EPRI DATA ANALYTICS CASE

Meter Connectivity (Phase ID)

The Data Challenge

The mismatch of utility assets to their connected electrical phase creates inaccuracies within the geospatial information system (GIS) that persist until a costly field check is completed to rectify the issue or a check is conducted coincident with some other premises visit or other regionally related work can be leveraged. The effects of an inaccuracy is compounded when GIS phasing data is used by other utility systems to reliably and efficiency operate the distribution grid.

Solution Overview

Robust algorithms and applications will be developed to predict the asset-to-phase association and to automatically update the GIS with limited or no user input.

Potential Methods for Solving the Problem

The voltage-correlation approach is relatively straightforward[1]. The voltage pattern at each meter should correspond to one of the three voltage patterns for the phases at the head of the circuit or at some point on the circuit. Single-phase loads and system events cause subtle differences in the voltage patterns of the three phases, even when the voltage is regulated by a common voltage-regulation device. Additionally, some utilities have voltage-regulation devices, such as single-phase regulators and capacitor banks, which are operated independently between the three phases. Circuits with single-phase voltage-control devices provide more diversity in the voltage measurement. As a result, predicting the phase of the meter is easier. Simple analytical software packages can be used to solve the challenges of phase connection.

The main challenges for phase prediction based on usage data is the computational complexity of the algorithms and the applicability of the methods given typical data-quality issues for feeder and AMI meter data. Some phase-prediction algorithms can use comparatively limited customer-level usage measurements, such as billed kWh in conjunction with load research sample data, but also require information on feeder topology[2]. Other solutions of the phase-identification problem require only interval usage data from AMI meters and corresponding feeder-level load data but employ computationally complex solution methods that are implemented in costly specialized software[3]. However, this solution also describes a formulation of the phase-identification problem that can be solved using regression methods, which are relatively easy to implement in a variety of analytical software packages.

The EPRI approach using kWh refines, and in part simplifies, the regression-based methods such that the phase predictions can be implemented using linear regression. The refinement was to allow the shapes

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[1] T. A. Short, “Advanced Metering for Phase Identification, Transformer Identification, and Secondary Modeling,” *IEEE Transactions on Smart Grid,* pp 651-658, vol. 4, 2013.

[2] Murat Dilek. *Integrated Design of Electrical Distribution Systems: Phase Balancing and Phase Prediction Case Studies.* Unpublished doctoral dissertation, Virginia Polytechnic Institute, Blacksburg, VA 2001.

[3] V. Arya et al., “Phase Identification in Smart Grids,” IEEE Technical Paper (2011).

of unobserved loads and losses to vary systematically by time of day, with separate shapes for weekdays and weekends, as well as incorporate day-of-week shifters for the unobserved loads and losses.

Available Data Sets

The data sets highlighted in the following figure are available in the EPRI Data Repository to solve this data analytics case.