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English Version

Fixed Installations for Railway Applications - Requirements for the validation of simulation tools used for the design of electric traction power supply systems - Part 2: specific DC urban case

Installations Fixes pour Applications ferroviaires - Exigences relatives à la validation des outils de simulation utilisés pour la conception des systèmes d'alimentation de la traction - Partie 2 : Cas spécifique des réseaux urbains en courant continu

Ortsfeste Anlagen für Bahnanwendungen - Anforderungen für die Validierung von Simulationsprogrammen für die Auslegung von Bahnenergieversorgungssystemen - Teil 2: Spezifisches Gleichstrom-Stadtbahnsystemen

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European foreword

This document (CLC/TS 50641-2:2024) has been prepared by CLC/SC 9XC “Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations)”, of Technical Committee CLC/TC 9X “Electrical and electronic applications for railways”.

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Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

Introduction

This document has been prepared following the publication of EN 50641, which will be renamed as EN 50641-1 in the future.

This document is Part 2 of the EN 50641 series and dedicated to urban rail transport with DC 750 V power supply, as well as other electric DC traction power supply systems. It has the same structure as EN 50641 but with input representative of urban rail transports with dense traffic and short feeding sections, small headways and frequent stops correlated with regenerative energy flows.

Experts representing approximately ten member states worked to draft this completely new document. The results and data are taken from the most well-known representative simulation softwares in Europe and related experts. This document provides a means of assessing simulation tools and provides assurance to anyone who depends upon their output.

1 Scope

This document specifies requirements for the test and acceptance of simulation tools used for the design of DC electric traction power supply systems for urban rail guided mass transport systems, such as tramways, elevated and underground railways, mountain railways, trolleybus systems, and magnetically levitated systems which use a contact line system. The validation process will be carried out for the 750 V DC voltage, and other voltages can be validated with the cross-acceptance.

This document focuses on the validation of the core simulation functions comprising the equations and functions which calculate:

— the mechanical movement of trains and

— the load flow of the electrical traction power supply system.

NOTE 1 This document provides only the requirements for demonstration of the algorithms and calculations of core functions. The use of a validated simulation tool in accordance with this document does not in itself, demonstrate good practice in electric traction power supply system design, neither does it guarantee that the simulation models and data for infrastructure or trains used in the tool are correct for a given application. The choice and application of any models and data, of individual system components, in a design is therefore subject to additional verification processes and not in the scope of this document. Competent development of design models and full understanding of the limits of design tools remain requirements in any system design. This document does not reduce any element of the need for competent designers to lead the design process.

This document also specifies procedures for the modification of simulation tools, in particular the limits of applicability of acceptance when tools are modified. These procedures focus on determining whether the core functions of the simulation model are modified.

Because the purpose of this standard deals with the verification of the core functionality, the test case described in this document does not represent an existing network.

NOTE 2 Additionally, the application of this document ensures that the output data of different simulation tools are consistent and verifiable when they are using the same set of input data as given in this document.

This document excludes complex models with active components such as controlled rectifiers and inverters.

This document does not mandate the use of a particular simulation tool in order to validate the design of an electric traction power supply system.

This document does not deal with validation of simulation tools by measurement.

The document is not applicable to the validation of simulation tools with respect to:

— short circuit studies;

— electrical safety studies (e.g. rail potential);

— harmonic studies;

— studies of transient phenomena; and

— electromagnetic compatibility studies over a wide frequency spectrum.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50163:2004, *Railway applications - Supply voltages of traction systems*

EN 50388-1:2022, *Railway Applications - Fixed installations and rolling stock - Technical criteria for the coordination between electric traction power supply systems and rolling stock to achieve interoperability - Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50163:2004, EN 50388-1:2022 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
electric traction system
electric traction power supply system
railway electric distribution network used to provide energy for rolling stock

[SOURCE: IEC 60050-811:2017, 811-36-21, modified – “electric traction power supply system” has been added as synonym and the Note 1 to entry has been removed.]

3.2
simulation accuracy
indicator dedicated to the characterization of the accuracy of the simulation output regarding a reference (measure or theoretical model) for a given case

3.3
simulation method
construction and solution of a numerical time-step or space-step model of train movement and electric traction power supply performance

3.4
simulation tool
software implementing one or more simulation methods

3.5
software quality management
management system for software to be updated

Note 1 to entry: The processes are the following:

— software development process comprising the steps of development request, software test, release,

— life cycle process with the steps release plan, versioning with code protection and changelog, bug tracking,

— documentation (user manual, help system, developer's guide if any).

3.6
track layout model
model describing the physical characteristics of the track such as curves, tunnels and gradient description

3.7
train set
combination of vehicles coupled together

Note 1 to entry: Vehicle includes banking locomotives.