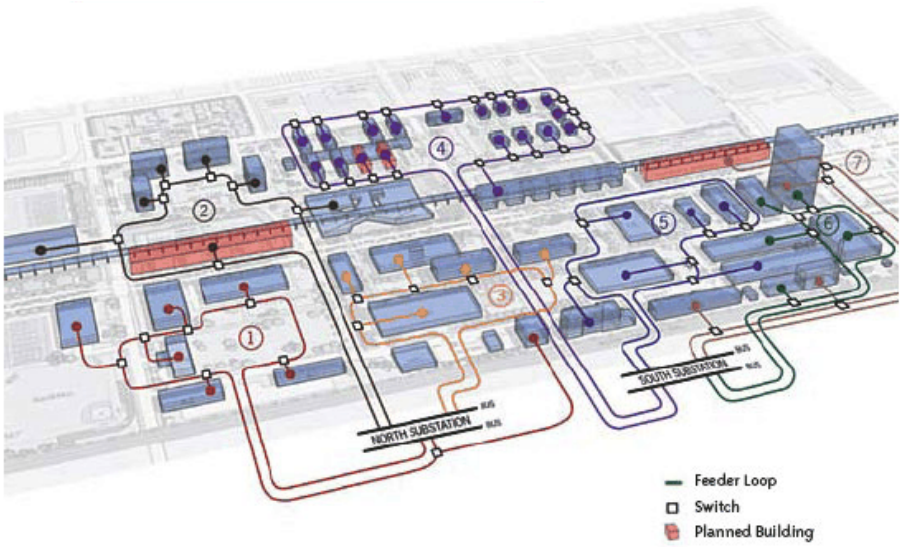
Illinois Institute of Technology RDSI Demonstration Project
"Perfect Power Prototype"



Illinois Institute of Technology Project Overview

Illinois Institute of Technology (IIT) in collaboration with Exelon/Commonwealth Edison Company (ComEd), the Galvin Electricity Initiative (GEI), and other key partners plans to develop, demonstrate, promote, and commercialize a system and supporting technologies that can achieve "Perfect Power" at the main campus of IIT. A "Perfect Power" system, as defined by GEI, is a system that cannot fail to meet the electric needs of the individual end-user. Different types of end-users will have different needs, and a Perfect Power system will have the flexibility to supply the power required by each type without fail.

The overall objectives of the project include: (1) achievement of system-wide Perfect Power and demonstration of its technological viability (through the implementation of distributed energy (DE) and advanced sensing, switching, feeder configuration and controls, IIT's electric power conditions will always meet or exceed each end-user's requirements); (2) a 50% peak demand reduction capability when called upon by Exelon/The PJM Interconnection; (3) a 20% permanent peak demand reduction from the 2007 annual peak demand; (4) deferral of ComEd planned substation upgrades due to the demand reduction achieved; (5) demonstration of the economic value of Perfect Power, specifically the avoidance of outage costs and the introduction of significant savings and revenue from providing ancillary services; (6) a design that can be replicated to any microgrid; and (7) promotion of the Perfect Power prototype.

DOE Renewable and Distributed Systems Integration (RDSI) Demonstration Projects

In 2008, DOE selected nine microgrid projects for federal funding, totaling $55 million over five years. The objective of these Renewable and Distributed Systems Integration (RDSI) Demonstration Projects is to increase the use of renewable and distributed

generation and decrease peak loads on a distribution feeder by 15%. The systems can operate in both grid parallel and islanded modes. The projects are aligned with RDSI goals of increasing reliability, reducing emissions, using fuel more efficiently, resolving cyber system vulnerabilities and allowing consumers to manage their energy costs. Five of the projects are in the western half of the continental U.S., three are in the eastern half, and one is in Hawaii.

Project Criteria 6 Critical Elements

IIT's Smart Grid project aligns with the six critical elements that EPRI has identified as key criteria to achieve the goals of its five-year Smart Grid Initiative.

Integration of multiple distributed resource types

To further expose issues that need to be addressed and enable widespread integration of DER.

IIT has already installed over 2 MW of standby engine generators and 8 MW of gas turbine backup. IIT is also upgrading its steam heating system to incorporate natural gas-fired boilers, as well as installing advanced lighting, windows, and other energy-reducing technologies. Using this combination of technologies, the deployed Perfect Power system will be able to provide 10 MW of demand reduction within 30 minutes of notification by ComEd or the ISO (PJM). This includes 5 MW of firm demand reduction due to redundant demand response and distributed generation capability. This will allow ComEd to defer $2 million in substation upgrades. The proposed project provides a unique opportunity to demonstrate the economic benefits of demand response by leveraging the ability to control IIT load demand in the PJM ISO's day-ahead and real-time markets.

Application of critical integration technologies and standards

To identify gaps associated with standards, harden critical integration technologies, and advance adoption.

This project attempts to integrate a large number of distribution system side and end use technologies and capabilities. For example, IIT will leverage Zigbee two-way communications to monitor, collect, and analyze data on energy usage by certain devices at IIT. At the same time, Exelon or PJM can send a signal to IPPSC which will transmit signals to the building controllers that use ZigBee devices to control devices at IIT. Accepted standards will be used in all aspects of the project. More generally, the project will advance adoption of various smart grid integration technologies in a variety of ways described below.

Incorporation of dynamic rates or other approaches to link wholesale conditions to customers

To evaluate integration issues and incentives associated with customer response and linking supply with demand.

Because IIT is a single large customer of Exelon/ComEd, how IIT interacts with the PJM Interconnection is of prime concern in this project. IIT will essentially be entering PJM's real-time markets and mitigating the risk of participating in these markets via extensive on-site generation and building demand response capabilities. IIT natural gas-fired generation with rapid start-up capability will enable IIT to provide spinning reserve

services to ComEd and PJM. IIT calculates that if it had participated in these markets in 2008, they would have reduced their electricity costs by about $800,000. IIT will also be able to enter into power purchase contracts; one such contract alone may reduce IIT's electricity bill by as much as 25%.

Integration into system planning and operations

Demonstrate integration tools and techniques to achieve full integration into system planning and operations.

The IIT prototype will be the first of a kind integrated microgrid system that provides for full islanding of the entire campus load based on PJM/ComEd market signals. Specific innovative technology applications include:

- **High Reliability Distribution System** – High-speed, intelligent, automated switches will be installed to detect and isolate a fault without loss of power to the building.
- **Intelligent Perfect Power System Controller** (IPPSC) – IIT will design and provide a low cost means for coordinating a diverse set of demand response and pricing signals to optimize the facility response.
- **Advanced Distribution Recovery Systems –** IIT will leverage dNetSim, a software-based distribution network simulator, with an agent-based control system for fault detection, location and isolation; feeder reconfiguration; volt/VAR management; service restoration; emergency response; and integration of distributed resources.
- **Buried Cable Fault Detection and Mitigation** – IIT will develop a fast Fault Detection and Mitigation system

In the system planning area, the project will defer the need for construction of a third substation to serve the campus. A variety of power system enhancements to improve reliability and sustainability will impact system planning.

Compatibility with initiative goals and approach

Enable high-penetration of DER and advance interoperability and integration for the electric power industry.

This Perfect Power Prototype design, which exceeds the DOE solicitation requirements, is replicable to campuses, complexes, developments, investor owned, and municipal electric systems. The IIT Perfect Power prototype provides the capability to reduce IIT's 10 MW campus load by using DR and DG. The prototype can be replicated later throughout the PJM territory and in markets with high electricity prices such as the Northeast and California. The commercialization of Perfect Power systems, once the IIT's prototype is completed, could provide campuses, cities, major developers, and utilities with a model for leveraging emerging wholesale and ancillary markets. The key partners of the proposed project are committed to commercializing the proposed technology through various strategies.

Leverage of additional funding sources

Secure required participation, commitment, and funding for a successful project.

This project leverages $7 million in DOE funds and $5 million in industry funds over five years. All team members are providing a cost share in one form or another, including the Illinois Institute of Technology, the Galvin Electricity Initiative, S&C Electric, Intelligent Power Solutions, and Exelon/Commonwealth Edison Company. Based on this $12 million cost, estimated one-time savings of $5 million, and estimated annual savings of $1.3 million, the project team estimates a simple payback period of five years.

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