

Transmission Efficiency Initiative: Host Demonstration Project

Improving Energy Efficiency of Existing Substation Auxiliary Systems



Substation control

Project Objective

We Energies is a leader in environmental stewardship and in the design of substations that are considerate of the environment. This initiative will use existing commercial Green Building standards in the design of electrical substations. The advantages of adopting these standards include the following:

- Further demonstration of environmental stewardship
- Easier project acceptance by the public
- A better work environment for our employees
- Potential reduction in operating costs
- Marginal costs after the first demonstration

Background

Sustainability involves the development and application of integrated, whole-building design solutions that create energy-efficient buildings, deplete fewer natural resources, generate less waste, and provide healthy indoor environments for a building's occupants. The industry standard for measuring sustainability is provided by the Leadership in Energy and Environmental Design (LEED) rating system developed by the U.S. Green Building Council (USGBC).

- Define substation construction standards compatible with LEED rating system.
- Refurbish or remodel existing substations to enable LEED certification.
- Quantify savings based on EPRI M&V protocol.
- Benefits include reduced system energy losses and reduced carbon footprint.

The LEED rating system is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. Ratings are based on the following five major criteria:

- Sustainable sites
- Water efficiency
- Energy and atmosphere
- Materials and resources
- Indoor environmental quality

Sustainable Sites

This criterion encourages the use of Brownfield site redevelopments, as many of our new or rebuilt substations (such as the current Harbor and Burleigh substation projects) do. It does not permit development on the following land types:

- Provincial agricultural or forest land reserve
- Less than 5 ft (1.5 m) above 100-year or 3 ft (0.9 m) above 200-year flood plain
- Ecologically sensitive land
- Endangered species habitat
- Within 100 ft (30.5 m) of wetland
- Public parkland, without trade of same or better

Storm water runoff is a major item of concern for this criterion, and our testing has shown that our gravel substations are

excellent bio-filters for storm water. An oil containment system using polymers that allow water migration but block the oil is preferred over a standard concrete containment system. In addition, we are experimenting with pervious concrete pavement for substation driveways. These technologies create more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices. In doing so, they can lower overall project costs on a first-cost basis. Additional points are provided for the following features:

- Minimizing the site's heat island effect by using light-colored materials (such as white gravel).
- Minimizing light pollution by lighting areas only as required for safety and comfort

Water Efficiency

In general, our substations do not use water. However, points are available for the selection of water efficient (drought-tolerant or native plant) landscaping.

Energy and Atmosphere

Credits are available for optimizing the energy efficiency for new or existing buildings. New substations are designed to reduce energy consumption by 25% below the Model National Energy Code for Buildings (MNECB) reference case and reduce the design energy cost by 18% relative to American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard 90.1 reference case. Electric meters that monitor auxiliary power usage enable comparison of energy consumption on new versus existing substation designs. Insulation and HVAC economizers can substantially increase building energy efficiency. Additional points are available for enhanced refrigerant management and green power.

Materials and Resources

Our substations are designed to recycle as much as soil as possible on the site. In addition, we use fly ash in the design of our concrete structures and foundations. Additional points are provided for the use of certified (Forest Stewardship Council Principles and Criteria) wood in the concrete forms during construction and the use of local materials.

Indoor Environmental Quality

An HVAC economizer provides outdoor air delivery to meet air change effectiveness greater than 0.9 according to ASHRAE standard 129-1997. An occupancy sensor and

control system could supplement the HVAC system and control the lighting system. Additional points are provided for the following:

- Prohibiting smoking in the building
- Using low-emitting materials (adhesives, sealants, paints, and so on) in the building's construction
- Monitoring CO₂
- Using natural lighting

Other Environmental Non-LEED Considerations

Some items to consider in creating or applying a new LEED-type standard specific to electrical substations might include the following:

- Using non-ozone-depleting materials (such as SF₆ gas) in the electrical equipment or using systems that can detect and alarm leaks of 1% per year
- Using vegetable-based rather than mineral insulating oils in electrical equipment or using systems that can monitor and correct leaks
- Incorporating plug-in hybrid vehicles such as substation maintenance trucks

Project Scope

Phase 1 entails a study to determine the necessary changes and improvements to current substation standards to meet LEED requirements and the development of guidelines and standards for construction and refurbishment. Phase 2 will apply these standards to refurbish one or more existing substations. Candidate substations will be identified based on a substation audit that will be conducted as part of this project, as well as analysis of historical operation and maintenance data.

Approach for Measurement and Verification

A consistent measurement and verification (M&V) methodology, which will be developed as part of EPRI's transmission efficiency research portfolio, will be applied to quantify and assess energy and CO₂ emission savings. For this purpose, We Energies will measure and record energy consumption and other relevant variables of candidate substations for a predefined period before and after the efficiency upgrades have been performed. A final project report will describe the study results, lessons learned, and implementation considerations.

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