EPRI Smart Grid Demonstration Update

An EPRI Progress Report **March 19, 2010**

ABOUT THE NEWSLETTER

The EPRI Smart Grid Demonstration Initiative is a five-year collaborative research effort focused on design, implementation, and assessment of field demonstrations to address prevalent challenges with **integrating distributed energy resources** in grid and market operations to create a "Virtual Power Plant." This newsletter provides periodic updates on the project and relevant industry news and events.

PROJECT UPDATE

Use Case Repository – Upload Capability Documents & Protects your IP

EPRI recently added "Upload Capability" to our use case repository. This enables anyone to upload their use case to the repository while logging and tracking your use case uploads to recognize your contribution to the industry without the risk of others claiming the associated Intellectual Property at a later date that could prohibit broader use and benefits to the industry.

7th & 8th EPRI Smart Grid Demonstration Host Sites to be presented at EPRI Board of Directors Meeting in April.

KCP&L & Exelon's Smart Grid demonstration projects have completed both the EPRI Technical and Peer reviews and will be presented to the EPRI Board of Directors in April.

Kansas City Power & Light (KCP&L)

KCP&L's "Green Impact Zone" objective is the integration of distributed resources into all levels of grid operations including market trading, generation dispatch, distribution operations, and consumer interaction that creates an end-to-end Smart Grid around a major SmartSubstation.

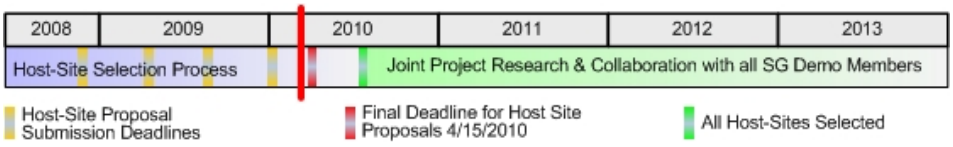
Exelon (ComEd / PECO)

The Exelon project is collaborative effort bringing together ComEd and PECO technologies and applications

More to come…..

Smart Grid Demonstration Host Site Proposals – Final Notice

April 15th is not only "tax day" but also the deadline to submit host site proposals. We will continue to perform research on smaller projects into 2012 for all of our Smart Grid demonstration members, but we need to identify all the host-sites now so we can complete the associated research on time. Please contact Matt Wakefield if you are planning on submitting a proposal for our final host-site review cycle.



Smart Grid Industry News – Now with RSS Feed

We are posting industry news item on the home page of EPRI's Smart Grid Resource Center and making available via RSS web feed. Click here to subscribe to EPRI's "Smart Grid in the News" RSS Feed.

EPRI Smart Grid Demonstration Advisory Meeting Hosted by AEP

The meeting focused on Architecture Approaches to Integrate DER – March 2-4, 2010

The Winter EPRI Smart Grid Demonstration Advisory meeting included a joint meeting with the EPRI IntelliGrid Advisors as well as the Public Advisory Group providing three days of Smart Grid updates and discussion along with tour of AEP's world-class laboratories. The focus of the Smart Grid Advisory meeting included seven presentations focused on architecture approaches to integrate DER including system interfaces, protocols, benefits, and gaps/challenges.

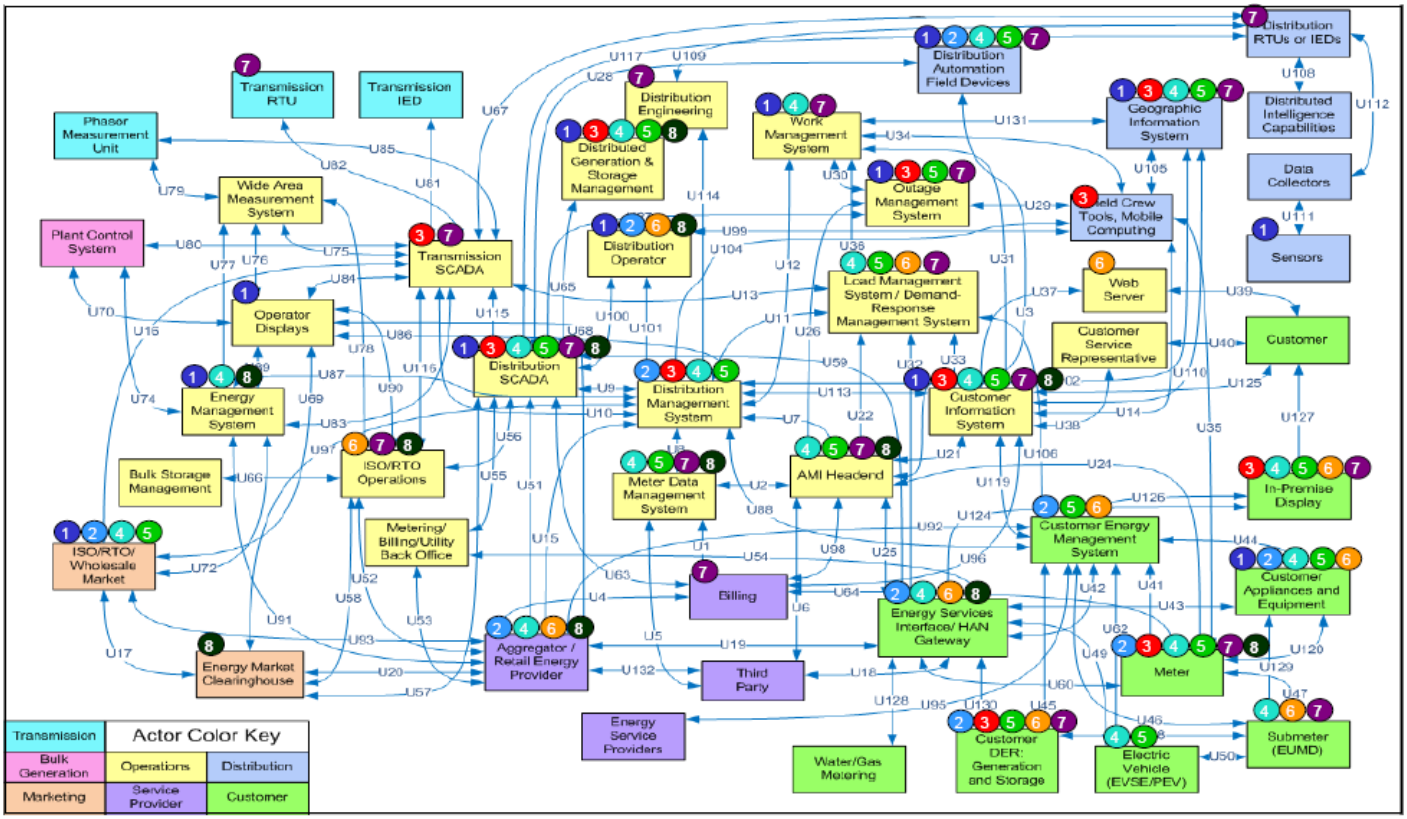


Figure 1: NIST Unified Logical Interface Diagram – Mapped to key system interfaces for integrating DER

Admittedly, Figure 1 is a bit of an eye-chart, but it represents a high-level view of eight different approaches and key system interfaces for integrating DER, six of which were presented during the meeting. EPRI will consolidate content from all seven presentations and the panel discussion in a report this Spring.

EPRI Smart Grid Demonstration Host-Site Updates

This section provides a brief highlight of recent activities. See the associated Host Site "Progress Report" for details on the host-site activities accomplished to date. Progress Reports are listed in the Technology Transfer section under Deliverables Update.

American Electric Power (AEP)

EPRI Project Manager, Gale Horst

AEP has looked at grid storage options at several levels. This includes system level, substation level, and at the grid edge. Four key features were identified as being desirable. To be able to not only provide backup power, but also buffer renewables located at a customer site, the storage needs to be very close to the customer. To provide load leveling and Volt/VAR support, the storage needs to be connected to the grid. Thirdly, for optimized grid performance and load diversity, the storage must be operated by the utility. And finally, by owning the storage it can be a standardized resource and gain commodity pricing advantages lowering the cost.

By placing Community Energy Storage (CES) units at the transformer level, AEP seeks to realize these key features. Although CES units may be local to a transformer, they can still be activated as a fleet of storage units to provide coordinated benefits at the feeder level with dispatched response similar to a substation battery. Advantages of this approach include reliability, scalability, easier installation / maintenance, and better support and buffering for customer owned renewables.

During 2010, the AEP SG Demonstration will continue to utilize tools such as OpenDSS to run simulations on circuit data to make a number of determinations regarding the deployment and utilization of various technology. These simulations will include CES, Volt/VAR, and PHEV, but may also consider additional items such as PV and DR. Three phases of simulation levels are being mapped. The first phase is to simulate the impact of each single technology on the distribution system and grid. A second phase will include cross-technology impacts. For example, phase two will simulate the impact of having both CES and PHEV/EV on the same system. When you combine various types of new technology onto the same system, what are the impacts? Will the controls for each technology need to interact in some way to avoid unwanted consequences?

A third phase will be mapped out following the single and cross-technology simulations that will carryover into future years of the project. This has been titled "Cross-Utilization Impact". Some technology resources will provide multiple benefits depending on utilization. Concurrent utilization opportunities for the technology will need to be resolved and business and technical prioritization schemes developed. More information will be forthcoming on this aspect as further work ensues.

Con Edison
EPRI Project Manager, Gale Horst

The Consolidated Edison SG work is focusing on interaction with customers who own generation. In addition to aggregation of resources, visibility of the resources and ability to dispatch in a targeted area are being examined. Plans are to continue with the design of a system that provides visibility of these resources and ability to call on them when needed. If a building generation can be dispatched as a demand response (DR) system it could be called on to control overload conditions extending the life of critical assets.

Moving intelligence toward the end nodes utilizing "grid agents" enables a distributed intelligence concept. Two key components targeted are the Demand Response Command Center (DRCC) and the Distribution Control Center (DCC). Multiple DRCCs can provide a interoperable system of command centers via open protocols, verification, and auditable gateway between a group of resources (or facilities) and the utility operator. A utility operator can initiate a program call to optimize the system by transmitting instructions to each resource.

Various technologies can be represented at the DCC level where resources can be called upon for capacity, energy, and ancillary services. Capabilities allow visibility into system resources and provide tools for planning, early detection of potential problems, and ability for early response.

Gaps and challenges include understanding the additional opportunities or issues that may come along with interfacing with customer-owned resources. Can support for distribution systems be enabled in addition to ISO/RTO reliability programs? What is the role of independent DR aggregators and interfaces in conjunction with other resources? Will other customer decisions relative to owned equipment come into play?

ESB Networks
EPRI Project Manager, John Simmins, PhD

The ESB team participated in a Use Case workshop, put on by EPRI. The purpose of the workshop was to develop the Use Case narrative, identify all the relevant actors, and work through the steps of several workshops involving Plug-in Electric Vehicles (PEV). The initial Use Case described the customer being able to re-charge at their premises any time they want. The workshop helped focus the team on the details of the project like never before. Seventeen actors were identified and several important details were brought out.

- Electrical vehicle load will be separately monitored from other domestic load.
- Harmonics, power factor, voltage and current in addition to kWh in time intervals will be monitored at the customers' premises.
- Selection of customers will be made and equipment installed in advance of the study.
- The same standard of metering will be carried out at the substation in addition to three phase monitoring.
- An agreement will be made with the customer to participate in the study and then the device will be installed and monitored for the period of a month before the trial.
- Customer meter is replaced with a smart meter.
- After the customer meter, tails with a separate fuse board will be taken off to supply the EV connection, which is monitored separately by a power quality meter. This is to be confirmed as to being acceptable from an ESB / ETCI point of view.
- EVs will be delivered to the customers and training supplied.
- The customers will then sign a document stating that they are suitably trained. Customers will then be monitored for three months and the process repeated with other customers.

There will be a questionnaire/survey to assess customers, both in terms of behavior and physical situations. Customer selection criteria will include dual tariff customers at time of trial and customers situated at various positions on the network, clustered and un-clustered on a single phase. A model of the population being tested will be developed and the results of this first Use Case will be used as a basis of subsequent, more involved Use Cases.

Electricite de France (EDF)
EPRI Project Manager, John Simmins, PhD

Quantifying CO_2 Emissions Reductions at Real Time

In France, 90% of electricity is generated by using nuclear and hydraulic power plants. The quantity of CO_2 emitted when electricity is produced has a trend toward high CO_2 at load peak periods. However, even if the trend is confirmed, load peak periods and CO_2 emissions are not fully correlated.

Depending on the generators used to feed a determinate area, load shifting or load shedding (with rebound effect) actions at load peak times do not always reduce green house gas emissions. Real time estimation of CO_2 emission reductions seems to be difficult currently because of the lack of public information on the employed set of generators used hourly.

PREMIO Platform Modeling

A first model has been built taking into account load curve modification, energy savings and CO_2 emissions reductions at local scale. It simulates the impacts of a single PREMIO platform with different penetration rates of PREMIO technologies on local consumption uses. The representativeness of the local load curve modeled (without PREMIO platform) has been validated thanks to the monitoring data collected at distribution sub-station level in 2005. A first study has projected local demand for the year 2015 and simulated two scenarios: a medium and a maximal diffusion of PREMIO technologies (respectively 50% and 100% penetration rate).

To assess load savings, energy and CO_2 impacts of the deployment of PREMIO platform, considering:
- The local diffusion of PREMIO technologies connected to one central gathering unit.
- The deployment of several PREMIO platforms over PACA region.
- Projection with future power demand evolution.
- Different upstream operator logics (technical, commercial, environmental).

Aggregated load profiles (France level aggregation) per consumption uses were applied for local load curve modeling (e.g. at city level) by modifying quantity of energy. Dynamic load control technologies impacts were assessed by using modeling methods which re-shaped load profiles of traditional uses. Simulation studies showed that a high penetration rate of load control technologies might cause new power system operational problems. Figure 2 below shows the appearance of "load holes" that appear at a 50% penetration and increase through 100% penetration. Thus, a "smart" load control strategy is necessary in case of massive smart technologies diffusion.

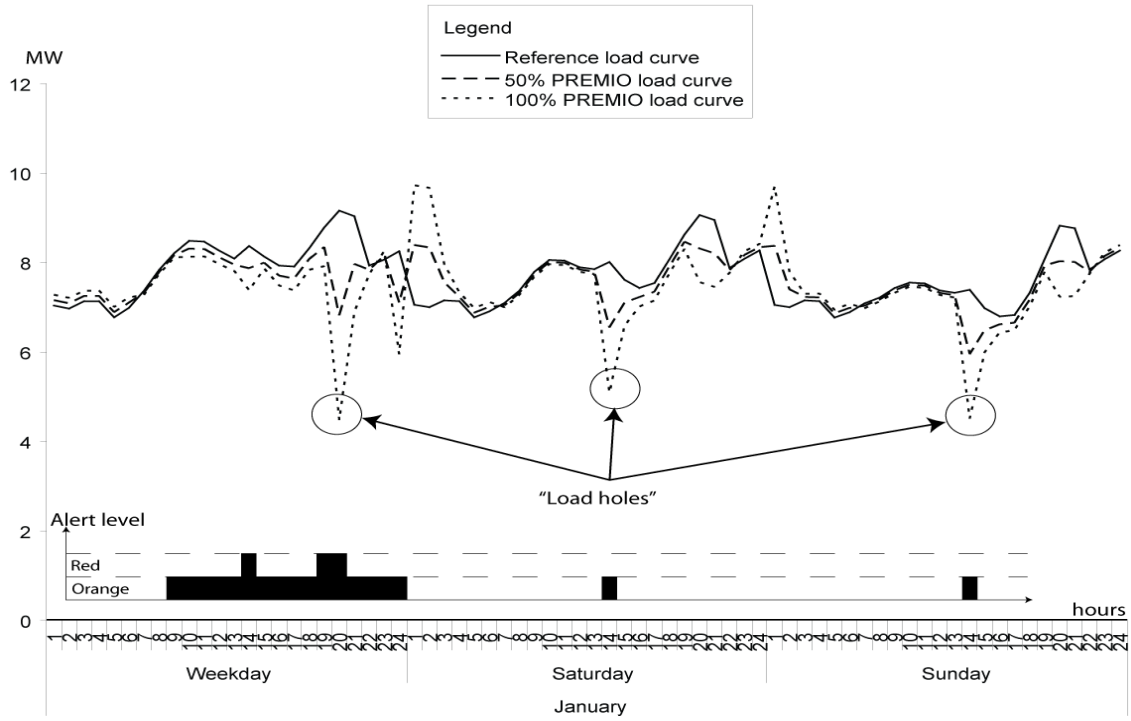


Figure 2: PREMIO Modeling at Reference, 50% & 100% load curve

FirstEnergy / JCP&L

EPRI Project Manager, Gale Horst

Distributed Energy Resources (DER) are being deployed at JCP&L targeting peak load management for system reliability and efficiency in addition to participation in PJM market programs. An integrated control platform uses a two-way communication system for DER visibility and control. Coordination of DER happens in near real-time by including advanced communication and control technology for sensing and dispatch.

The initial phases have been focused on direct load control enabling real-time monitoring and control of non-critical end use equipment, specifically air conditioners, to support management of peak loads during high system load conditions. Additional resources such as line sensors and permanent peak load shifting equipment are also being integrated into the smart grid platform.

Key system functional requirements include visualization and integrating of multiple device signals into a common view. Conditions can be recognized from multiple sources to isolate manageable attributes and manageable logical groupings. A response can be dynamically configured to match system needs complete with response verification to allow evaluation of the impact. As conditions change, the response of the DER can be adjusted and optimized. The system can respond to system wide stress recognizable at the ISO/RTO level and coordinated with market conditions. The system can also target isolated stress and target the load reduction to assist with items such as operational efficiency, voltage management, load shaping, and asset management.

Additional customers are currently being solicited and installed to expand the program in both commercial and residential locations. In preparation for the 2010 summer cooling season, these expanded resources will provide additional capability and capacity for measurement and control. Use cases are being developed to further explore and document the system potential.

PNM Resources

EPRI Project Manager, John Simmins, PhD

Modeling Issues Illustrate the Need for Standards

There is more than one issue into loading the necessary data to build the GridLAB-D model for the Mesa del Sol feeders. GridLAB-D is meant to simulate distribution system at a very fine-grained level. As a result, the amount of information that needs to be translated is large. There are two main parts to the problem, namely the physical infrastructure, and the loads.

For the physical infrastructure, the University of New Mexico (UNM) started with GIS data files provided by PNM, which contain the technical information on various system components (e.g. fuses, switches, transformers, conductors). A further file provided by PNM contains the connectivity. Typically, each element in the distribution grid is defined by two nodes. The connectivity file defines how the nodes that define each element are connected. From each element in the GIS files, UNM read the unique descriptor then searched the connectivity file for the same descriptor, and extract the end nodes. The end nodes and their characteristics (including geographic

location, voltage, phases, etc.) are written into an array, making sure that nodes are not duplicated. Nodes are the basic components of the GridLAB-D model (GLM) file.

Problems that still need to be dealt with are how to fill in holes where the GIS files don't contain enough information (e.g. have default values for some components, but still flag them) or for service lines that are not in the database at all. UNM is working with PNM to define a sequence of operations that works at least in a probabilistic sense.

For the loads, PNM is providing UNM with 12 months of meter information (these are standard dumb meters, read monthly). From that, UNM will need to get some statistics on the average load for each type of user (residential, commercial, light industrial) and reverse-engineer the individual loads from various UNM devices (washers, A/C units, refrigerators etc.). GridLAB-D has the capacity to assign statistical properties to each load curve, so it should be possible to simulate fine-grained load info that reflects the measured agglomerated monthly data. The fine-grain is necessary because when UNM starts implementing "smart" controls, they will have to act on that scale.

Each utility has its own GIS database, they are generally all different and it is very labor intensive to translate into GLM format. In principle, once UNM has the Mesa del Sol feeder translation done, the process should extend easily to the rest of PNM's grid, but if grid simulators are to become widely used, then the translation should be built-in to the GIS application. UNM did not find anything at fault with GridLAB-D itself, in fact the file structure makes a lot of sense, the difficulty lays in translating massive amounts of information from one format to another.

Technology Transfer Activities – Deliverables Update

Unless stated otherwise, EPRI members can download deliverables at www.epri.com.
Note: There are a large amount of deliverables, please consider the deliverables as resources or reference materials to use at the appropriate time as you evaluate and implement smart grid applications and technology.

Task 1 Deliverables – Analytics

- Product ID 1018945: Smart Grid Distributed Energy Resources (DER) Project Assessment
- Product ID 1020313: Distributed Resource Integration Framework
- Product ID 1020314: Assessment of Wholesale Market Opportunities for Participation and Aggregation of Distributed Resources
- Product ID 1020385: Methods to Firm Distributed Energy Resources, EPRI Smart Grid Demonstration Project Task 1.3
- Product ID 1020342*: Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Project

Task 2 Deliverables – Critical Integration Technologies & Standards

- Product ID 1020213: BTES/TVA Smart Water Heater Technology & Lessons Learned
- Product ID 1020435: Development of a Standard Language for Photovoltaic and Storage Integration
- Product ID 1020343*: Utility Reference Guide to NIST Smart Grid Roadmap
- Product ID 1020432*: Concepts to Enable Advancement of Distributed Energy Resources – White Paper
- Product ID 1020674*: TVA/BTES Smart Water Heater Pilot – Summary of Data Analysis and Results

Task 3 Deliverables – Smart Grid Demonstration Host-Sites

- Product ID 1020225: Smart Grid Demonstration Overview
- Product ID 1020226: American Electric Power (AEP) Smart Grid Demonstration Host-Site Overview
- Product ID 1020188: American Electric Power (AEP) Smart Grid Demonstration Host-Site Project Description
- Product ID 1020354*: American Electric Power (AEP) Smart Grid Host Site Progress Report
- Product ID 1020227: Con Edison Smart Grid Demonstration Host-Site Overview
- Product ID 1020190: Con Edison Smart Grid Demonstration Host-Site Project Description
- Product ID 1020355*: Con Edison Smart Grid Host Site Progress Report
- Product ID 1020228: Electricité de France (EDF) Smart Grid Demonstration Host-Site Overview
- Product ID 1020191: Electricité de France (EDF) Smart Grid Demonstration Host-Site Project Description
- Product ID 1020597*: ESB Networks Smart Grid Demonstration Host-Site Project Description
- Product ID 1020229: FirstEnergy Smart Grid Demonstration Host-Site Overview
- Product ID 1020189: FirstEnergy Smart Grid Demonstration Host-Site Project Description
- Product ID 1020352*: FirstEnergy Smart Grid Host Site Progress Report
- Product ID 1020230: PNM Smart Grid Demonstration Host-Site Overview
- Product ID 1020187: PNM Smart Grid Demonstration Host-Site Project Description
- Product ID 1020353*: PNM Resources Smart Grid Host Site Progress Report

Task 4 Deliverables – Technology Transfer

- Product ID 1018926: EPRI Pre-Workshop Proceedings: Active Distribution System Management for Integration of Distributed
- Product ID 1019584: Summary of potential use cases for Distributed Solar (PV) Integration
- Product ID 1020384: Integration of Requirements and Use Cases into an Industry Model
- Product ID 1020214: Strategic Intelligence Update - Smart Grid Conferences and Events
- Product ID 1020566*: Strategic Intelligence Update - Smart Grid Conferences and Events
- Product ID 1020303*: International Smart Grid Projects Update: EPRI Smart Grid Demonstration Task 4.2
- Several new use cases available in the Use Case Repository: http://www.smartgrid.epri.com/Repository/Repository.aspx
- Characterization of DOE RDSI Projects: http://www.smartgrid.epri.com/smartgrid_projects.html
- EPRI Smart Grid Resource Center provides public project updates, news, events and related smart Grid content

* Indicates new deliverable since last newsletter

EPRI "Resident Researcher" Employee Program - Smart Grid Engineer or Analyst

EPRI has an opening for a Smart Grid Engineer or Analyst in our Knoxville TN office.

The "Resident Researcher" program is open to utility members supporting the Power Delivery and Utilization (PDU) Sector. The five-year Smart Grid Demonstration Project has created a unique opportunity to expose your new or seasoned engineers or analysts to hands-on smart grid projects focused on integration of Distributed Energy Resources. Location of the position is in Knoxville, TN and duration can be from 1 to 3 years. This opportunity will provide broad experiences in real-word smart grid industry activities and help strengthen and prepare your workforce for the future. Please email or call Matt Wakefield (865-218-8087) for more information.

KEY EPRI SMART GRID DATES

EPRI Smart Grid Demonstration Meeting - June 2010

When/Where: June 10 & 11, 2010, Hosted by Electricité de France, Clamart, France. This meeting is scheduled the same week as the CIRED 2010 conference in Lyon, France on June 7 & 8 and will be at the same venue with joint participation **A**ctive **D**istribution networks with full integration of **D**emand and distributed energy **RES**ource**S** (**ADDRESS**) meeting June 9th & 10th.

EPRI Power Quality and Smart Distribution 2010 Conference and Exhibition

When/Where: June 14 - 17, 2010, Quebec, City, Canada. Register here.

Come join us this summer in the heart of historic Old Quebec - one of Europe's oldest American settlements - as we explore new paths in the drive toward the emerging Smart Grid. EPRI and Hydro-Québec invite you to the 2010 EPRI Power Quality (PQ) and Smart Distribution 2010 Conference and Exhibition as we explore the future challenges of power quality, smart distribution, and electric transportation. The rapid growth of power quality data coupled with smart distribution systems gives us the opportunity to explore new possibilities to manage and improve the grid efficiency. We encourage you to attend and discover all the possibilities for your own application.

This conference will provide an unparalleled forum for electric power end users, distribution engineers, reliability and power quality professionals, and related technology manufacturers to gather, share experiences, and learn from one another in a highly efficient and focused environment. The week of events will also include pre-conference tutorials/workshops in power quality, smart distribution, and electric transportation as well as post-conference EPRI working meetings for the EPRI Power Quality (Program 1) and Smart Distribution (Programs 30, 124 and 128) research areas.

EPRI Smart Grid Demonstration Meeting - Fall 2010

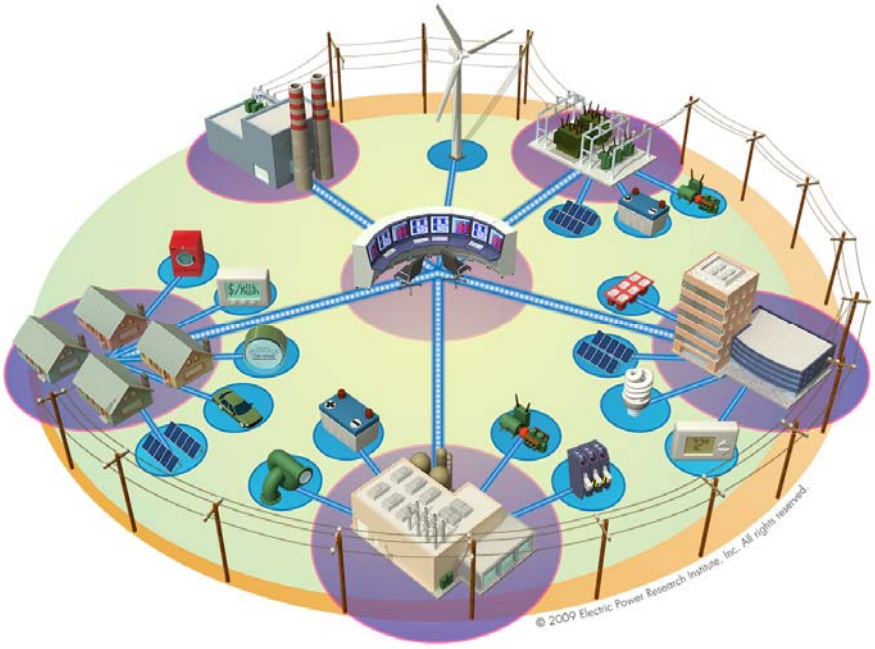
When/Where: Hosted by Con Edison, New York City, Date TBD.

This will be our first meeting where we have all host-sites identified. The focus of this meeting will be to clarify key research areas for cross collaboration among all host-sites as well as complimentary activities at non host-site utilities.

4th International Conference on Integration of Renewable and Distributed Energy Resources

When/Where: December 6th – 10th, Albuquerque, NM (http://www.4thintegrationconference.com/)

A portion of the meeting will provide an update on EPRI Smart Grid Demonstration projects. Registrations are now open.



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