

Railway Technology Today 3 (Edited by Kanji Wako)

Railway Electric Power Feeding Systems

Yasu Oura, Yoshifumi Mochinaga, and Hiroki Nagasawa

Introduction

Electric power technology in the railway industry refers to the means of supplying good-quality electric power to the electric motors. It primarily consists of power conversion technology at sub-stations, feeding circuits for DC and AC feeding systems, and the structure, materials, measurement, and maintenance of the electric overhead lines.

Power collection via the overhead line and pantograph, introduced nearly 100 years ago early in the history of electric railways, remains basically unchanged in physical appearance. However, technological developments during the past century have done much to greatly increase the current capacity, speed, and safety. Today, the capacity is more than sufficient to drive modern super high-speed trains. This article discusses all aspects of electric power supply systems for railways, ranging from the history of electrification of Japanese railways to today's sophisticated power supply facilities. It also compares them with their counterparts in other countries.

World Railway Electrification Systems

Table 1 shows various feeding systems around the world and the electrification distances.

The history of electric railways dates back to 1835 when T. Davyport fabricated a model electric car powered by voltaic cells and put it on public exhibition. The first practical electric cars debuted in 1879 when a 150-V dc, 2.2-kW, bipolar motor pulled three passenger cars at a maximum speed of 12 km/h at the Trades Exhibition in Berlin. In 1881, Siemens-Halske built the world's first electric railway in Lichtenfelde marking the first passenger electric railway.

Electric operation is often preferred on

railways with many long tunnels or on underground railways because the energy efficiency is higher than steam or diesel locomotives and does not involve on-board combustion. The high tractive force also makes electric operation suitable for lines running through hilly regions. As a consequence, electric train operation made remarkable progress. It started first with direct-current feeding systems capable of driving a DC motor directly and offering high tractive force and easy-speed control.

Although a 3000-V dc feeding system is widely used in many other countries, some Japanese railways using DC rely on a 1500-V dc system.

The other alternating-current feeding system originated in Europe using a single-phase, commutator-type motor. Special low frequencies such as 25 Hz and 16.66 Hz were introduced in Austria, Germany,

and other countries to minimize rectification failures. Later advances in silicon commutator technology paved the way for AC feeding systems using commercial frequencies in France and elsewhere. The 25-kV system is used widely around the world while Japan relies on a 25-kV system for shinkansen and a 20-kV ac feeding system for 'conventional' railways. (In this article, 'conventional' means all JNR/JR narrow-gauge lines, all non-JR railways, and the Aomori and Yamagata shinkansen, which were converted to standard gauge from narrow gauge.)

The three-phase, alternating-current feeding system is used with induction motors in Europe for railways with steep mountain grades, while a 600-V system, featuring speed control by a power converter, is used in Japan for new urban transit systems.

Table 1 World Electric Railway Feeding Systems and Electrified Distances (1996)

System Type	Japan ¹		World (excluding Japan)			
	km	%	km	%		
DC	Less than 1,500 V	915	5	5,106	2	
	1,500 V to 3,000 V (Mostly 1,500 V)	10,484	61	22,128	9	
	3,000 V or more (Mostly 3,000 V)			75,276	33	
Single-phase AC	50 Hz	Less than 20 kV		245	0	
	60 Hz	20 kV	3,741	22	3,741	2
		25 kV	2,027	12	84,376	36
		50 kV			1,173	0
	25 Hz	11 kV to 13 kV		1,469	1	
		16.66 Hz	11 kV		120	0
	15 kV		35,461	15		
Three-phase AC		30	0	43	0	
Unknown				3,668	2	
Total		17,207	100	225,816	100	

Notes: ¹ Statistics include Japanese subways and Aomori.
² Kazakhstan is 3,500 km (21,000 V AC and 60 Hz 25 kV ac) but details are not known.
 Source: (1) Railway Electrification Meeting Association of Japan, vol. 8, no. 14, pp. 3-5, Oct. 1997
 (2) *Stat., vol. 8, no. 11, pp. 77-78 and pp. 81-83, Nov. 1997*

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**Morris Brenna, Federica Foiadelli, Dario
Zaninelli**

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INTELLIGENT TRANSPORT SYSTEMS PRADIP KUMAR SARKAR,AMIT KUMAR JAIN,2017-11-15 Over the time Intelligent Transport System ITS has become important for any country not only for traffic congestion management but also for modern infrastructure and safety Since there is a dearth of literature on this subject this book attempts to fill the gap and provides a holistic work on ITS encompassing theory examples and case studies on various facets in both road and railway sectors The basic principles of various technologies used for ITS have been explained in such a manner that students from non technical background can also comprehend them with ease It also discusses the emerging technologies such as autonomous vehicles electric vehicles cooperative vehicle highway system automated highway systems 5G mobile technology etc Considering the need of huge funds required for ITS implementation the text provides various funding options available Conclusively it is a unique book that contains all aspects of ITS which a student of engineering is expected to know The book is intended as a text for postgraduate students of transportation engineering and as a reference book for professionals such as transport planners town planners traffic engineers transit operators and consultants Key Features ITS architecture with a number of case studies based on real life situation Concept of smart city importance of advanced transport system and applications of ITS technologies in smart cities ITS in Rail sector intelligent trains train control systems and intelligent train maintenance practices Chapter end questions for practice and bibliography *Power Distribution for Electric Railroads* Louis Bell,1897 **Electric Rail Transport** Source Wikipedia,2013-09 Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online Pages 87 Chapters Multiple unit Overhead lines Amtrak s 25 Hz Traction Power System List of current systems for electric rail traction 15 kV AC railway electrification Electric locomotive Railway electrification system List of installations for 15kV AC railway electrification in Germany Austria and Switzerland Railway electrification in Great Britain Third rail Railway electrification in Malaysia Railway electrification in Iran Railroad electrification in the United States Central Organization For Railway Electrification List of rail transport systems using third rail Electric power supply system of railways in Sweden Trolley pole Railway electric traction Ground level power supply Conduit current collection Brighton Belle Urban rail transit Traction power network Electric multiple unit Multiple unit train control FS Ale 642 List of railway electrification systems in Japan Accumulator railcar Multi system Ski collector PESA ELF Kinetic Traction Systems Traction substation Stud contact system Motorman UTE3600 Series Traction powerstation Double electrification Three phase AC electrification of Ferrovie dello Stato Leo Daft **Electrical Railway Transportation Systems** Morris Brenna,Federica Foiadelli,Dario Zaninelli,2018-02-05 Allows the reader to deepen their understanding of various technologies for both fixed power supply installations of railway systems and for railway rolling stock This book explores the electric railway systems that play a crucial role in the mitigation of congestion and pollution caused by road traffic It is divided into two parts the first covering fixed power supply systems and the second concerning

the systems for railway rolling stock In particular after a historical introduction to the framework of technological solutions in current use the authors investigate electrification systems for the power supply of rail vehicles trams and subways Electrical Railway Transportation Systems explores the direct current systems used throughout the world for urban and suburban transport which are also used in various countries for regional transport It provides a study of alternating current systems whether for power supply frequency or for special railway frequency that are used around the world for the electrification of railway lines long distance lines and high speed lines In addition this resource Analyzes multiple railway systems from a theoretical and realizable vantage point with particular regard to functionality electromagnetic compatibility and interferences with other electrical systems Studies electric traction railway vehicles presenting various types of drives and auxiliary devices currently in circulation Discusses solutions employed to ensure interoperability of vehicles that run along lines powered by different systems e g DC and AC at different frequencies Electrical Railway Transportation Systems is an ideal text for graduate students studying the subject as well as for industry professionals working in the field Electric Power Stations International Correspondence Schools,1906 Railway Electrification Harry Frederick Trewman,1924

Practical Helps for the Electric Railway Shop, Track, Power, Line and Rolling Stock Departments ,1919

System of Electric Railways and Transmission of Power Van Depoele Electric Manufacturing Company,1887

Advantages of a Feeder and Sub-feeder System for Electric Railways Sprague Electric Railway & Motor Co,1897

Railway Applications. Supply Voltages of Traction Systems British Standards Institute Staff,2005-01-06 Railway electric

traction equipment Railway equipment Traction current collecting devices Current collecting equipment Railway vehicles

Tramcars Railways Voltage Rated frequencies Electric power networks Railway applications **Electric Power and**

Traction Francis H. Davies,1907 Smart Traction Power Supply Systems for High-speed Railways Shibin Gao,Zhengqing

Han,2025-01-24 Given the increasingly busy railway networks increased axle loads and railway speeds modern railways and

urban transport systems require smart and energy efficient tractionpower supply products and solutions to ensure safe

reliable and environmentallysustainable operations Based on the latest development and achievements of China straction

power supply system Smart Traction Power Supply Systems for High speedRailways focuses on the latest research into smart

traction power supply systems Startingfrom the concept of smart technologies it describes the structure and functions of

smarttraction power supply systems including smart power supply and transformation facilities smart power supply

operation and maintenance management systems smart power supplydispatching systems and high speed communication

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selfhealingreconstruction fault prognosis health assessment and power supply dispatching Discusses what is meant by the

term smart traction power supply systems and technology trends Reviews the new concept of the traction substation

Describes how to develop smart traction power supply systems Electric Power Stations: Electric Railway Systems, Line

and Track, Line Calculations, Motors and Controllers, Electric-Car Equipment, Multiple- Anonymous,2022-10-27 Design, Construction and Operational Principles of Telecommunication, Power and Electrified Railway Facilities ,1989 Functions of power networks three phase systems networks protection and arrangements affecting disturbance phenomena electric traction installations power feed sub stations traction motors telecommunications line transmission systems disturbing phenomena effects of coupling

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Railway Applications. Fixed Installations. Stationary Energy Storage System for DC Traction Systems British Standards Institute Staff,1917-07-05 Railway electric traction equipment Stationary Storage Direct current Testing Test methods Electric power systems Railways Railway fixed equipment Electrical installations

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System British Standards Institute Staff,1916-11-30 Railway equipment Railway fixed equipment Electric power systems
Railway vehicles Railway electric traction equipment Interoperability Compatibility Electric substations Circuit breakers
Electrical faults Short circuit currents Harmonics Braking Test methods Railway Applications

Railway Electric Power Feeding Systems Ejrcf Or Book Review: Unveiling the Magic of Language

In an electronic digital era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Railway Electric Power Feeding Systems Ejrcf Or**," published by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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