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IEEE Trial-Use Guide for Smart Distribution Applications

IEEE Power and Energy Society

Developed by the
Transmission and Distribution Committee

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Abstract: Important smart distribution applications are categorized, descriptions of the critical functions involved are developed, important components of these systems are defined, and examples of the systems that can be considered as part of distribution management systems or other smart distribution systems are provided in this guide.

Keywords: capacity, distribution, efficiency, grid, hosting, IEEE 1854™, market, power, power quality, reliability, smart

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Introduction

This introduction is not part of IEEE Std 1854-2019, IEEE Trial-Use Guide for Smart Distribution Applications.

Many applications are being considered as part of smart distribution system development and distribution management systems. These applications can include advanced automation and supervisory control and data acquisition systems for reliability improvement, outage management systems, fault location and fault management, voltage and var management systems, distributed resource and renewable generation integration, demand response systems, advanced protection systems, equipment diagnostics and asset management, real time simulation for system optimization, microgrids, and many others. Terminology and descriptions of these systems are not standardized, which makes it difficult to develop specifications for these functions as part of planning and developing smart distribution systems. This guide categorizes important smart distribution applications, develops descriptions of the critical functions involved, defines important components of these systems, and provides examples of the systems. The guide is a reference for distribution planners and designers and will be a living document that can expand and grow as technology and the applications change over time.

Acknowledgments

Figure 14 is from Goel, Wu, and Wang, 2008 [B47]. Reprinted with permission from DTU Electrical Engineering.

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1. Overview

1.1 Background

Modern distribution systems are not always passive systems. Maintaining integrity and operating the system requires reliable access to timely information and the ability to remotely control distribution grid elements through automated devices and their sensors.

Although the distribution system is the main connector and direct link between the transmission system and customer, for some utilities the integration of distribution automation (DA) and associated technologies is lagging those of generation and transmission systems. This could be partially attributed to the large number of components and significant investment needed to automate the system. However, with the increasing customer dependence on reliable power and expectations of quality of service, bi-directional power flow, social and regulatory drivers, and developments in communication technologies opportunities are emerging, and many utilities are moving toward the modernization of distribution systems using DA.

While new devices may have modern features, such as communications, remote control, and automation capabilities, much of the present infrastructure is composed of older, yet still very functional, devices that are not capable of supporting DA objectives. As utilities move toward smart distribution technologies, it is advantageous to install standalone line sensors in proximity to these older generation devices. While not affording any control ability, this could provide relevant status information such as current, conductor temperature, voltage (e.g., switch opened or closed), etc. Placing additional sensors throughout the system at key locations brings additional visibility to the operators (IEEE Std 1547.3™ [B60]). A smart distribution application incorporates:

— Measurement of distribution component states or values

— Communication to and from a processor

— Analysis and decision making by the processor

— Supervision to execute the decisions made by the processor

These items are discussed for smart distribution applications in general, and some sample applications (e.g., VVO) are described in some detail within this guide.

1.2 Scope

This guide categorizes important smart distribution applications, develops descriptions of the critical functions involved, defines important components of these systems, and provides examples of the systems; however, it does not describe in detail what technologies and communications support what smart distribution applications, which can be found in widely available published literature (as shown in the bibliography).

2. Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[1]

advanced distribution automation: The integration of analytical decision making and supervision to execute decisions with distribution automation (DA) devices to improve the operation of the electric distribution system.

advanced metering infrastructure (AMI): The AMI-SEC taskforce defines AMI as the communications hardware and software and associated system and data management software that creates a network between advanced meters and utility business systems and which allow collection and distribution of information to customers and other parties such as competitive retail providers, in addition to providing it to the utility itself.

combined heat and power (CHP): CHP or cogeneration includes technologies using a variety of fuels to produce electricity or power and heat.

conservation voltage reduction (CVR): The practice of using voltage reduction, within predefined parameters, whenever possible to promote energy conservation and during specific time periods to reduce demand load.

data warehouse: A data warehouse provides data storage functions for future reference and can also provide a source of information to maintenance, work management, other programs and systems, and advanced system analysis.

demand response (DR): A change in the power consumption of a customer to better match the demand for power with the supply.

distribution automation (DA): A technique used to limit the outage duration and/or customers interrupted and restore service to customers through fault location identification and automatic switching.

distributed energy resource (DER): Source of electric power that is not directly connected to a bulk power transmission system. DERs include both generators and energy storage technologies.

distributed generation (DG): Electric generation facilities connected to an area electric power system (EPS) through a point of common coupling (PCC); a subset of distributed energy resources (DERs).

distribution management system (DMS): A collection of applications designed to monitor and control the distribution network efficiently and reliably.

fault location, isolation, and service restoration (FLISR): Application often used by utilities to improve reliability across their distribution systems as it manages outages and recovers from them quickly.

[1] *IEEE Standards Dictionary Online* is available at: http://dictionary.ieee.org.