

# Transmission Efficiency Initiative: Host Demonstration Project

## Substation Siting with Transmission System Efficiency Consideration



*Substation location to improve efficiency*

### Project Scope

As part of EPRI's Transmission Efficiency Initiative, FirstEnergy is evaluating a possible demonstration project to assess the benefits of locating substations near load centers to transmission efficiency and utilization.

### Technology Description

In general terms, the location of a substation is initially determined by transmission requirements and line routing. A substation in the transmission system might be required either to supply the extra high voltage transmission lines from power stations or to serve as a grid supply point to reduce the voltage to lower levels for the local distribution companies. In the second case, the nearer a substation is to the load center, the lower the distance that the electric energy flows through the lower voltage paths to reach the load and, consequently, the lower the overall transmission and distribution system losses will be.

Siting substations is an important problem that utilities face when defining expansion plans to meet future electrical loads. The planning objective is to minimize the cost of new

- Evaluate the impact of locating substations near the load center on the efficiency of transmission systems.
- Monitor before and after energy losses and CO<sub>2</sub> emissions and document results.
- Benefits include reduced losses and reduced carbon footprint.

substations and the electrical losses when operating the system. However, suitable locations for substations are subjected to a number of constraints and considerations apart from the power system operation viewpoint. Human and environmental impacts are usually major obstacles. Indeed, siting approvals for substation projects are often hindered by public concerns about perceived impacts of substations. Issues such as noise, property values, electric and magnetic fields, visual impacts, and other environmental concerns are often cited by the public in opposing substation projects.

FirstEnergy has already implemented an integrated substation siting approach that includes assessment of transmission system efficiency. It involves the Cranberry substation, a new 500/138-kV substation with two 3-winding transformers, each of which has 330/448/560 MVA of capacity. The geographic location of the substation will reduce the MW-miles of power flow on the lower voltage level paths. Initial evaluations indicate that demand losses at peak conditions are reduced by approximately 3.4 MW as a result of this location.

### **Expected Benefits**

One or more of the following benefits might be realized through the application of this concept:

- Reduced transmission system losses
- Shorter sub-transmission and distribution grids
- Better voltage control

### **Approach for Measurement and Verification**

A key objective of EPRI's Transmission Efficiency Initiative is to verify and validate the "actual" benefits realized by the application of the technology using a consistent measurement and verification (M&V) methodology that will be developed as part of EPRI's transmission efficiency research portfolio.

The detailed methodology of M&V will be developed during the course of the project using the following general approach: Demand, energy, and loss reduction will be determined based on load flow analysis and system operation simulations, considering the siting of the Cranberry substation.

### **Project Schedule**

The schedule of the project tasks is as follows:

1. FirstEnergy will provide information on the original system load flow and configuration and with the new Cranberry substation. Results of previous studies conducted by the company will be used as reference.
2. FirstEnergy will provide the system technical and operational data and information needed to conduct the analysis.
3. EPRI will perform the analysis in close coordination with FirstEnergy staff.
4. Final project report, December 2011.