material and use it in a lab scale spray dryer to investigate the carbon dioxide capture potential. Then evaluate the biproduct for use in cement, mortar, and concrete. The learnings could further development of carbon dioxide capture technologies.

High Temperature Cement for Geothermal Applications

A partnership with UK CAER to research and test thermal cement formulations for downhole grouting of high temperature geothermal wells. Materials will have substantially increased thermal conductance over existing formulations allowing for wells to operate at increased temperatures and improving efficiency of geothermal systems. The analysis would provide insight into material considerations for potential future geothermal applications.

Variable Temperature Studies for Redox Flow Battery Storage

A partnership with UK CAER to study the impact of variable temperatures of commercially viable redox-active molecules and electrolytes, coupled with variations in concentrations, on the electrochemical properties of non-aqueous redox flow battery (NARFB) materials. In particular, we will make use of an in-house library of phenothiazines (PT) that have demonstrated good performance in NARFBs with electrolytes in standard conditions. The solvent comprising the solutions will be acetonitrile and propylene carbonate, which are commonly used in NARFBs; propylene carbonate, in particular, offers the ability for operation at high temperatures. Following previous work, we will examine electrochemical and physicochemical properties at cold and hot temperatures to evaluate how the electrochemical performance changes. Properties of interest could entail solubility, viscosity, conductivity, diffusion, stability of charged states of the redox-active molecules, and cross-over rates. Should time permit, we will also explore the use of in-house ionic liquids on the electrochemical performance of these systems, as well as varied concentrations of the redox active molecules and electrolytes. The learnings could be applied to a new research energy storage system at one of the battery test bays at E.W. Brown Generating Station.

Silicon Based Electrodes from End-of-Life Solar

A partnership UK CAER to research and develop a sustainable method for recycling end-of-life mono- and polycrystalline solar photovoltaic modules, incorporating selective recovery of component materials with sufficient purity to enable their use in lithium-ion batteries (LIB). The findings could benefit the full life cycle of deployed solar panels.

Moth Eye Micro Lense to Improve Solar Output from Seasonal Changes

A partnership with UK CAER to research and test reducing efficiency losses in photovoltaic (PV) systems through engineered surface textures using “moth eye” micro-lenses to mitigate

changes in output due to seasonal changes in sun angle. The University of Kentucky will measure enhancements in PV output for cells with an applied "moth-eye" film at incident angles mimicking both day and seasonal solar variation. The day and seasonal variation are important for researching the intermittency of solar.

Determining the Contained Value of Solar Panels for Recycling

A partnership with UK CAER to determine the contained value of solar panels for recycling. The goals are to determine the value of the raw materials in a solar panel, evaluate solvents for glass disengagement, and identify key separation variables for recovering the components. The research could be important for the full life cycle of deployed solar panels.

Screening Chromophores for Enhanced Photoconversion

A partnership with UK CAER to screen a series of molecules to reduce thermal efficiency loses in silicon solar panels with the potential to increase power output by as much as 30%. The learnings could be applied to solar installations.

University of Kentucky College of Engineering

Carbon Capture Large Scale Pilot Projects Program Project

A partnership with the University of Kentucky, the project was awarded approximately $72 million in federal funding from the Department of Energy (DOE) to develop a 20-megawatt carbon dioxide capture unit at Cane Run natural gas combined cycle generating station. The first phase of the project is the front-end engineering design study which includes additional partners such as the Electric Power Research Institute (EPRI) and the original equipment manufacturers. The project is using the carbon capture process that Research and Development has been developing with the University of Kentucky since 2006. Development at this scale is part of the progression of scaling up the carbon dioxide capture technology.

University of Kentucky Carbon Management Research Group (CMRG)

A partnership with the University of Kentucky, CMRG is a group focused on advancing decarbonization technologies, such as the carbon dioxide capture process that we are implementing as part of the Cane Run natural gas combined cycle carbon capture project.

Enhancement of Carbon Capture Reactor Performance

A partnership with the University of Kentucky to research and improve the reactor performance for carbon capture. The research will focus on novel carbon capture materials and reactor components that increase carbon dioxide capture mass transfer within the absorber and could lead to safe, reliable, and low-cost carbon capture. The research is in response to the Department of Energy project and the results could be applied to the 20-megawatt carbon dioxide capture unit.

Negative-Emissions Enabled Direct Air Capture with Hydrogen Production

A partnership with the University of Kentucky as part of a $3 million Department of Energy federal award to develop a cost-effective net-negative emissions process for the direct air capture of carbon dioxide (CO2) at a 5 kilogram-per-hour scale. The process builds upon UK's technology on electrochemically regenerated hydroxide solvent for direct air capture and hydrogen co-production. It includes further integration with renewable power from solar photovoltaics to decouple the direct air capture process from secondary carbon emissions and provide additional grid-management options by varying the output of electricity and hydrogen/carbon dioxide. The project intends to deploy the test unit at E.W. Brown Generating Station in one of the open testing bays.

Engineering Controls to Reduce Volatile Organic Compounds During Amine Degradation in Carbon Capture

A partnership with the University of Kentucky to develop a membrane-activated carbon hybrid unit to remove formaldehyde, acetaldehyde and ammonia from the stripper overhead condensate stream prior to amine loop return. The project scope includes two tasks for operating parameter optimization at lab-scale and one task for integration on UK's field-pilot installed at the coal-fired E.W. Brown Generating Station. The lab-scale experiment will use simulated condensate. The learnings will be important for the federally funded 20-megawatt carbon capture demonstration unit for application at a natural gas combined cycle power plant.

Advanced Electrode from Recycled Metals from End-of-life Lithium-ion Batteries

A partnership with the University of Kentucky to repurpose the reclaimed nickel-cobalt alloy derived from spent lithium-ion batteries, transforming it into cost-effective and durable electrodes suitable for both hydrogen gas production from water electrolysis. The project's scope generally encompasses streamline the steps of using nickel-cobalt as catalyst to decorate a carbon electrode and optimize the operating condition that will be tested in an electrolyzer for hydrogen production. Success criteria may include (1) present 20% reduction of overpotential at the negative electrode for hydrogen production; (2) remain stable performance for no less than 6-month operation, and (3) reduce energy cost for hydrogen production by no less than 10%. This builds on earlier research with UK to improve the recovery of lithium from end-of-life lithium-ion batteries. The goal is to produce 0.5 kg per day of high purity lithium. The learnings could be applied to the full life cycle of the batteries that the company has deployed.

A Method to Recover Silver from End-of-Life Solar Panels

A partnership with the University of Kentucky to develop a novel electrochemical method to recover silver and manage regulated species from the end-of-life solar cells, featuring reduction of acid usage, decrease in treatment time, and improvement of the silver recovery rate in comparison of the traditional methods using strong acids. The research could be important for the full life cycle of deployed solar panels.

Data Driven Thermal Runaway Risk Prevention

A partnership with the University of Kentucky to (1) leverage a programable language to examine the potentially performance degraded battery modules and cells, (2) visualize the degradation performance by plotting the presentable parameters, and (3) identify the

degradation mechanism. The learnings are important as the company continues to operate the 1-megawatt/2-megawatt-hour lithium-ion research battery.

Predictive Models for Classes of Customer Data

A partnership with the University of Kentucky to develop models that not only provide predictions of energy usage based on weather, time-of-day, day-of-week, and season, but also that will provide important insights into opportunities for load-shifting/peak-leveling based upon the dynamics of these models. Two different model identification/learning approaches will be evaluated. Models will be developed based on subsets of the provided data for each customer class, and the predictive effectiveness will be evaluated using data subsets not used in the training. It is expected that the models will be developed, trained, and tested within MATLAB. The two different model identification/learning approaches will be compared to each other and to selected other approaches developed in the literature. The models will be used to evaluate opportunities for demand shifting or energy efficiency programs. Analysis of the model and its sensitivities will identify parameters with strong sensitivity to certain temperature fluctuations, time of day, or both, and this will help separate out portions of the model for thermal loads and time-based loads. The separate portions of the model for different load types will help identify opportunities for different demand-shaping or energy efficiency programs by the utility.

Data Center Opportunities

A partnership with University of Kentucky to consider opportunities and challenges of hosting data centers in the utility service territory. The analysis will examine multiple data sources and use various analysis techniques to help the utility understand its competitive advantages and disadvantages in its service territories, and to better understand expectations and impacts of hosting data centers.

Direct Ocean Carbon Capture

A partnership with the University of Kentucky and University of Rhode Island to develop an effective aqueous ocean capture (AOC) system, three project objectives are targeted, including; (1) a feasibility and conceptual study with detailed guidelines on site selection, identified site, major equipment and their specification, preliminary facility design and general arrangement, cost estimate and pilot-project schedule; (2) a performance-confirmed UK process for producing a ≥95% carbon dioxide purity stream at ≤1.5 volts in the depolarized electrochemical reactor (DER) featuring catalytic electrodes, ohmic loss suppression, and bipolar architecture, and (3) preliminary analysis on economics, life-cycle, and environmental health. The project builds upon the carbon dioxide capture technology that the company has been working on with the University of Kentucky since 2006.

Performance Evaluation of PV Modules at E.W. Brown Power Generation Station

A partnership with the University of Kentucky to research the degradation of solar panels based on historical data on power output and weather. The analysis evaluated the 10-megawatt E.W. Brown solar farm, and the information could be applied to future solar installations.

Solar Car Performance

A partnership with University of Kentucky to test the feasibility of developing a solar-powered electric vehicle (EV) through building, testing, and maximizing the University of Kentucky's solar car. The solar car team is optimizing the vehicles effective range, speed, and efficiency on solar power and batteries. The research builds upon testing the electrification of transportation.

Renewable Dashboard

A partnership with University of Kentucky to develop an online-accessible dashboard representing live and historical data from the solar, wind, and hydro-powered units at the E.W. Brown Generating Station. This resource will provide offsite monitoring and data analysis while also publicly sharing renewable energy data for Kentucky.

University of Kentucky Power and Energy Institute of Kentucky (UK PEIK)

Heat Pumps for Building Cooling Study

A partnership with the UK PEIK to study the operation of heat pumps for Demand Response (DR) and Virtual Power Plant (VPP) controls with a view at power system integration and support capabilities in Kentucky. The study will include systematic reviews of latest research reports from the Department of Energy (DOE), National Renewable Energy Laboratory (NREL), and other reputable organizations, and of papers recently published in specialty technical conference proceedings and scientific journals. While heat pump technology has expanded over the years in the US southern climates and in California, the deployment of the technology in the Midwest and the utility's service areas is rather limited, especially due to the concerns related to occasional extremely low temperatures. The research will also include simulations of heat pumps providing energy storage and load shifting for power system integration and support and operation under extreme weather conditions.

Battery Cell Balancing Voltage Detection Fire Mitigation Research

A partnership with UK PEIK to study how cell voltage in large utility-size electric battery energy storage systems can help preemptively identify possible problems within the battery and prevent a fire, with a focus on the latest developments and practices for online monitoring such systems for safe and reliable operation. Batteries are expected to play a key role in the ongoing developments of the electric power grid, especially as the deployment and integration of renewable resources is increasing. The research into battery safety and reliability is hence of utmost and urgent importance and is of general interest to the utility. The research will benefit the existing 1-megawatt and 2-megawatt-hour experimental battery system at the E.W. Brown Generating Station site, which has been a national leader in fire prevention and was the first non-military system in the world to have off-gas chemical detection to identify precursors to battery fires.

Wind Data Analysis

A partnership with the UK PEIK to study the wind energy generation potential with a view at power system integration capabilities in Kentucky. The research includes systematic reviews of latest research reports from the Department of Energy (DOE), National

Renewable Energy Laboratory (NREL), and other reputable organizations, and of papers recently published in specialty technical conference proceedings and scientific journals. The research will also include simulations of wind turbine generators and their combination with batteries for energy storage, and new hydrogen infrastructure with a view at power system integration.

Electric Vehicle Analysis for LG&E and KU

A partnership with the UK PEIK to study electric vehicles, charging and possible vehicle-to-grid operation with a view at power system integration capabilities in Kentucky. The study will include systematic reviews of latest research reports and will also include simulations of electric vehicle charging and combinations for energy storage with a view at power system integration.

Research and Development

Carbon Capture Large Scale Pilot Projects Program Grant

A partnership with the University of Kentucky, the project was awarded approximately $72 million in federal funding from the Department of Energy (DOE) to develop a 20 MW carbon dioxide capture unit at Cane Run natural gas combined cycle generating station. The first phase of the project is the front-end engineering design study which includes additional partners such as the Electric Power Research Institute (EPRI) and the original equipment manufacturers. The project is using the carbon capture process that Research and Development has been developing with the University of Kentucky since 2006. Development at this scale is part of the progression of scaling up the carbon dioxide capture technology.

Commercial Scale Carbon Capture Front End Engineering Design (FEED) Study

A partnership with EPRI to conduct a FEED study for retrofitting the Cane Run Unit 7 natural gas combined cycle generating station with the University of Kentucky's solvent-based carbon dioxide capture process. The $7.3 million project was awarded $5.8 million by the Department of Energy. The project will inform the scale up of the carbon dioxide capture process on natural gas power plants.

LG&E Only- Computational Analytics of Buried Natural Gas Pipes Subjected to Traffic Loads at Different Depths

A partnership with the University of Louisville, to develop a US Standard (SI) mathematical model to assess the stresses (as limited by ASME B31.8) and deformations within the trench system (soil, steel plate system, pavement, buried utility pipe, etc.) when subjected to transient loads. This is directly important for construction work on buried natural gas pipelines, to improve safety, lower customer cost, and prevent leaks.

Research and Development Wind Turbine

Kentucky's first utility scale wind turbine was installed for researching wind potential in the state by supplying the first ever wind generation data for the state at a utility scale. The turbine is also being used to charge Kentucky's largest lithium-ion battery for energy storage and renewable energy research projects. The wind turbine is an NPS-100-C-27, is capable of

producing 90 kilowatts, and has rotors and blades 90 feet in diameter, bringing the total height of the wind turbine to 165 feet. The wind turbine was installed at E.W. Brown Generating Station with Research and Development's other renewable energy projects to gather data on intermittent renewable energy resources. The data will provide insight into wind capacity in Kentucky, and can be used to inform future modeling of intermittent renewables.

Single Axis Tracking Solar

The project involved the installation of 30 kilowatts AC monocrystalline solar panels with 72 540-watt DC panels with three 10,000-watt string-level. The solar panels move on a single axis. The demonstration scale solar arrays are studying different ground coverage ratios (GCRs) to pursue optimal configurations and evaluate efficiency losses. The highly granular, module-level data that is being produced from this project can be used to model integration of intermittent renewables..

Multi-axis Tracking Solar Panels

The project involved the installation of the company's first multi-axis tracking solar array for research and development purposes at the energy storage site at E.W. Brown Generating Station. With a total of 9.84 kilowatts DC, there are two 4.92 kilowatts DC arrays 50 feet apart, each with a multi-axis tracker and 12 high efficiency Panasonic 410-watt solar panels that follow the sun like a sunflower as it moves in the sky. The DC power from the solar panel goes to two Sunny Boy inverters where it is converted to AC power and put onto the grid. The new solar array uses the highest-efficiency panels the company has ever used, which at 22.2% efficiency capture 21% more sunlight. Beyond new panels, the multi-access tracking capability will add an additional 25% output relative to fixed tilt. The system will provide valuable data on solar output, optimizing solar generation, parasitic load, operations and maintenance requirements which could potentially be used to inform future projects.

Solar Powered Electric Vehicle Charger

The electric vehicle charger includes a 4.3-kilowatt solar array and 20-kilowatt-hour battery, which can provide up to 205 e-miles a day through its level 2, dual port charger. The charger is used to study the intermittency of renewable energy coupled with electric vehicle charging at the energy storage testing facility, further allowing the utility to test micro-grid scenarios.

Electric Power Research Institute (EPRI)

EPRI Low-Carbon Resources Initiative (LCRI)

The Low Carbon Resources Initiative is an initiative led by the Electric Power Research Institute (EPRI) and Gas Technology Institute to help accelerate research and development of low-carbon and zero-carbon technologies. The Low-Carbon Resources Initiative is a collaborative focused on identifying, developing and demonstrating affordable pathways to economy-wide decarbonization. This initiative is pursuing fundamental advances in a variety of low-carbon electric generation technologies and low-carbon energy carriers,

such as advanced nuclear, carbon capture, utilization and sequestration, hydrogen, ammonia, synthetic fuels and biofuels. Research also includes assessing low-carbon pathways for producing, transporting and storing these energy carriers, as well as opportunities to use them in power generation, transportation and other applications.

EPRI Program 18 Electric Transportation

Project Summary: This project provides research critical to the development of technology, infrastructure, and analytics necessary to support the advancement of electric transportation.

Project Benefit: Value is gained from rate design, sharing of best practices, electric transportation standards development, general monitoring of the electric transportation infrastructure and vehicle technologies, and provision of vehicle ownership data for the service territory.

EPRI Program 35 Overhead Transmission

Project Summary: This program offers transmission asset owners and operators a portfolio of tools and information focused on components (e.g., conductors, insulators, compression connectors, and composite structures) and issues (e.g., lightning and grounding, live working, transmission capacity, inspection and assessment, and HVDC lines).

Project Benefit: The program delivers benefits such as field guides, software, and reference books along with longer-term research, such as component performance and durability tests and the development of failure and degradation models for line components.

EPRI Program 37 Substations

Project Summary: Develops tools, techniques, and methodologies to help utilities improve substation equipment inspection, assessment, maintenance, and risk-based asset management.

Project Benefit: Benefits include research on change management, PRC-005 maintenance methodologies, IEC 61850 substation communication protocol, and optical instrument transformers.

EPRI Program 39 Transmission Operations

Project Summary: Addresses the needs of system operators required to maintain efficient, effective and sustainable grid operations through the energy transition. This is accomplished through development of situational awareness, software, analysis, and control capabilities required to effectively operate the transmission grid of the present and future.

Project Benefit: Value is transferred to members through collaborative advisory and task force interactions, workshops and webcasts, and realistic case studies for specific applications and demonstrations of the developed methods and tools.

EPRI Program 40 Transmission Planning

Project Summary: Supports the development and validation of planning study models, processes and frameworks, protection system analysis, and reliability assessment analytics that will be required to build a reliable and economic transmission grid.

Project Benefit: The outcome of the research is anticipated to save resource-hours and costs as well as provide insights to make judicious investment decisions and ensure system reliability.

EPRI Program 94 Energy Storage and Distributed Generation

Project Summary: This project facilitates the availability and use of energy storage to support safe, reliable, affordable, and environmentally responsible electricity. This project integrates multiple activities, including technology evaluation, economic and technical modeling to support grid planning and operations, testing and field demonstration, and industry collaboration.

Project Benefit: Value is provided by the tools, methods, and best practices that support utilities and other users to assess and design energy storage, fueled distributed generation, and microgrid projects that are safer, more reliable, lower cost, and with environmental and societal benefit.

EPRI Program 174 DER Integration

Project Summary: Provides insights into utility interconnection practices and strategies related to future integration approaches, power management and communications; evaluates economic impacts and values of distributed energy resource (DER) integration.

Project Benefit: This project serves as a resource for a range of issues from updating technical interconnection requirements to assessing hosting capacity; handling and screening interconnection requests; grounding, protection, and metering for intermittent renewables; modeling and analyzing grid impacts; choosing grid-support functions and settings; applying DER monitoring and control systems (DERMS); and design of utility and community microgrids.

EPRI Program 180 Distribution Systems

Project Summary: Delivers a portfolio of tools and technologies to increase overall distribution systems reliability and resiliency, understand the expected performance for specific components throughout its life cycle, assess methods for evaluating the condition of system components, and develop and test new technologies.

Project Benefit: This project enhances the safety, both for utility workers and the public, improves asset and system reliability, and helps proactively plan capital and maintenance budgets.

EPRI Program 200 Distributions Operations and Planning

Project Summary: Provides planning processes and frameworks, models, tools, reliability assessment analytics, as well as incorporation of new automation, protection, and control technologies that will be required to transform the current distribution system into one that integrates and uses new distributed technologies.

Project Benefit: The project allows for assessment of costs and benefits of smart grid applications and advanced technology as well as supports the implementation of advanced distribution control functions for reliability improvement, voltage control, and the dynamic grid management.

EPRI Program 201 Energy, Environmental, and Climate Policy Analysis

Project Summary: The Energy Systems and Climate Analysis (ESCA) group conducts research that enables public- and private-sector decision-making on decarbonization, climate resilience, policy, investment strategies, planning methods, emerging technologies, environmental management, goal setting, and risk management. The intersection of policy, technology, economics, and climate impacts is an evolving landscape with many challenges. ESCA produces fundamental insights that inform long term strategy to face these challenges.

Project Benefit: The Energy, Environmental, and Climate Policy Analysis program provides public- and private-sector decision makers with analyses and information on the potential costs and benefits of domestic and international policy proposals and regulations and implications of technological change and shifting market drivers.

EPRI Program 206 Wind Generation

Project Summary: Research is conducted to benefit members and the public through innovation and collaboration for advancement of safe, economic, reliable, and flexible wind energy. In the face of increasing renewable generation deployment, the program provides current information on key renewable generation technologies, including technical performance and costs for next generation sites and operational calculations and algorithms for tracking performance, health, and reliability for current assets.

Project Benefit: The work undertaken in this program aims to enable cost-effective, reliable integration of renewables into the power generation mix while tackling the unique issues around renewable intermittency, operations, maintenance, and asset management. The program provides techno-economic quantification towards the next generation of long-term, utility-scale, wind power facilities.

EPRI Program 207 Solar Generation

Project Summary: A comprehensive understanding of the photovoltaic life cycle is needed to develop best practices for all aspects: design, commissioning, operations, maintenance and end-of-life. This project performs solar technology assessments, develops best practices along plant life cycle, and tracks trends in innovation.

Project Benefit: The Solar Generation program supports methods and technologies for the affordable, reliable, and flexible operation of renewable energy generating assets in an environmentally sustainable manner, while advancing innovative renewable energy technologies. The program also adapts established fossil generation asset management models to solar assets and collaboratively develops and demonstrates technologies to optimize costs and operating efficiency and improve reliability of large-scale renewable generation.

EPRI Program 209 Cyber Security for Generation Assets

Project Summary: This project addresses the specific considerations associated with existing and new fossil assets, new and existing renewable assets, and other critical infrastructure sector's interfaces with generation (i.e. transportation systems, municipal water, natural gas and fuel pipelines, etc.)

Project Benefit: Improves overall generation operational technology cyber security posture and maturity as well as better prepares to protect, detect, respond, and recover from cyber threats.

EPRI Program 214 Boiler Life and Availability Improvement

Project Summary: This project develops reliable and cost-effective inspections to reduce operations and maintenance costs and improve life-management options, tools for boiler component life management and remaining-life assessment, high-energy steam and water piping safety and reliability techniques and understanding how damage mechanisms affect piping components.

Project Benefit: Value is gained from reducing costs by avoiding lost availability due to boiler tube failures and knowledge sharing by consulting with EPRI and other utilities.

EPRI Program 215 Power Plant Piping

Project Summary: The Power Plant Piping program relies on EPRI's Integrated Life Management (ILM) strategy to enhance safety, reduce risk, and maintain availability for power plant piping systems and components. EPRI's ILM strategy utilizes the institute's decades of research towards the development of a well-engineered, rigorous approach to life management.

Project Benefit: EPRI has conducted decades of research related to power plant piping issues that have challenged the industry, including longitudinal seam weld failures, circumferential weld failures, general corrosion, and flow-accelerated corrosion (FAC) failures. Methodologies to evaluate the damage mechanisms that lead to challenges and availability issues, are available through the Power Plant Piping program.

EPRI Program 218 Heat Recovery Steam Generators

Project Summary: This project provides technical tools to improve the performance and reliability of combined-cycle heat recovery steam generators (HRSGs) and balance of plant equipment.

Project Benefit: Value is derived from reduced risk of in-service failures to high-temperature and pressure components, reduced impact of lost availability due to HRSG tube failures, and the extension of time between outages and inspections though the use of advanced inspection and analysis techniques.

EPRI Program 219 Steam Turbine and Auxiliary Systems

Project Summary: This project supports continuous improvement in the safety and availability of steam turbines, generators, and auxiliary systems through applied research in component life management, preventive maintenance, condition assessment, advanced monitoring, and control systems.

Project Benefit: Value is provided by improvement to the safety, reliability, and availability of steam turbines - key systems for overall plant performance in conventional, combined-cycle, and nuclear generating asset types.

EPRI Program 220 Generators and Auxiliary Systems

Project Summary: This project supports continuous improvement in the safety and availability of generators and auxiliary systems. R&D in this program supports all aspects of generator

asset management through applied research in component life management, preventive maintenance, condition assessment, and advanced monitoring.

Project Benefit: Value is provided by improvement to the safety, reliability, and availability of generators - key systems for overall plant performance in conventional, combined-cycle, and nuclear, and hydro generating asset types.

EPRI Program 221 Bulk Energy Storage

Project Summary: This project performs research on bulk energy storage technologies (primarily chemical, mechanical, and thermal types), with the end goal of supporting the acceleration of these technologies to viable use in the marketplace.

Project Benefit: The program provides information and data on the entire arena of bulk energy storage and applicable technologies, along with detailed cost, performance, and operational information that can be used to determine solutions that may be viable.

EPRI Program 222 Advanced Generation and Carbon Capture and Storage

Project Summary: The program's research and development in fossil and biomass power generation is focused on gasification, integrated CO2 capture, and novel fossil power cycles (e.g., supercritical CO2). The objective is to identify and accelerate the development of new approaches for generating power from fossil fuels while providing flexible, lower carbon, synchronous power generation.

Project Benefit: This program aims to assist the global electric power industry in reducing its CO2 emissions from fossil fuels by conducting research to facilitate the advancement of high-efficiency power cycles, continued reduction of the cost to capture CO2 from flue gas, reduced uncertainties related to CO2 geologic storage, and identification of large-scale CO2 utilization options.

EPRI Program 223 Heat Rate and Flexibility: Generation Fleet Optimization

Project Summary: The focus of this project is to improve fossil fuel plant efficiency and heat rate, independent of the fuel type used for generation. Heat rate improvements bear a direct relationship to the amount of fuel consumed for generation and therefore affects not only the Company's fuel expenditures but also the amounts of air emissions released. Any reduction in fuel consumed for a fossil source (coal or gas) leads to a direct reduction in the amount of CO_2, NOx, SO_2/SO_3, Hg, ash, and other regulated emissions. Operating with lower heat rate assists the plants in maintaining environmental compliance with stack emissions.

Project Benefit: Benefits include enhanced monitoring, avoided fuel costs, reduction in auxiliary power, avoided lost generation, and avoided feedwater heater costs.

EPRI Program 224 Integrated Asset Management

Project Summary: This project develops maintenance processes and technologies to improve the safety, reliability, and performance of plant staff and equipment.

Project Benefit: Value is provided by resolution of maintenance, equipment and reliability issues within the industry - enhancing best practices - in a manner that can be integrated into enterprise systems.

EPRI Program 229 Materials

Project Summary: This project provides integrated materials selection guidance, repair and welding technologies, and corrosion mitigation methods to improve equipment performance, reliability, and safety.

Project Benefit: Value of project is the increased availability through better understanding of plant materials, minimization of repeat failures and equipment damage, and reduced outage frequency and duration.

EPRI Program 233 Continuous Emissions Monitoring and Measurements

Project Summary: This project supports development and validation of accurate, robust, and low-maintenance continuous emissions monitoring and reporting capabilities.

Project Benefit: Value of project is in the investigation and development of best practices for system operations and maintenance and stack testing methods and access to a comprehensive continuous emissions monitoring information repository and training/reference resources.

EPRI Program 235 Air Quality Assessments and Multimedia Characterization

Project Summary: Focus on power plant air toxics measurement, risk assessment, fate-transport across media (air/water/aquatic life), modeling future regulatory scenarios, and total recordable incidents calculations-reporting.

Project Benefit: This program enables independent communications and assessments of questions raised by policymakers, regulators, the public, and other stakeholders. Multimedia characterization also benefits stakeholders, including the public, by minimizing the overall costs of managing potentially toxic substances released from electric power generating facilities as well as minimizing adverse impacts to the environment.

EPRI Program 238 Water Treatment Technologies

Project Summary: Identifies, evaluates, and demonstrates technologies to support cost-effective and reliable treatment for limiting pollutants discharged from fossil power plants, re-use of water streams within the power plants, and use of alternative sources of water.

Project Benefit: Project research demonstrated that lime and acid are not needed in the Process Water System Chemical and Physical Treatment. There is additional research in tertiary treatment for effluent limitation guideline systems that are unable to meet compliance, providing vital information for the options surrounding non-compliant systems.

EPRI Program 240 Water Quality and Effluent Guidelines

Project Summary: Evaluates wastewater discharges in terms of metals, inorganics and organics to properly characterize emissions and evaluate treatment options.

Project Benefit: The project benefits effluent limitation guideline-related issues for fossil plant water treatment as well as research of alternative treatments for cooling tower biological control for increasing regulatory concerns of environmental impacts and including potential cost-reduction economic drivers.