



## *Tutorial*

*on*

### **Renewable Energy and Regenerative Energy Application in Power Supply System for Electric Railway**

#### **Abstract of Tutorial:**

Railway is well known as one of the eco-friendly transportation modes and CO<sub>2</sub> emissions from railway is about 1/7 of car and 1/5 of airplane in Japan, respectively. The total electric energy consumption in railway industry in Japan is, however, about 2% of total Japanese electric energy consumption and each railway company is making effort to reduce their energy consumption and enhance energy efficiency more. In this tutorial, I would like to survey two trends related to renewable energy research and applications around railway system in Japan.

Firstly, photovoltaic applications around railway apparatus in Japan will be shown <sup>(1)-(3)</sup>. For example, 450kW roof-top PV systems at Tokyo station, mega-solar system at Keiyo Depot and Hiraizumi Zero-emission station will be shown. Our simulation study and on-site experiments at Keiyo Depot about distribution line voltage control by reactive power control will be also shown.

Secondary, energy storage system application for regenerative energy utilization in d.c. traction power supply system will be shown <sup>(4)-(6)</sup>. More than 20 energy storage systems have already installed in d.c. traction power supply system in Japan. The purposes of energy storage system installation are not only regenerative energy utilization but also voltage drop compensation, avoidance of regenerative brake cancelation and emergency power supply.

Lastly, regenerative energy utilization in a.c. traction power supply system will be shown <sup>(7)</sup>. Only one practical example is RPC application in a.c. system. The future possibility and potentials in a.c. traction power supply system for high speed railway will also be mentioned.

This tutorial will be conducted mainly based on the measured data from practical power supply system of electric railway and will be instructive to understand future prospects in this field.

## References:

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He graduated from the University of Tokyo in 1994 and received master degree and doctor degree in 1996 and 1999 from the University of Tokyo, respectively. He was Assistant Professor of the University of Tokyo from April, 1999 to June, 2002.

He entered East Japan Railway Company in July, 2002 and worked for R&D center of East Japan Railway Company from 2002 to 2006, maintenance of traction substation for high speed railway in Omiya Branch Office from 2006 to 2008 and Railway Operation Headquarters from 2008 to 2016, respectively. He has been a manager of Electric Department, Tokyo Branch Office since April, 2016 and is responsible for traction power supply system around Tokyo metropolitan area.

He is Professional Engineer of Mechanical Engineering, Electrical & Electronics Engineering, Applied Science and Comprehensive Technical Management. He won the first prize paper award in IPEC2005 and the 73th IEEEJ Technical Development Award in 2017.

He is one of the expert members of Working Groups or Maintenance Teams of IEC-61992, DC Switchgear, IEC-62128, Electrical safety, earthing and the return circuit, IEC-60850, Supply voltages of traction systems, IEC62505, Particular requirements for a.c. switchgear and so on.

His previous research area was, high voltage engineering, electric discharge, linier motor and magnetic levitation applications, plasma diagnosis, compact torus plasma confinement, and power supply system of electric railway.