Kansas City Power & Light
SmartGrid Demonstration Project

1. INTRODUCTION AND APPROACH

Kansas City Power & Light (KCP&L or the Company) is a firm believer in the need to advance our energy infrastructure and the critical role that SmartGrid technologies and solutions will play in industry progression. Throughout its history, KCP&L has been at the forefront of designing, testing, implementing, and operating new technologies, business models, systems and protocols to improve the delivery of energy to customers. The Company also has a strong record and history of community and customer involvement and views its infrastructure investments as a means to provide benefits to its service territory by:

- Deferring the need for more costly generation;
- Positively impacting our environment and reducing emissions;
- Helping our customers reduce their energy costs;
- Enabling economic investment and job creation in both the local and national economy through job training and workforce development; and
- Reducing our reliance on fossil fuels, which leads to increased energy independence.

This approach is nothing new to KCP&L as the Company has a strong track record of community and customer service involvement. Kansas City Power & Light (KCP&L) is known for its commitment to community engagement and a demonstrated ability to bring together diverse stakeholder groups to develop regional energy solutions. In 2007, KCP&L won the Edison Electric Institute's top award for innovation and contribution to the advancement of the electric industry and is the only utility in the U.S. to reach an agreement with the Sierra Club to pursue renewable energy and energy efficiency projects while building a high-efficiency coal generating station. Recognizing the need for a new approach to electricity generation, transmission, and distribution, KCP&L intends to deploy a fully integrated SmartGrid demonstration. KCP&L believes a demonstration or pilot approach is required to further prepare us to understand how a SmartGrid can enable, or integrate new technologies, business models, systems and protocols to improve the delivery of energy to customers. The pace of enterprise level SmartGrid deployments is dependent on many yet to be fully understood factors, technical advancement and adoption of distributed energy resources, environmental goals and policies, demand growth and optimization of current infrastructures.

KCP&L's demonstration approach is being driven by rising environmental awareness and increasingly price sensitive consumers that will require the energy industry to become more responsive to the need for timely energy usage and pricing information, more tailored energy options and greater individual customer control. The utility of the future involves a shift from a model in which electricity is generated and controlled centrally to one in which energy is generated at a local level and integrated into the grid to improve energy efficiency and reduce transmission losses while taking advantage of renewable energy sources. Recognizing this paradigm shift, KCP&L is planning to design and deploy a demonstration program to develop, operate, test and report on a complete, end-to-end regional SmartGrid demonstration (the SmartGrid Demonstration) in a socially and economically diverse area of Kansas City, Missouri (the Demonstration Area). The SmartGrid Demonstration will be critical not only for developing and proving concepts, technologies, and protocols, but also for serving as a blueprint for capturing, understanding and demonstrating economic costs and benefits.

2. SMARTGRID DEMONSTRATION COMPONENTS

The primary objective of the SmartGrid Demonstration project is twofold: (1) to demonstrate, test and report on the feasibility of combining, integrating and applying existing and emerging SmartGrid

technologies and solutions to build innovative SmartGrid solutions and (2) to demonstrate, measure, and report on the costs, benefits, and business model viability of the demonstrated solution. The proposed technologies and solutions will be evaluated both individually, and as part of a complete end-to-end integrated SmartGrid system in a defined geographical area. The project will demonstrate certain operational, economic, consumer, and environmental benefits that can be enabled by single SmartGrid technologies and further enhanced by integrated solutions as proposed for this demonstration. For specific parts of the solution, KCP&L intends to demonstrate the potential for innovative and flexible business models that can be employed in the integration of its solutions.

The objectives of individual initiatives are focused on implementing a next-generation, end-to-end SmartGrid that will include Distributed Energy Resources (DER), enhanced customer facing technologies, and a distributed-hierarchical grid control system.

2.A. TRANSMISSION & DISTRIBUTION (T&D) INFRASTRUCTURE

2.A.1) SmartSubstation

The primary objective of the SmartSubstation program is to develop and demonstrate a fully automated, next-generation distribution SmartSubstation with a local distributed control system based on IEC 61850 protocols. The new SmartSubstation will enable the following benefits that will be quantified throughout the demonstration period:

- Improved real-time operating data on critical substation equipment
- Reduced O&M costs of relay maintenance, and
- Improved reliability by enabling distribution automation

By achieving these objectives, we expect to demonstrate Advanced Distribution Automation (ADA) capabilities such as the ability to monitor and capture real-time transformer temperature and gas data; the enablement of real-time equipment ratings; full substation automation with intelligent bus throw-over; and all the benefits of intelligent electronic relays such as peer-to-peer communication, fault recording, fault location, circuit breaker monitoring and increased ease of maintenance.

2.A.2) SmartDistribution

The primary objective of the SmartDistribution program is to develop and demonstrate a fully automated, next generation Distributed Control and Data Acquisition (DCADA) controller that incorporates a Customer Information Management (CIM) based model of the local distribution network and performs local grid assessment and control of individual intelligent electronic device (IED) field controls. The DMS and Smart-Substation™ Controllers will provide the operational backbone of the system supporting significant levels of automation on the feeders, complex and automated feeder reconfiguration decisions, and tightly integrated supervision with the Control Centers. The DMS serves as the primary point of integration for the grid facilities and network management functionality including Distributed System Control and Data Acquisition (D-SCADA) systems, Distributed Network Architecture (DNA) systems, Outage Management Systems (OMS), Distributed Energy Resource Management (DERM) systems, Geographical Information Systems (GIS) and other supporting systems.

The new SmartDistribution implementation will enable the following benefits that will be quantified throughout the demonstration period:

- Improved service reliability by reducing the frequency and duration of sustained outages.
- Reduced frequency of momentary outages.
- Reduced operational expenses as many functions will occur automatically without human intervention or be performed remotely without a field crew.
- Reduced maintenance expenses by providing rich data to enable predictive and proactive maintenance strategies

In achieving the above objectives, we expect to demonstrate a family of automatic, distributed "first responder" distribution grid monitoring and control functions:

- Sub and Feeder Load Profile Metering at 15-minute intervals
- Circuit outage and faulted section identification and isolation switching
- Sub and Feeder VAR Management
- Sub and Feeder Voltage Management
- Sub and Feeder Integrated Volt/VAR Management
- Sub and Feeder Overload Management w/ Dynamic Voltage Control (DVC & CVR)
- Distributed DER monitoring & management
- Sub and Feeder Overload Management w/ DER
- Feeder Overload Management with Ambient & Duct Temperature
- Digital Fault Recording on Breaker Relays
- Incipient Fault Detection and Reporting

We also expect to demonstrate time-synchronized voltage and current from strategic points on the circuits, which will improve the accuracy of capacity planning models and will enable better load balancing and improved decision-making for capacity additions.

2.A.3) SmartMetering

The primary objective of the SmartMetering program is to develop and demonstrate state-of-the-art integrated AMI & meter data management (MDM) capabilities that support two-way communication with 14,000 SmartMeters in the Demonstration Area and provide the integration with CIS, DMS, OMS, and DERM. The SmartMetering infrastructure will provide the technology basis for recording customer and grid data that will be used to measure many SmartGrid benefits. The new AMI/MDM implementation will enable the following operational benefits that will be quantified throughout the demonstration period:

- Improved accuracy of meter reads, frequency of reads and flexibility of read scheduling by enabling customers to select dates for turn on/turn off requests without associated field visits.
- Improved accuracy of meter inventory and reduction in untracked meters.
- Increased percentage of automated reads and reduced amount of stale reading within the existing automated one-way meter reading system.
- Increased percentage of near real-time outage notifications and power restoration that would be supplied by a two-way metering system, and:
- Provided real-time, two-way communication for Demand Response (DR) program control initiation and verification of program participation

The SmartMetering technology will also provide advanced meter-to-HAN communications to facilitate in-home display, home energy management systems, and other consumer-facing programs.

2.B. SMARTGENERATION (DISTRIBUTED ENERGY RESOURCE TECHNOLOGY)

2.B.1) Smart DR/DER Management

The primary objective of the Smart DR/DERM program is to develop and demonstrate a next-generation, end-to-end DERM system that provides balancing of renewable and variable energy sources with controllable demand as it becomes integrated in the utility grid, coordination with market systems, and provision of pricing signals. We expect to demonstrate a number of capabilities including:

- The ability to manage and control diverse types of Distributed Energy Resources (e.g. DVC, DG, bulk and mobile storage)
- The ability to manage and control various DR programs including dispatchable/direct load control programs.
- The ability to manage price-based and voluntary programs with market-based and dynamic tariffs similar to those described under SmartEnd-Use
- The ability to manage various market and transmission operation support products such as

mapping DR/DER capabilities to wholesale energy products and managing energy and ancillary services capacity
- The interoperability with the DMS to monitor distribution grid conditions and manage distribution grid congestion, and
- The ability to track and manage renewable portfolio standards (RPS) and greenhouse gas (GHG) reduction capabilities of distributed and demand side resources

By achieving these objectives, KCP&L expects to demonstrate advanced capabilities in demand side resource management, including the ability to leverage those capabilities for operational and environmental efficiencies as well as the ability to aggregate and use such capabilities in support of wholesale market operations.

2.B.2) SmartGeneration

KCP&L's primary objective in its SmartGeneration program is the implementation of DER technologies and DR programs sufficient in quantity and diversity to support the DERM development and demonstration. To achieve this objective, the demonstration program will include:
- Installation of a variety of roof-top solar systems on a mix of residential and commercial buildings (a larger scale, 100kw, installation is planned for a school or public building)
- Installation of a 1MWh grid-connected battery to provide grid support.
- Integration of the existing EnergyOptimizer DR thermostat program in the demonstration area
- Integration of the existing MPower load curtailment program customers in the demonstration area
- Implementation of public accessible plug-in hybrid electric vehicle (PHEV) charging stations to demonstrate smart-charging strategies.

In addition to the primary objective, KCP&L expects to demonstrate the ability to offset fossil-based generation with renewable sources as well as the potential for flexible, alternative business ownership models. With respect to PHEVs and charging stations, KCP&L expects to demonstrate an intelligent, two-way communication between plug-in vehicles, charging stations and the utility grid while controlling the flow of electricity to plug-in vehicles, balancing real-time grid conditions with the needs of individual drivers.

2.B.3) SmartEnd-Use

The primary objective of the SmartEnd-Use program is two-fold. The program will achieve a sufficient number of consumers enrolled in a variety of consumer-facing programs to 1) support the DERM development and demonstration; and 2) measure, analyze, and evaluate the impact that consumer education, enhanced energy consumption information, energy cost and pricing programs and other consumer-based programs have on end-use consumption. We have identified several secondary objectives for the suite of SmartEnd-Use programs expected to be deployed in the Demonstration Area:
- First, we intend to improve customer satisfaction by increasing awareness and reducing costs through energy efficiency and demand response program execution.
- Second, we expect to improve KCP&L productivity through increased knowledge of customer behavior and usage patterns.
- Third, we expect to improve peak load profiles, reducing the need for capacity expansion, as customers are incented to utilize energy in off peak periods.
- Fourth, we expect to pilot alternative time-of-use (TOU) rate programs designed to provide the incentives to reduce energy usage during peak periods.

By achieving these objectives, we expect to demonstrate how the integration of a broad suite of efficiency and innovative rate programs into a complete SmartGrid solution can enhance the overall benefits of the solution and optimally leverage the additional technical and operational capabilities that the investment will enable.

3. PROJECT PHASES & TIMELINE

In it's application to the DOE for a SmartGrid Demonstration Grant, KCP&L organized the project into five phases according to a timeline that complied with DOE grant guidelines. In Phase 1, we will further develop our project approach, install a formal project management structure and ensure we meet NEPA compliance requirements. In Phase 2, implementation of the AMI solution will take place, which will be foundational to gather baseline information around operational and financial performance of the network area covered by the SmartGrid demonstration. In Phase 3, we will deploy the T&D SmartGrid infrastructure components, including building our SmartSubstation implementing the SmartDistribution capabilities. Phase 4 is focused on deployment of DER applications such as SmartGeneration components, end-user incentive programs and the DERM systems implementation. Phase 5 will involve the actual operation, testing and demonstration of the solution and is expected to last approximately two years from mid 2012 to mid 2014.

Proposed SmartGrid Demonstration Project Timeline

Phase	Task Name	2010				2011				2012				2013				2014			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
PHASE 1	**Project Definition and NEPA Compliance**																				
Task 1.0	Update PMP for SmartGrid Demonstration																				
Task 2.0	National Environmental Protection Act (NEPA) Compliance																				
Task 3.0	SmartMetering Implementation																				
Task 4.0	Project Management, Administration & Reporting																				
PHASE 2	**Project Performance Baseline**																				
Task 5.0	Project Integration Architecture Definition & Design																				
Task 6.0	Public Outreach and Education Planning																				
Task 7.0	Performance Baseline Data Collection																				
PHASE 3	**T&D Smart Grid Infrastructure Deployment**																				
Task 8.0	SmartSubstation Implementation																				
Task 9.0	Distribution SmartGrid ADA Implementation																				
PHASE 4	**Distributed Energy Resource Deployment**																				
Task 10.0	Smart EndUse Implementation																				
Task 11.0	Smart Generation Deployment																				
Task 12.0	Smart DER/DR Management Implementation																				
PHASE V	**Commissioning & Operations**																				
Task 13.0	Integrated System Operational Test & Demonstration																				
Task 14.0	Operate Integrated Solution																				
Task 15.0	Program Data Collection																				

4. MERIT & CRITERIA DISCUSSION

4.A. PROJECT APPROACH

4.A.1) Comprehensiveness and completeness of the Statement of Project Objectives (SOPO) that describes the proposed interrelated tasks and of the Project Management Plan that includes a schedule with milestones and explains how the project will be managed to achieve objectives on time and within budget

The Company has established an aggressive, yet achievable SmartGrid Demonstration project organized into five phases. This plan was developed by the KCP&L SmartGrid Demonstration project team along with the assistance of experienced KCP&L managers and strategic partner experts. This plan is explicitly linked, project by project, to the Project Budget and will be funded in accordance with the Project Funding Profile.

The SmartGrid Demonstration is organized into five distinct, yet interrelated phases, which align with the DOE's expectation with regard to approval stages, operations and reporting. These five stages were specifically designed to manage the SmartGrid Demonstration deployment in the most expeditious and cost-effective manner possible over the expected project time frame.

The SmartGrid demonstration architecture will evolve over time as additional applications, requirements, and technologies evolve. Throughout the execution of the Demonstration, the Company will access the capabilities of industry resources and associates such as EPRI as well as the expertise, capabilities and planning resources of its strategic partners.

4.A.2) Completeness of the proposed demonstration approach to effectively address each of the goals of the SmartGrid Demonstration Initiative.

The SmartGrid Demonstration has been explicitly designed to be a complete end-to-end SmartGrid demonstration program in a geographically defined area of Kansas City. By focusing on the circuits and distribution feeders surrounding its Midtown Substation, the Company will be able to assess the potential benefits of a SmartGrid solution from SmartGeneration through to SmartEnd-Use in a regionally unique, controlled "laboratory" environment. The goals of this demonstration are in sync with those of the SmartGrid Demonstration Initiative – to quantify SmartGrid costs, benefits and cost-effectiveness as well as verify SmartGrid technology viability, and validate new SmartGrid business models, at a scale that can be readily adapted and replicated around the country. Each of these goals in the context of KCP&L's demonstration is addressed below:

- Quantify SmartGrid costs, benefits and cost-effectiveness**:** A key objective in our SmartGrid Demonstration will be to quantify the costs and benefits of each of our solutions separately and as a complete solution. The Demonstration is designed as a regionally unique effort to display the benefits of single initiatives and the overall synergies and interrelations that can occur as a result of building complete programs. In our budgeting process, we have defined the operating and capital costs of each of the initiatives along with an estimate of potential benefits. These benefits include operational, economic, customer and environmental improvements. Where possible, specific, quantifiable methodologies were developed to translate benefit metrics into potential monetary value. For the overall solution, additional program management costs were included and synergistic benefits were estimated. These costs and benefits will be periodically evaluated during the Demonstration as part of the required DOE reporting process. Additionally, where possible, we will quantify the cost-effectiveness of the technology solutions developed for the demonstration vs. existing and / or alternative technologies and solutions to determine the cost-effectiveness of our demonstration vs. existing and emerging alternatives.
- Verify SmartGrid technology viability: As part of the Demonstration, we are implementing a number of new and emerging technologies and combining and integrating both new and existing technologies in unique ways to form an end-to-end solution. Such technologies include the installation of DCADA/SmartSubstation components, the integration of DER and DR Management systems, the addition of a complete DMS system, an AMI system implementation along with associated smart meters and Field Area Network (FAN), and Smart Home devices including DR thermostats and residential and commercial EMS. Each of these technologies will be tested against anticipated net benefits and their ability to generate sufficient savings or other benefits to justify their cost of implementation and use. Each of these systems will be evaluated separately and as part of a complete solution to determine their most optimal use and application, either as separate systems or as part of the more holistic demonstration.
- Validate new SmartGrid business models: A key reason we designed the Demonstration as an end-to-end solution from SmartGeneration through SmartEnd-Use is to test and evaluate the potential for a variety of business models. For example, with SmartGeneration applications such as roof-top solar, we will test the viability and practicality of eventual customer-owned generation assets and capabilities with the potential to sell excess capacity back to the grid. The Company expects to test this concept in other DER applications as well such as parallel generation and potential PHEV vehicle-to-grid applications.

4.A.3) Adequacy of the proposed demonstration approach to quantifiably advance program metrics.

The SmartGrid Demonstration has been specifically designed to address as many program metrics as possible. The complete solution approach to the SmartGrid Demonstration will allow KCP&L to evaluate, test and report on the program's effect on a wide variety of metrics, including economic (e.g. T&D system losses, % of MWh served by DG), reliability and power quality (e.g. SAIFI, SAIDI, CAIDI, MAIFI), and environmental (% of MWh served by renewables, % of feeder peak load served by renewables). This testing process will be further enabled by focusing on one substation for which substantial historical data already exists. Prior to receiving approval for Final Design and Construction, we will establish a formal baseline of all metrics to be measured.

4.A.4) Validity of the proposed approach and likelihood of success based on current technology maturity and regulatory / stakeholder acceptance of the technology. Innovativeness of the project, including introduction of new technologies and creative applications of new and state-of-the-practice SmartGrid technologies

Our Project Team seeks to demonstrate the value of using SmartGrid technology and communications to manage distributed energy resources within a utility's service territory. In particular, we are targeting edge of grid resources using a comprehensive SmartGrid platform in order to integrate and manage distributed grid assets. In developing the scope, objectives and approach for this project, KCP&L explicitly balanced the inclusion of widely accepted technologies with new and emerging concepts and approaches. We also evaluated innovative combinations and applications of best of breed technologies rather than single solutions or the implementation of single vendor platforms.

The goal of the Demonstration is to design, develop, and deploy a next generation end-to-end (or top-to-bottom) distribution grid management infrastructure, which will be based on distributed-hierarchical control concepts, an emerging technology. Our approach is centered on the upgrade of our Midtown Substation, an existing urban substation, to create a next-generation Smart Substation with IEC-61850 communication protocols and control processors to implement distributed, unattended control with automated "first responder" monitoring and control functions. Ten distribution circuits served by the Midtown Substation will be upgraded with a variety of feeder based monitoring and control IED to evaluate the impact of a variety of Advanced Distribution Automation (ADA) functions and leading edge smart customer initiatives will provide consumers with enhanced information regarding energy use and cost. Finally, SmartGeneration initiatives including emerging photo-voltaic solar technologies and PHEV charging stations and vehicles will be implemented to test the potential for distributed generation and innovative business models. Each of these initiatives utilizes some combination of existing and accepted technologies combined with emerging technologies, protocols or systems. In addition, we believe the combination of best of breed technologies and the unique application of these technologies in an end-to-end, regionally-defined urban application is unique and could serve as an urban renewal blueprint for future applications.

4.A.5) Appropriateness and completeness of the demonstration plan including performance objectives of the demonstration, the criteria and requirements used in selecting demonstration site(s), the data collection and evaluation plan, the metrics for success, and the measurements that will be made to confirm success. Adequacy and completeness of the proposed approach in delivering demonstration project data and information to the SmartGrid Clearinghouse, the DOE and the public.

KCP&L has a rich history of performance data in the region and has begun work on establishing a set of baseline parameters on the economic, operational and environmental performance metrics to be reviewed. As we prepare for the execution of the demonstration, a preliminary performance and cost model will be developed to define a baseline case for this project. A complete range of baseline data will

be collected by individual project teams and across projects as defined in the project plan. This will include both operational/performance (reliability, usage, etc.) and financial (cost to serve, rates, etc.) information. This baseline data will be the basis for measuring the impact on grid performance, system efficiencies, and end-use consumption patterns achieved by the demonstrated technologies. KCP&L will collaborate with the DOE to determine the distribution feeder and customer data needed to support the DOE standardized cost benefit analysis methodology.

The defined site for the project – the Company's Midtown substation along with multiple circuits served by the substation – will provide a very efficient testing and demonstration environment. The Company has served this area for many years and has a rich history of data for the region as well as the capabilities to collect and report data to the SmartGrid Clearinghouse on a regular basis. The final demonstration solution will be compared with this baseline case to measure the benefits of the approach and quantify performance relative to expectations.

The project team will develop a grid monitoring and test plan for the two-year demonstration. The plan will address various modes of grid, DR, and DER, operation; validate key operating features of the distributed resources (e.g., stand-alone and parallel operation); validate the key operating and control features of the distributed-hierarchical grid control systems; and confirm the safe and reliable operation of the electric grid with integrated distributed resources. The monitoring plan will provide for compilation of the necessary data to measure improvements in grid efficiency, grid performance, reduced consumer energy consumption and demand reduction.

During the 24 month demonstration, our team will collect the detailed data in different operational modes, including normal and contingency switching configurations. Both grid performance and consumption data will be collected, compiled and analyzed for the project area This data will be compared against the baseline data to measure the impact on grid performance, system efficiencies, and end-use consumption patterns achieved by the demonstrated technologies.

As a member of EPRI's five-year SmartGrid demonstration project, our project data transfer activities will be coordinated through EPRI's formalized SmartGrid demonstration project. Specifically, EPRI will coordinate the sharing of field results, lessons learned, architectural challenges, issues impacting standards, key technology gaps, and useful tools to help interoperability of SmartGrid technologies and systems related to the project. Project data including scope, schedule, and results of the project will be supplied to the "SmartGrid Information Clearinghouse."

4.A.6) Suitability and availability of the proposed project site(s) to meet the overall program objectives for scope and scale appropriate for the technology(ies) being demonstrated.

As noted above, the Demonstration Area is an ideal project site for this type of demonstration as it consists of 10 circuits served by one substation across 2 square miles with approximately 14,000 customers comprising both commercial and residential customers with a broad array of demographics, income levels and energy usage and needs. Since this area is explicitly defined and served by one substation, it can provide the ideal "laboratory" environment from which to demonstrate and test program results.

Part of the Demonstration Area also contains the Green Impact Zone, a wider urban revitalization project designed as a means to use Federal funds to redevelop an urban core. Key to this redevelopment is the provision of a modern energy infrastructure. The Green Impact Zone has significant political and community support which will provide the catalyst for high customer engagement to better demonstrate our integrated view of the SmartGrid.

4.A.7) Adequacy of plans for data collection and analysis of project costs and benefits, including the following aspects:

- **Thoroughness of the discussion of data requirements (including what types of data and their**

availability) and how that data will be provided to the DOE so that project costs and benefits can be properly analyzed

- **Logic and completeness of the discussion of how the data can be used by the DOE to develop estimates of project costs and benefits, including the discussion of the Applicant's quantified estimates of project benefits**
- **Comprehensiveness of the plan for determining the baseline against which the costs and benefits will be assessed**

A range of baseline data will be collected by individual project teams and across projects as defined in the Project Management Plan. This will include both operational / performance (e.g. reliability, usage, etc.) and financial (cost to serve, rates, etc.) information. As much as possible, we will include metrics that not only show monetary benefits, but also progress on demonstrating SmartGrid "characteristics" as defined in the FOA. Based on historical data on our performance in the Demonstration Area, a preliminary performance and cost model will be developed to define a baseline case for this project. The final demonstration solution will be compared with this baseline case to measure the benefits of the approach and quantify performance relative to expectations.

The Company intends to provide a variety of data to the SmartGrid Clearinghouse using the DOE's cost-benefit analysis methodology or an approach that is very similar and provides the input data required for the DOE to evaluate project success along a wide variety of metrics. The Company plans to actively track and measure a complete set of performance data at regular intervals and report results to the DOE versus the project baseline.

4.A.8) The degree of the proposed estimates of project benefits

KCP&L expects this demonstration to show significant improvements in monetary benefits and the progress of the Demonstration Area toward exhibiting SmartGrid characteristics. This information is not all-inclusive and the estimates will be further refined and quantified over the next few months and will be formalized with the DOE after Notice of Award and prior to the Operational Readiness Review Approval. Specific benefits, sources, metrics and potential degree of impact are shown below:

4.B. SIGNIFICANCE & IMPACT

4.B.1) Significance of the proposed demonstration application vs. current practices – Completeness of this assessment to consider benefits in terms of anticipated performance improvements (technical, operational, and environmental aspects) and the cost savings of the proposed application over current practices

This Demonstration effort is designed as a means to test and evaluate a potential step change improvement in KCP&L's electricity distribution system. Specifically, we are designing a system with a communication architecture that will facilitate automated system monitoring and control with open systems that will allow the integration of technologies and components from multiple vendors in a "best-of-breed" solution along with a new electrical architecture and protection system that will enable an interoperable, secure network of components.

We expect this Demonstration to display significant performance improvements as a result of the technologies and solutions considered. Substation and distributed feeder line automation systems can significantly reduce O&M costs, improve reliability and enhance the environmental footprint through automated fault location detection, automated switch operation, improved voltage control and regulation, improved Outage Management System communications, enabled two-way end-user communication and information flow and the integration of distributed energy resources, allowing for a greater role of renewable energy generation into grid operations.

4.B.2) Degree to which the demonstration project is broadly applicable and adaptable throughout the region, including the completeness and adequacy of the deployment plan for large-scale deployment in and/or beyond the proposed region

The Demonstration Area is a self contained distribution network anchored by KCP&L's Midtown Substation within the Green Impact Zone. The Demonstration will design, deploy, test and report on the implementation of a complete end-to-end SmartGrid system within multiple circuits served by the Midtown Substation over a 2 square mile area with approximately 14,000 commercial and residential customers. Both the commercial and residential customer base is very diverse with large public institutions such as the University of Missouri at Kansas City and the Midwest Research Center as well as a residential population from virtually all demographics and income groups.

By designing this Demonstration as a complete end-to-end SmartGrid research and testing project in a geographically defined area, the Company has effectively designed a demonstration program that could either be scaled up as a large scale SmartGrid "Investment" program or deployed in different urban areas of the United States. It is truly a transferable and scalable solution.

4.B.3) Adequacy and impact of the public outreach and education plan on public acceptance of SmartGrid transformation

In order to promote this Demonstration in the Green Impact Zone and the Demonstration area in general, we have worked with our partners to design a comprehensive marketing, education and training program. In addition, as part of the Demonstration, we have designed a number of end-use programs.. In order to demonstrate the full value of these programs, KCP&L has developed both a business-to-business and business-to-consumer marketing and education campaign.

KCP&L will serve as the primary point-of-contact for our Demonstration Partners and will manage and coordinate all resources required, including KCP&L marketing and customer service professionals and third-party service providers (i.e., advertising agency, call center and printer). KCP&L will also work with our Demonstration Partners' marketing teams to create a highly targeted customer enrollment program that achieves goals and meets brand objectives and preferences for interacting with customers.

For more information and description of the Company's public outreach and education plan, please see Section 3 (Project Description) above.

4.B.4) Completeness of the proposed commercialization strategy for the technology(ies) being demonstrated

In designing this demonstration, KCP&L's initial goals are similar to those under this Application – to quantify SmartGrid costs, benefits and cost-effectiveness, verify SmartGrid technology viability, and validate new SmartGrid business models, at a scale that can be readily adapted and replicated around the country. We have explicitly incorporated the advanced digital technologies that support the SmartGrid Regional Demonstration Initiative, as described under section 1304 (b) (2) (A)–(E) of the Energy Independence and Security Act (EISA) of 2007. As such, we believe that this is a demonstration project and not a commercial endeavor. However, certain solutions that are developed as part of this demonstration could be commercialized in the future, particularly by our strategic partners, and also may become readily transferrable and applied as use cases for national implementation and replication.

4.B.5) Extent to which demonstration advances research and demonstration objectives of the program

The SmartGrid Demonstration is explicitly designed to advance the research and demonstration objectives of the SmartGrid Demonstration Initiative. Specifically, we have developed a proposed SmartGrid architecture that employs and integrates emerging technologies being developed for use in the planning and operations of the electric power system. Such technologies include microprocessor-based measurement and control, advanced two-way communications, and next generation computing and

information systems. These systems (e.g. electronic substation relays, DA automation circuits, electronic capacitor controls, communicating faulted circuit indicators, voltage monitors and two-way communication devices throughout the distribution test area) will be combined in a unique and innovative manner to enable distribution automation and facilitate the integration of end-use and SmartGeneration add-ons to form a self contained complete "SmartGrid". This regional "laboratory" will serve as a research and demonstration site for the explicit testing of these advanced technologies as specified under the EISA.

4.B.6) Viability and practicality of the proposed technology to meet the needs of the target market in a cost effective manner.

The SmartGrid Demonstration is explicitly designed to advance the research and demonstration objectives of the SmartGrid Demonstration Initiative. Specifically, we have developed a proposed SmartGrid architecture that employs and integrates emerging technologies being developed for use in the planning and operations of the electric power system. Such technologies include microprocessor-based measurement and control, advanced two-way communications, and next generation computing and information systems. These systems (e.g. electronic substation relays, DA automation circuits, electronic capacitor controls, communicating faulted circuit indicators, voltage monitors and two-way communication devices throughout the distribution test area) will be combined in a unique and innovative manner to enable distribution automation and facilitate the integration of end-use and SmartGeneration add-ons to form a self contained complete "SmartGrid". This regional "laboratory" will serve as a research and demonstration site for the explicit testing of these advanced technologies as specified under the EISA.

4.C. INTEROPERABILITY & CYBER SECURITY

4.C.1) Adequacy and completeness of approach to address interoperability, how integration is supported to achieve interoperability, and how interoperability concerns will be addressed throughout all phases of the engineering lifecycle, including design, acquisition, implementation, integration, test, deployment, operations, maintenance and upgrade

KCP&L fully understands that one of DOE's SmartGrid priorities is to use its work with NIST and FERC on a framework for interoperability standards. KCP&L has been an active participant in the development of the NIST SmartGrid Interoperability Standards Roadmap and believes that this SmartGrid Demonstration provides an ideal opportunity to field test the interoperability standards.

The SmartGrid Demonstration project is based on an integrated end-to-end solution that demonstrates interoperability of key Smart Grid components and will provide a commercial application for five (5) SmartGrid use cases – Demand Response, Electric Storage, Electric Transportation, AMI Systems, and Distribution Grid Management – that form the basis of the proposed NIST' Interim Smart Grid Interoperability Standards Roadmap.

The SmartGrid Demonstration will implement bulk power energy management, scheduling and market systems, enterprise systems, distribution network management system, substation, feeder and distribution automation systems, distributed resource and demand-side management systems, advanced metering infrastructure and customer-based energy management and behind-the-meter resources and loads. We will leverage EPRI's IntelliGrid^{SM} methodology to support the technical foundation for a smart power grid that links electricity with communications and computer control to achieve tremendous gains in reliability, capacity, and customer services. The IntelliGrid Architecture is an open-standards, requirements-based approach for integrating data networks and equipment that enables interoperability between products and systems. This methodology provides tools and recommendations for standards and technologies when implementing systems such as advanced metering, distribution automation, and

demand response and also provides an independent, unbiased approach for testing technologies and vendor products.

The Project Team will assess the applicability and the gaps of the NIST standards, and will adopt, and extend where necessary, these standards in this project. To the extent feasible, our project will coordinate our implementation efforts with NIST and the Standards Development Organizations acceleration efforts.

4.C.2) Adequacy and completeness of approach for cyber security concerns and protections and how they will be addressed throughout the project, including the adequacy of the discussion of the integration of the new SmartGrid application into the existing environment, and how any new cyber security vulnerabilities will be mitigated through technology or other measures.

Securing the networked communications, intelligent equipment, and information is critical to the operation of the future SmartGrid. Due to the complexity and far reaching aspects of the SmartGrid, planning for physical and cyber security, in advance of deployment, is essential to provide a more complete and cost effective solution.

As a member of EPRI's five-year Smart Grid demonstration project, our cyber security requirements and design will be coordinated through EPRI's formalized smart grid demonstration project. KCP&L intends to leverage EPRI's IntelliGrid^{SM} Architectures' strategic vision to support our technical approach on cyber security.

The development of the SmartGrid T&D infrastructure will involve cyber security considerations in every aspect and phase of the project and also numerous standards at all levels of the IT and grid infrastructure. One of the objectives of the proposed project is to demonstrate end-to-end cyber security and incorporate the appropriate NIST identified "low-hanging fruit" standards. The Project Team will assess the applicability and the gaps of these and other standards, and will adopt, and augment where necessary, these standards in this project. To the extent feasible, our project will coordinate our implementation efforts with NIST and the Standards Development Organizations acceleration efforts.

KCP&L has also chosen to implement the demonstration using private communications media wherever practical. By using the Corporate IT WAN and utility owned FAN, the KCP&L SmartGrid system designs can still leverage the vast amount of research and development into Internet Protocols (IP) and technologies. They will just be implemented over a private Intranet instead of the public Internet to minimize the exposure to cyber security attacks.

The far reaching and complex nature of the SmartGrid dictates that no-single security policy can be developed to properly secure the SmartGrid. The hierarchical nature of the technologies that will be implemented to create the SmartGrid Communication Network provides for security "check-points" between control and network layers that may have different security requirements. Therefore, it is a natural extension for the Security Architecture to be constructed around Security Domains.

These Security Domain represent a set of resources (e.g. network, computational, and physical) that share a common security requirements and risk assessment. For example; within the 'bulk power system' there are two distinct Security Domains: NERC-CIP and NERC-nonCIP. While having different security requirements, all Security Domains will be secured and managed through a consistent set of security policies and processes. Secure connectivity, data encryption, firewall protection, intrusion detection, access logging, change control and the audit reports associated with these applications will likely be required for all SmartGrid security domains.

5. RELEVANCE AND OUTCOMES / IMPACTS

5.A. RELEVANCE

KCP&L's Green Impact Zone SmartGrid Demonstration initiative is a collaborative effort by all parties focused on addressing prevalent challenges with integrating distributed resources in grid and market operations as well as in system planning. Multiple demonstration components will be designed and implemented to address the variety of barriers and incompatibilities associated with the integration of distributed resources (e.g., local storage, demand response, distributed generation, renewable resource, and grid management) into system operations. These barriers include lack of appropriate technical operations and decision-aiding models, insufficient communication and control infrastructure, incompatible market and pricing structures, and the lack of interoperability standards. The project will demonstrate a variety of approaches for overcoming these barriers and identify appropriate standards and best practices for distributed resource integration.

Electric utilities around the world are assessing the technical issues and the related benefits and costs of modernizing the grid. Many are already investing in the communication and information infrastructure that is expected to be the backbone of the SmartGrid. These infrastructures will require tens of billions of dollars of capital investment in equipment and new technologies. Investors and regulators want to know if the investments will be a technical and financial success. Customers want to understand if benefits will justify the costs that may ultimately be borne by them as ratepayers. Our project contributes to addressing these concerns by leveraging the investments in communication infrastructure to demonstrate effective integration of multiple components and systems.

The scope of the demonstrations encompasses numerous SmartGrid network component, grid management and control systems, and distributed resources that operate together including:

- AMI - Advanced Metering Infrastructure including RF mesh FAN providing IP based AMI and ADA field communications
- MDM – Meter Data Management for management and analysis energy consumption patterns.
- DMS – Distribution Management System with D-SCADA and OMS functions
- ESB – Enterprise Service Bus providing IEC61968 integration for all distribution management systems components
- SA – Distribution Substation Automation with IEC61850 protocols and advanced IEDs
- ADA – Advanced Distribution Automation with automated "first responder" monitoring and control functions with substation DCADA controller.
- Adopting distributed, hierarchical control methods between DCADA, DMS, and DERM
- DERM – Distributed Energy Resource (DR/DER) Management system that interoperates with DMS, MDM
- DER – A variety of utility managed DER components will be integrated including DVC, DR thermostats, roof-top solar, grid-connected battery, and conversion of stand-by to parallel generation.
- DSM- A variety of consumer demand side management technologies will be integrated including In-home Display, EMS-Web Portal, HAN, experimental TOU rates, PHEV charge management and critical peak signals.

Enabling widespread penetration of SmartGrid systems and technologies in support of grid operations requires overcoming prevalent integration barriers. Integration barriers range from technical and economic to institutional and customer-driven barriers. Technical barriers relate to lack of infrastructure, accepted standards and processes/protocols to aggregate and automate distributed resources in a fashion that meets system operator requirements. The requirements themselves need to be carefully defined to achieve system operator confidence in relying on distributed resources on the one hand, yet not overly burden the demand-side and thereby discourage aggregation and demand-side participation. Economic type barriers include establishing justification for integration costs and designing retail incentive

structures to incent sufficient response from distributed resources in support of grid needs. Institutional barriers surround the need to better connect wholesale with retail electricity markets and to bridge organizational silos to better achieve end-to-end integration, from wholesale to retail markets and down to end-use.

The Smart Grid project will demonstrate a variety of approaches for overcoming these barriers and identify appropriate standards and best practices for distributed resource integration. Lack of standards and associated high integration costs are prevalent challenges in enabling widespread penetration of distributed resources. Other challenges include lack of appropriate decision-aiding models, insufficient communication and control infrastructure, incompatible market and pricing structures, and the lack of interoperability standards. EPRI's IntelliGrid methodology will be applied to identify approaches for interoperability and integration. Methods, processes, and technologies will be researched, developed, and applied to demonstrate and measure project effectiveness in overcoming integration barriers.

5.B. OUTCOME/IMPACTS

The primary outcome/impact of the SmartGrid Demonstration project will be multifaceted:

- (a) When combined the individual project components will implement and demonstrate a next-generation, end-to-end SmartGrid that will include Distributed Energy Resources, enhanced customer facing technologies, and a distributed-hierarchical control system of a significant regional distribution grid serving 14,000 customers, the Kansas City Green Impact Zone, and UMKC with 69.5 MVA demand.
- (b) Demonstration, measurement, and reporting on the costs, benefits, and business model feasibility of the demonstrated solution. The project will demonstrate certain operational, economic, consumer, and environmental benefits that can be enabled by single SmartGrid technologies and further enhanced by integrated solutions as proposed for this demonstration.
- Our project will use existing and emerging integration technologies and standards for implementing the T&D SmartGrid Infrastructure. By applying NIST identified SmartGrid interoperability, the project can help NIST and relevant SDOs identify issues and gaps associated with the standards (e.g., common object models, communications interfaces, etc.). This effort is focused on an accelerated timetable for the development of a standards development roadmap and a process for getting standards for interoperability in place as rapidly as possible.

In addition to the above specific Smart Grid metrics and impacts, the project will demonstrate the following key capabilities:

5.C. SMARTGRID METRICS

The following table lists the relevant SmartGrid statistics that have been established by the DOE to measure the progress SmartGrid adoption and what will be demonstrated and or quantified by our project related to each of these statistics

DOE SmartGrid Statistics

Relevance and Outcomes/Impacts	What will be demonstrated
Transmission and Distribution Infrastructure	
• T&D system reliability: duration and frequency of power outages	• Using DR/DER capabilities to relieve load on distribution equipment and facilities
	• Utilizing DR/DER for balancing variable generation (solar PV), e.g., dispatching the proposed 1MW storage capability.
	• Provision of ancillary services from demand-side

	DR/DER • DMS real-time information and model will be used to track SAIDI/SAIFI and provide before/after comparison using 12 months of data for demonstrating the magnitude of improvements.
• T&D automation: percentage of substations using automation	• Rate of feeders automated for the selected substation will be measured as a model for further deployment.
• Advanced meters: percentage of total demand served by advanced metered customers	• The ability for the substation and control center to track and manage demand based on improved load models and Distribution Network Management will be measured/assessed per feeder.
• Capacity factors: yearly average and peak-generation capacity factor	• By utilizing DR/DER including storage, the project will be able to flatten the Load Factor and thus improve the capacity factors of the generating resources serving the load.
• Generation and T&D efficiencies: energy conversion efficiency of electricity generation, and electricity T&D efficiency	• Line losses will be optimized through better monitoring and management of feeder/circuit Voltage/VAr and phase balances. This will be achieved in part through scheduling and dispatch of DR/DER on distribution circuits.
• Dynamic line ratings: percentage miles of transmission circuits being operated under dynamic line ratings	Dynamic line/facility rating will be demonstrated on distribution feeders through monitoring of the equipment loading and environmental conditions.
• Power quality: percentage of customer complaints related to power quality issues (e.g., flicker), excluding outages	• PQ will be improved through proper planning, deployment, interconnection and operation of distributed energy resources (DER)
Information Networks and Finance	
• Open architecture/standards: Interoperability Maturity Level – the weighted average maturity level of interoperability realized between electricity system stakeholders	• Interoperability between DMS and DR/DER Management using IEC 61968/61970 application integration & IEC 60870/TASE.2 (ICCP) communications
	• Integration of DR/DER Management with AMI system using applicable IEC 61968/61970 protocols
	• Adaptation and extensions of IEC 61850-7-420 for interfaces and management of DER
	• Adaptation and demonstration of NERC CIP and applicable AMI SEC cyber security for DR/DER management
	• Integration
	• Adaptation and extensions of the Open ADR protocols for demand response.
Interoperability:	• Demonstrates an end-to-end interoperable solution that supports a general architecture with product component options. The number, type and system level of interoperable applications and devices

	communicating through standard protocols to achieve the defined solution functionality will be measured as the project progresses. This will be expressed as a number and a percentage of total components within the proposed project.
Cyber Security:	• Demonstrates an end-to-end solution that extends cyber security methodology and protection to ensure required security
Distributed energy resources technology	
• Load participating based on grid conditions: fraction of load served by interruptible loads, utility-directed load control, and incentive-based, consumer-directed load control	• This will be extensively demonstrated through the implementation of the DR programs in the Green Impact Zone, including utility-directed load control, incentive-based and customer-directed load control
• Load served by microgrids: fraction of entire load served by microgrids	• The project will assess microgrid potential in the Green Impact Zone including self-sustainable building with local generation/storage.
• Grid-connected distributed generation (renewable and non-renewable) and storage: percentage of all generation capacity that is distributed generation and storage	• The demonstration project will include both renewable (solar PV) and non-renewable (customer distributed generation) resources. Also included will be a 1MW Feeder level storage capability.
• EVs and PHEVs: percentage shares of on-road, light-duty vehicles comprised of EVs and PHEVs	• The demonstration project will include a representative set of PEVs and PHEV Charging stations. These capabilities will be fully integrated with the proposed solution in a scalable manner. The demonstration will include all aspects of managing the charging process, tracking the state of charge, monitoring the distribution network loading, as well as assessing the utilization of the PEV storage capability for grid support.
• Grid-responsive, non-generating, demand-side equipment: total load served by smart, grid-responsive equipment (smart appliances, industrial/commercial equipment including motors and drivers)	• The project will include integration of HAN based devices as well as in-home displays. Also included are integration of commercial/industrial customer demand-side resources and on-site energy management systems.