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IEEE Guide for Wayside Energy Storage Systems for DC Traction Applications

IEEE Vehicular Technology Society

Sponsored by the
Rail Transportation Standards Committee

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Abstract: Traction power systems experience some of the most extreme variations in local power loads as compared to most other large scale electric power supply networks. These variations create challenges in the construction of reliable electric power delivery systems and in the performance of the rolling stock dependent on power supplied by the system. A solution is offered by energy storage by smoothing out these power variations, absorbing energy as system voltage rises, and delivering energy as voltage drops. Engineers are helped by this guide to identify where these solutions can provide the greatest benefits, design solutions with the greatest impact, and quantify the costs and benefits of deploying new solutions.

Keywords: dc traction, energy recovery, energy storage, fixed guideway transportation, IEEE 1887, railway, traction power, wayside energy storage, wayside energy storage system

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Introduction

This introduction is not part of IEEE Std 1887™-2017, IEEE Guide for Wayside Energy Storage Systems for DC Traction Applications.

This introduction provides background on the rationale used to develop this guide, which may aid in the understanding of the application of wayside energy storage. The need for economic consideration and performance metrics to assist in the development of energy storage systems is discussed. The importance of safety and environmental concerns and the integration of energy storage into existing operating rail systems and their introduction as part of a new rail system are discussed. Means of simulating operation and integration for the objective of optimization are also discussed. The following topics are covered: normative references, definitions, applications, common technologies, common topologies, specifying a wayside energy storage system, economic considerations, modeling and simulation of energy storage, performance, safety and environment, installation and integration, and verification and validation.

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IEEE Guide for Wayside Energy Storage Systems for DC Traction Applications

1. Overview

1.1 Scope

This guide is intended to be a performance-based guide to assist engineers involved in the design, specification, and technical evaluation of traction wayside energy storage systems.

1.2 Purpose

Traction power systems experience some of the most extreme variations in local power loads as compared to most other large scale electric power supply networks. These variations create challenges in the construction of reliable electric power delivery systems and in the performance of the rolling stock dependent on power supplied by the system. Energy storage offers a solution by smoothing out these power variations, absorbing energy as system voltage rises, and delivering energy as voltage drops. This guide will aid engineers in identifying where these solutions can provide the greatest benefits, designing solutions with the greatest impact, and quantifying the costs and benefits of deploying new solutions.

With the rapid evolution of advanced power electronics, control methods and storage technologies available, combined with the wide range of applications, it is not possible, nor desirable, to include specific design requirements which might limit or preclude new ideas and concepts from being developed.

From a systems perspective, the goal of this guide is to provide an overview of the following:

— Common terminology used to describe performance
— Common applications and technologies
— Common equipment topologies
— Specification of energy storage systems
— Economic considerations and cost-benefit analysis
— Modeling and simulation
— Performance and functional considerations
— Interoperability considerations
— Tools and methods to verify safety