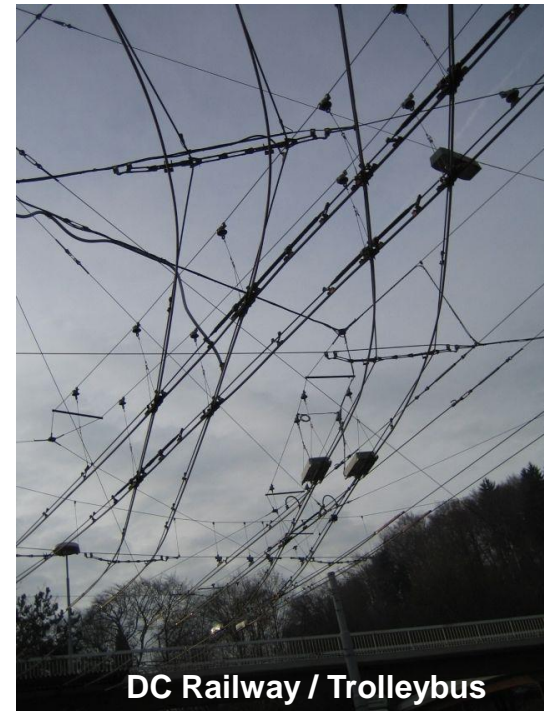


OpenPowerNet

The Co-simulation Tool for Traction Power Supply



AC Railway



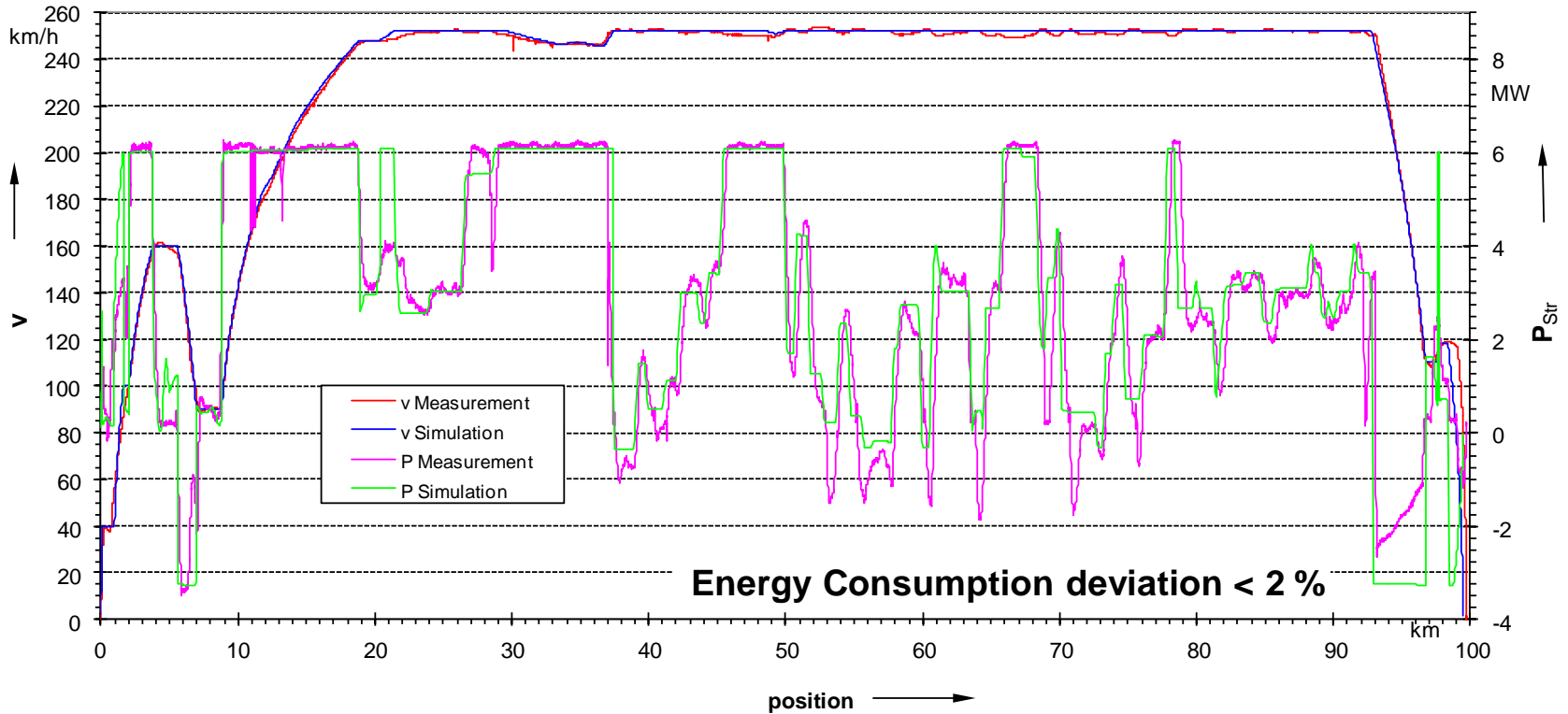
DC Railway / Trolleybus

Simulation software verification by measurements

Train Speed and Power Characteristics

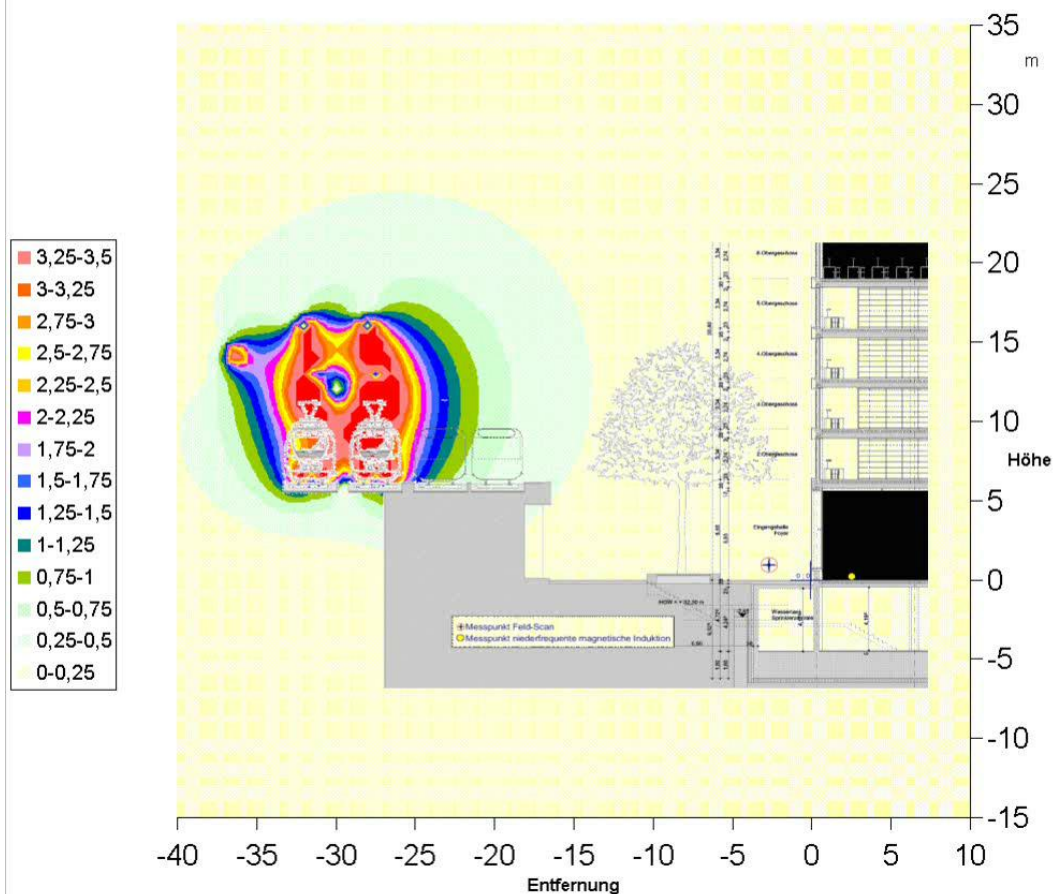
Measurement and Simulation Results

ICE1 Hannover – Göttingen

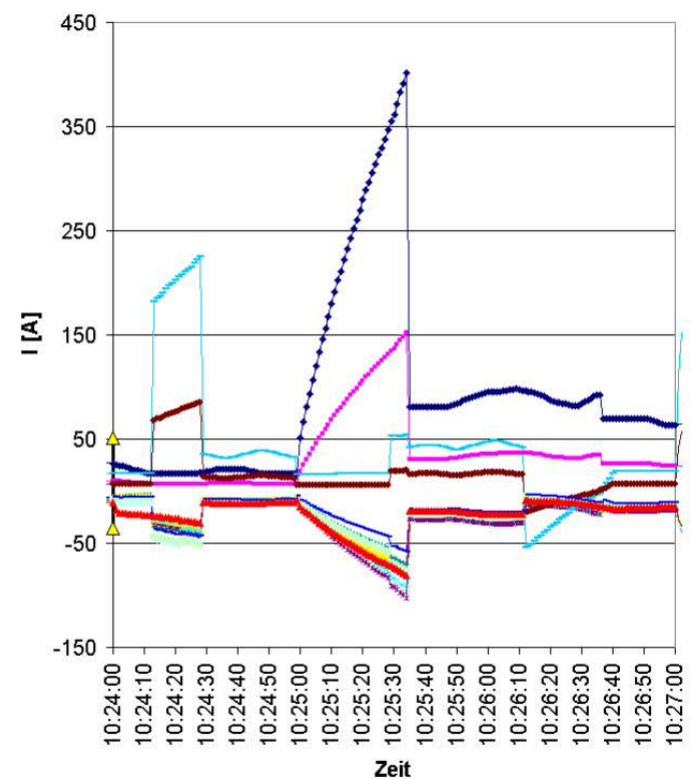


EMC – Magnetic Induction, Simulation and Measurement, Grimm Centre Berlin

Induction



Current distribution



10:24:00 Summe Oberleitungsströme = 58,39 A

- N CW 26,24 A
- N MW 9,93 A
- N RL -6,85 A
- N RR -7,65 A
- N RRF -8,73 A
- S CW 16,77 A
- S MW 6,35 A
- S RL -6,85 A
- S RR -6,49 A
- S RRF1 -7,49 A
- S RRF2 -5,71 A
- N E -10,38 A

Queensland Rail and ABB, Presentation at ACRPS 2017



ACRPS 2017, 10 MARCH 2017

The Wulkuraka Case

Static Frequency Converters (SFCs) for 50 Hz AC Railway Supply

Trevor Bagnall Queensland Rail, Cosmin Banceanu ABB, Thomas Schaad ABB



Queensland Rail and ABB, Presentation at ACRPS 2017

Performance results

Operational Experience

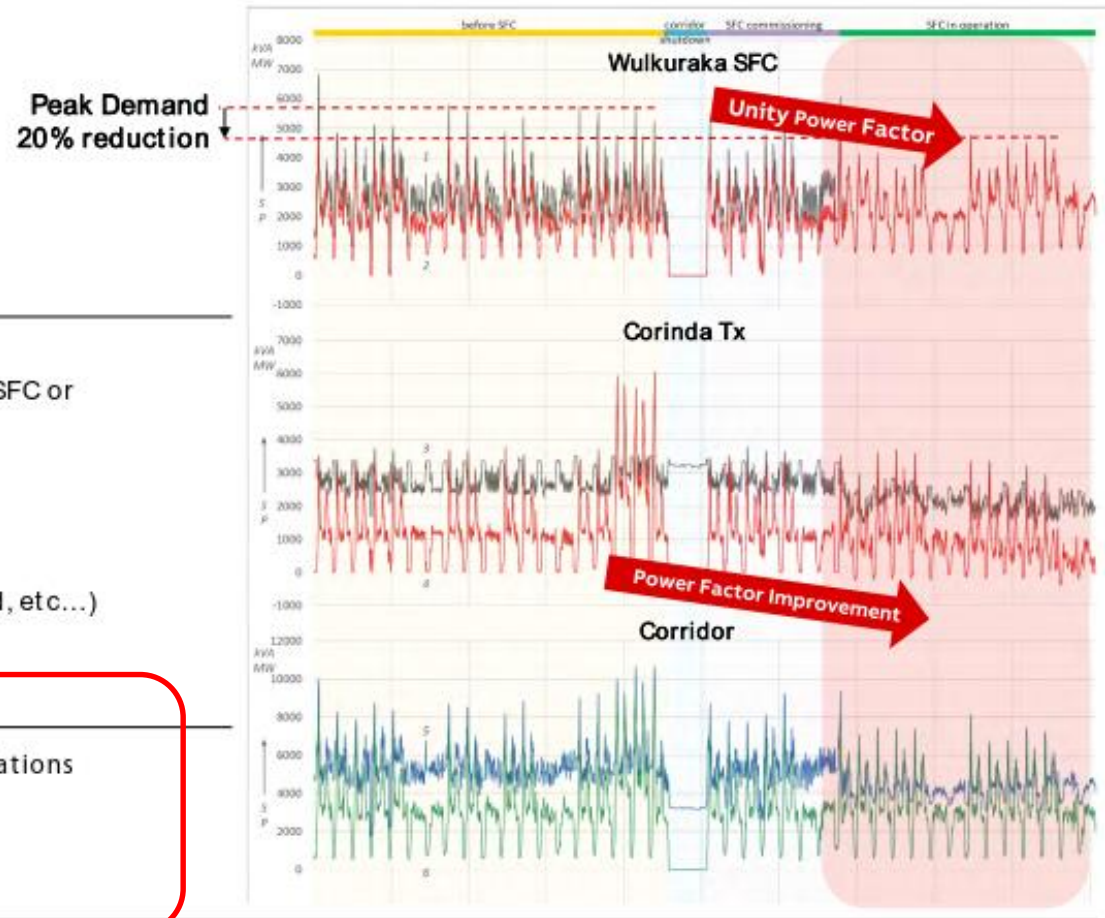
- Reliable
- Available (customers not affected by outages of SFC or transformer)
- Configurable (energy cost reduction)
- Some change management required
 - Parallel sources
 - New operational modes (Var Comp, Sync, Island, etc...)
 - System recovery from island (check sync)

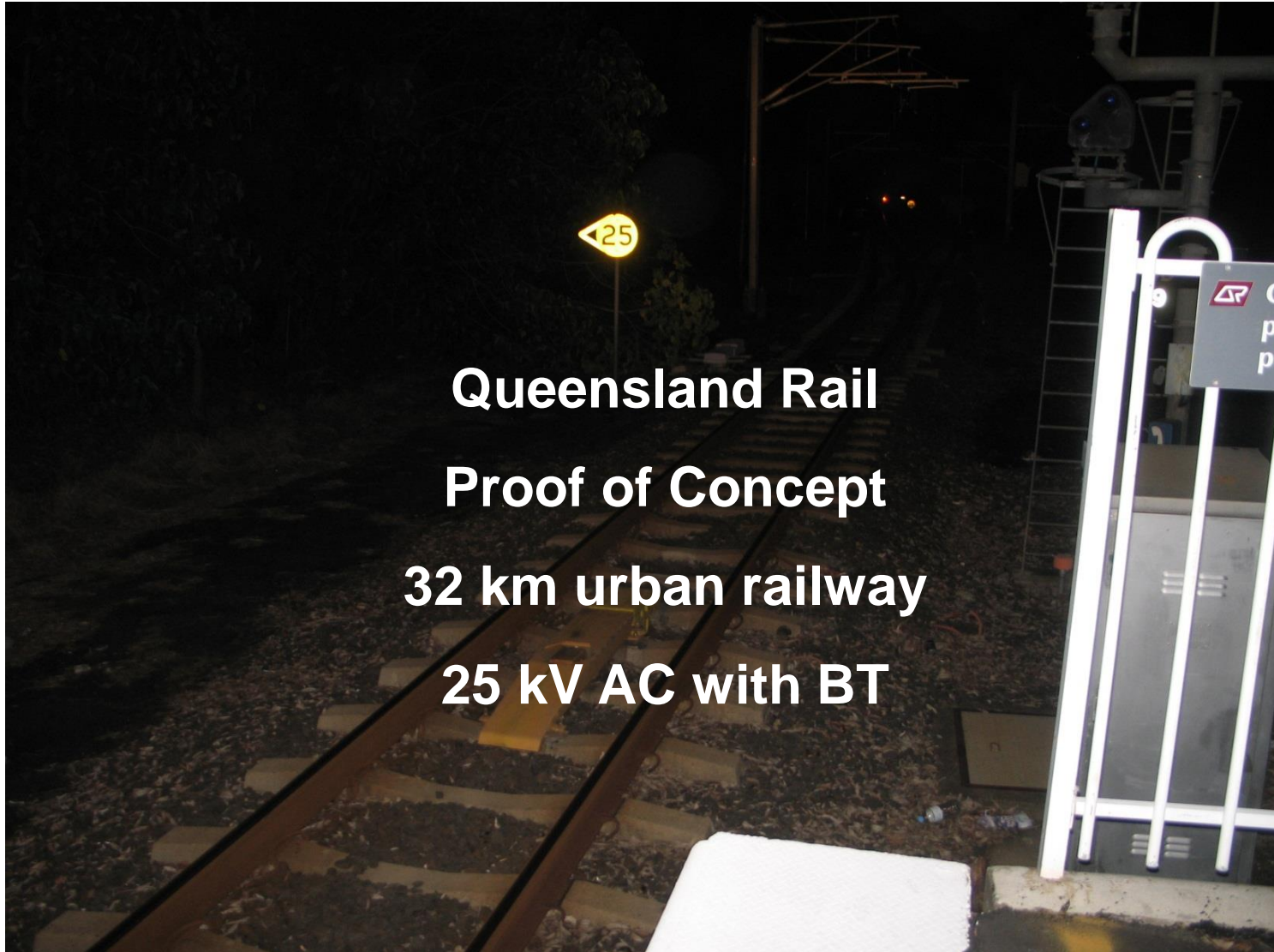
Simulation Experience

- Performance closely matches full timetable simulations



© Queensland Rail
February 10, 2017 | Slide 14



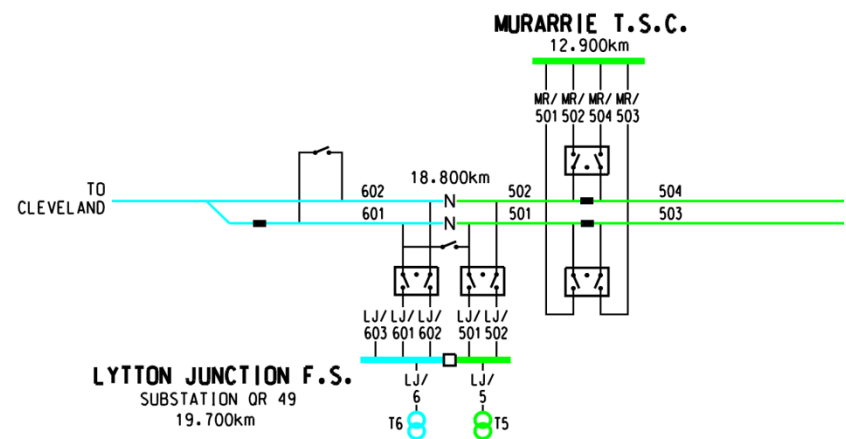
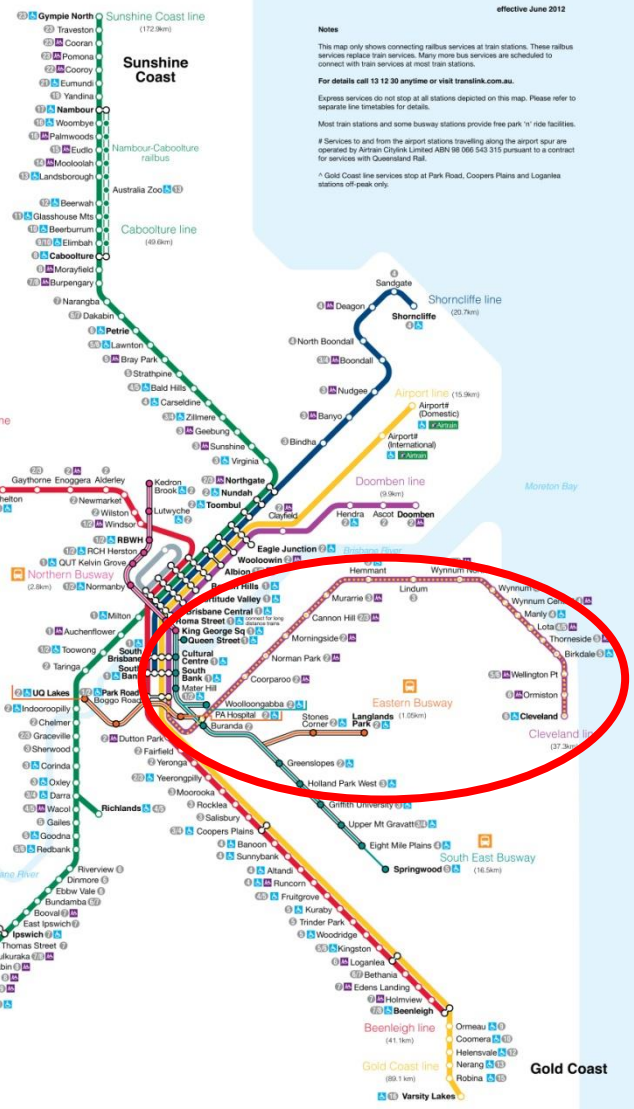


OpenPowerNet – Co-Simulation Tool for Traction Power Supply

Train and busway network map



- Key**
- Sunshine Coast line
 - Caboolture line
 - Ipswich-Rosewood line
 - Ferry Grove line
 - Beenleigh line
 - Doomben line
 - Cleveland line
 - Shorncliffe line
 - Airport line (Special fares apply)
 - East Coast line
 - Exhibition line and station (Open for special events only. Special fares apply)
 - South East Busway
 - Northern Busway
 - Eastern Busway
 - Nambour-Caboolture railbus
 - Helidon-Rosewood railbus
 - Toogoolawah-Ipswich railbus
 - Connecting station
 - Zone number
 - Wheelchair access
 - Assisted wheelchair access

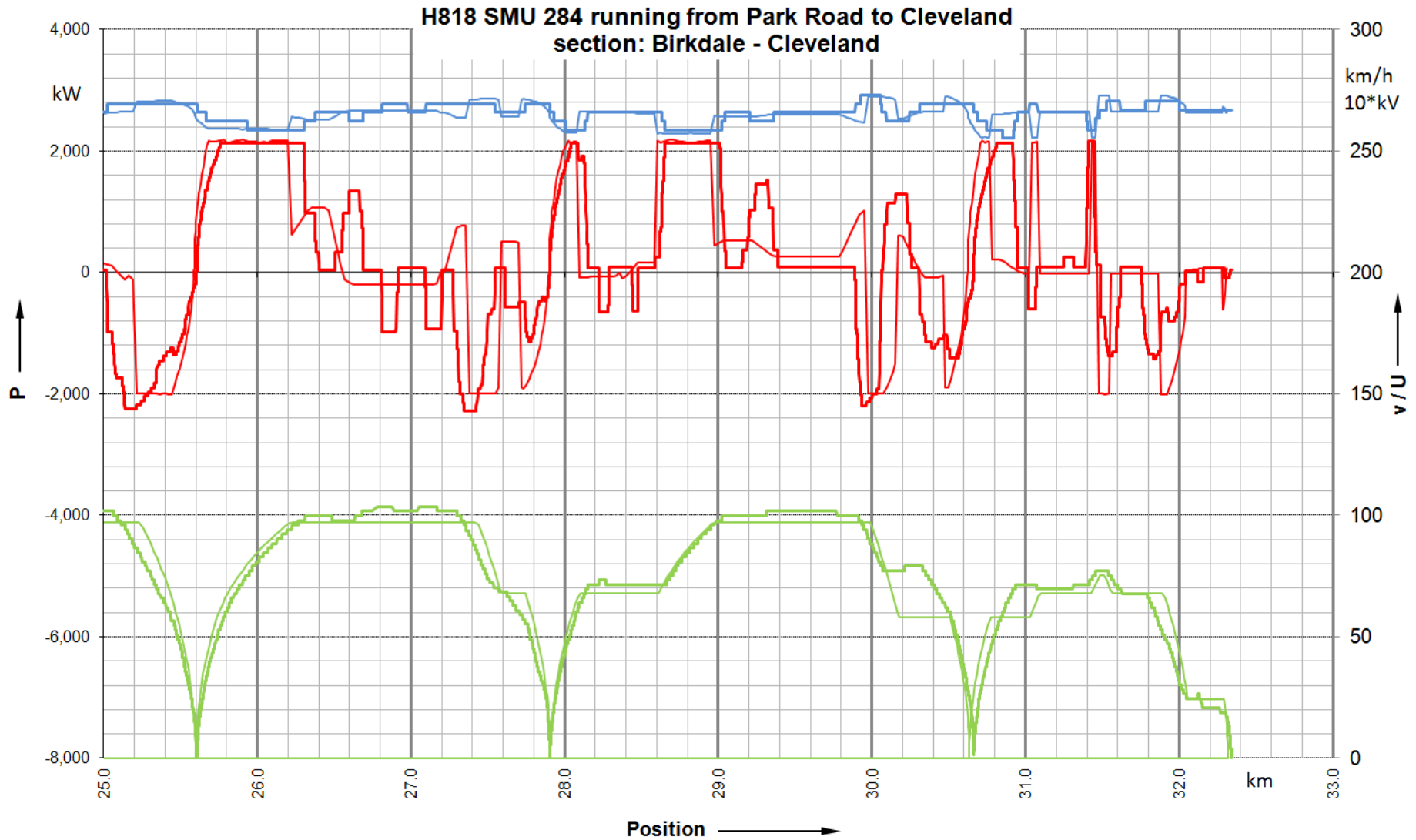


Proof of Concept Methodology

- 1. Model calibration with single train test runs**
- 2. Modelling of 5 days 4 h morning peak**
- 3. Measuring of 5 days 4 h morning peak energy consumption**
- 4. Comparing the simulated and measured energy consumption**

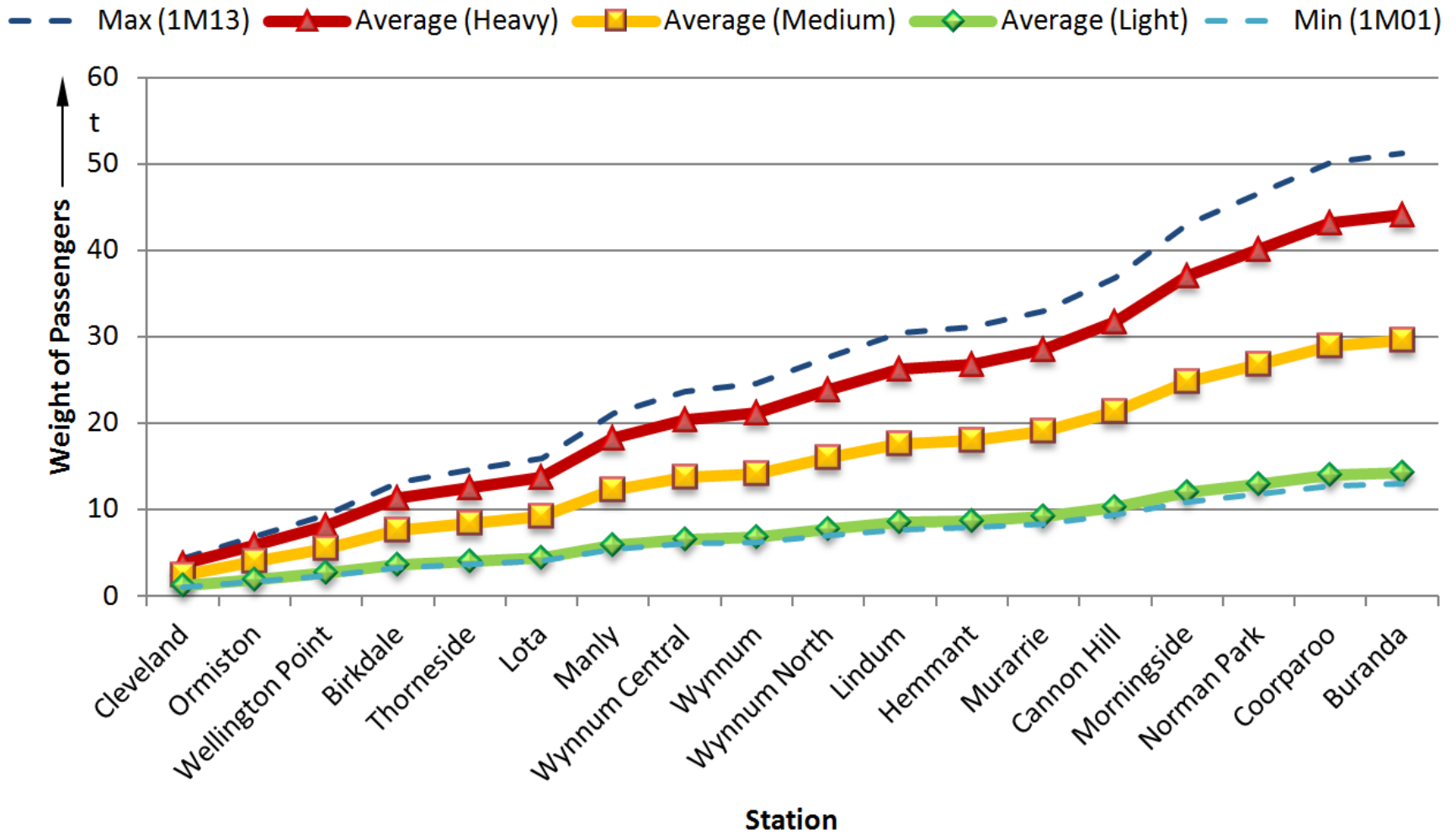
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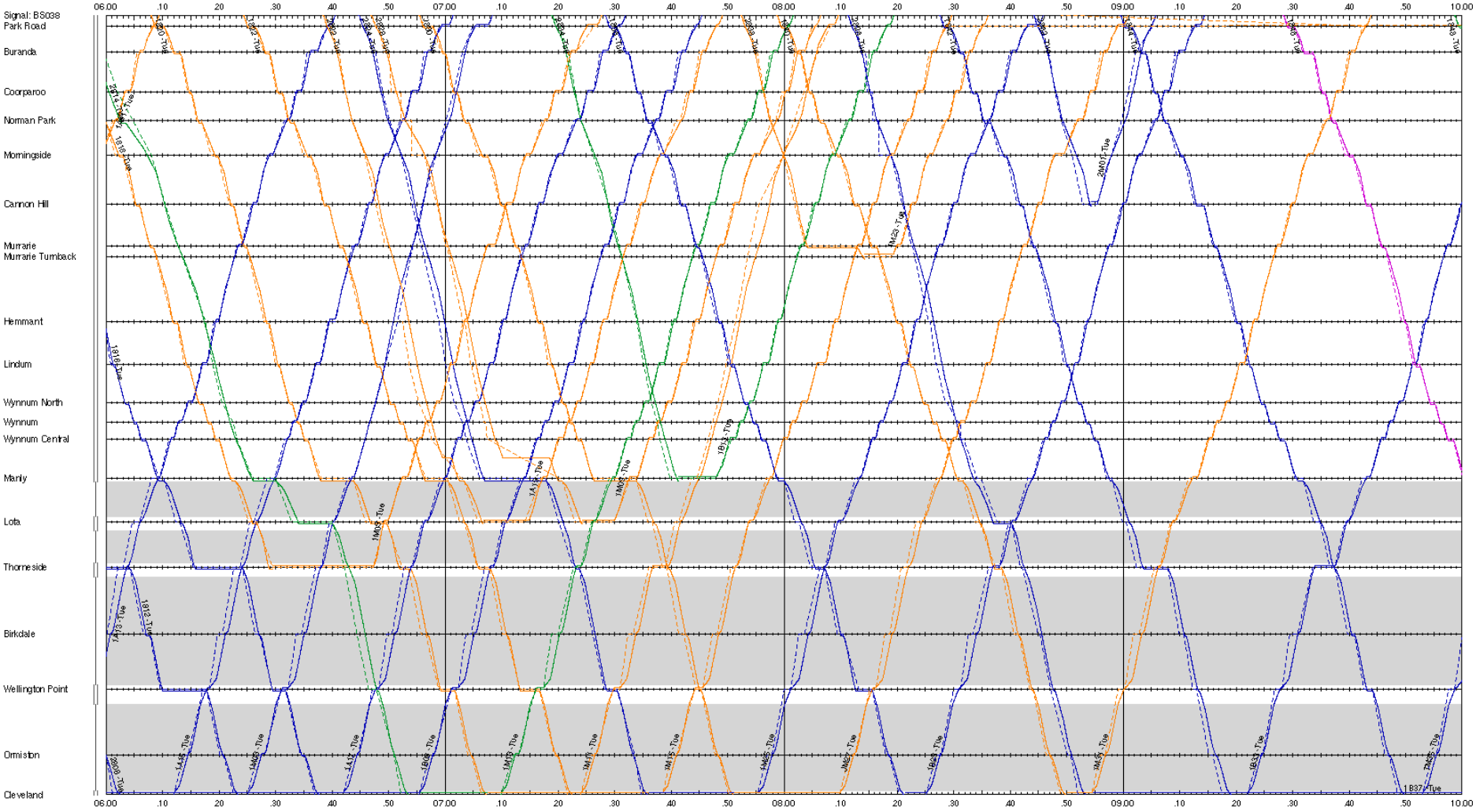


Proof of Concept Methodology

- 1. Model calibration with single train test runs**
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Signal: BS038 - Cleveland

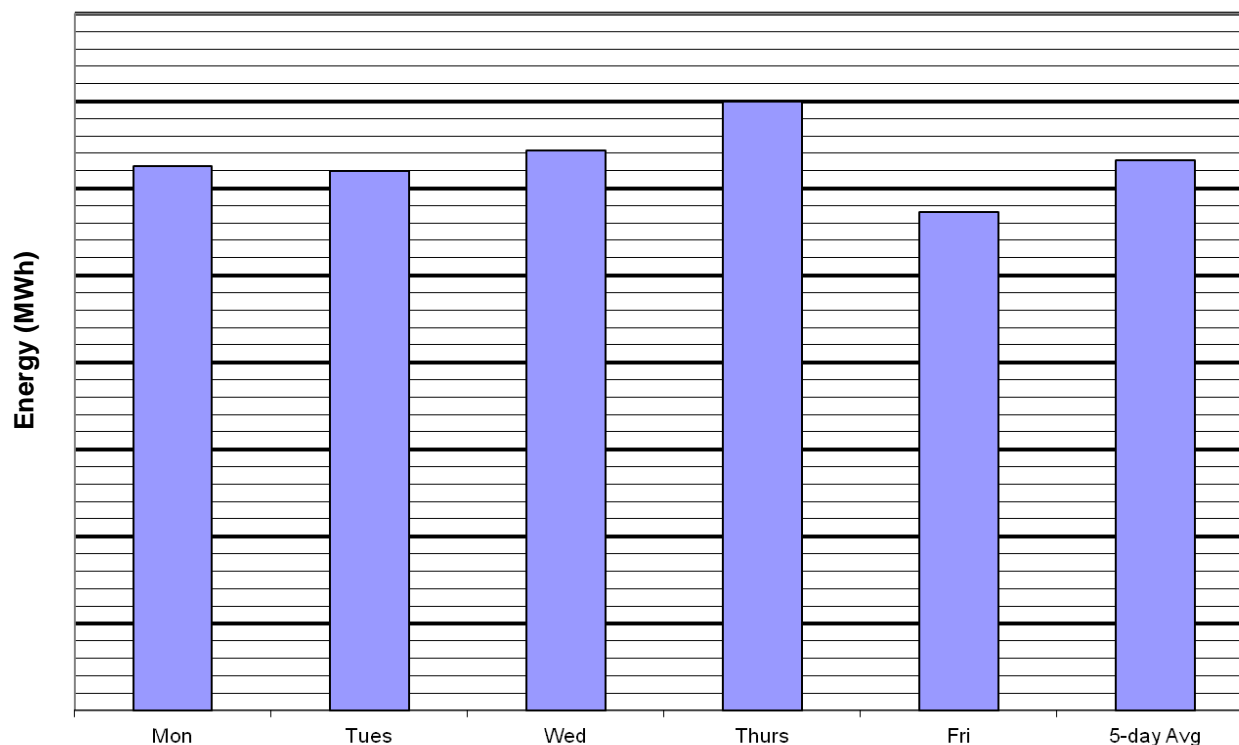


Proof of Concept Methodology

- 1. Model calibration with single train test runs**
- 2. Modelling of 5 days 4 h morning peak**
- 3. Measuring of 5 days 4 h morning peak energy consumption**
- 4. Comparing the simulated and measured energy consumption**

Measurements have been conducted by Queensland Rail to measure the energy consumption of the selected line during the 4 h morning peak.

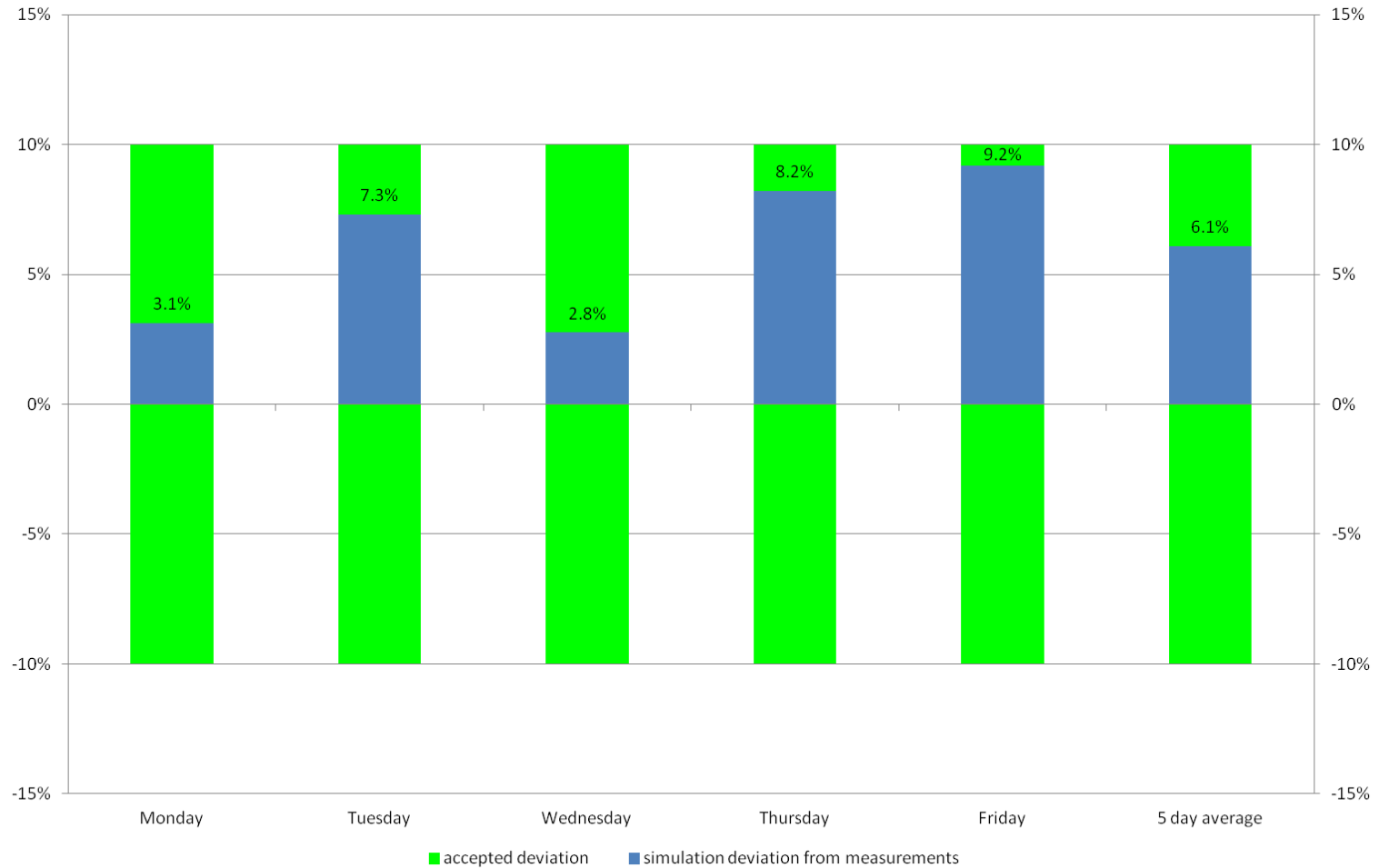
POC - Lytton Junction Power Demand
30.01.2012 - 03.02.2012 6am-10am Cleveland to Park Road



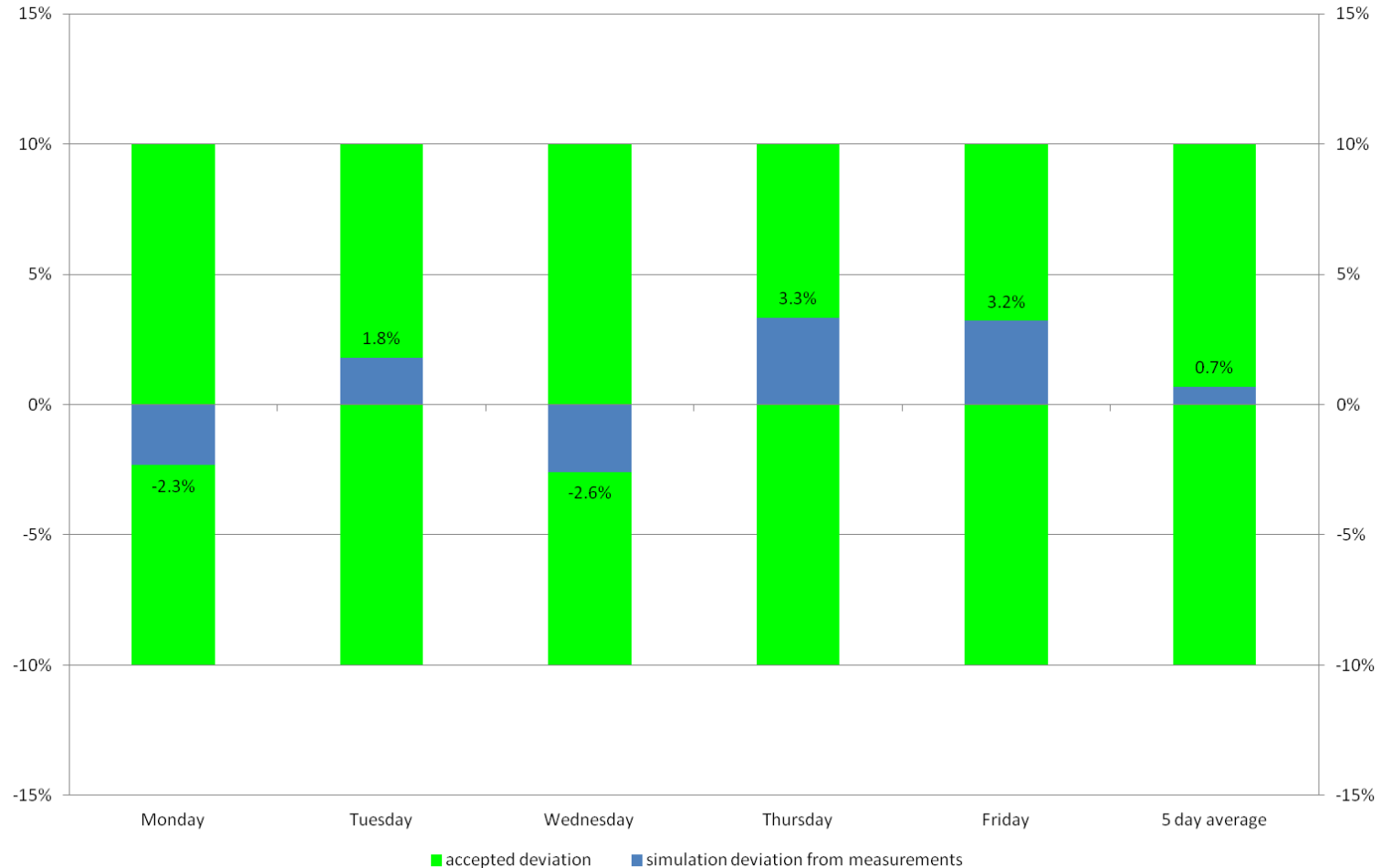
Proof of Concept Methodology

- 1. Model calibration with single train test runs**
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- 4. Comparing the simulated and measured energy consumption**

Deviation from measurements



Deviation from measurements with reduced auxiliary power (as in reality) for stabling trains in Cleveland

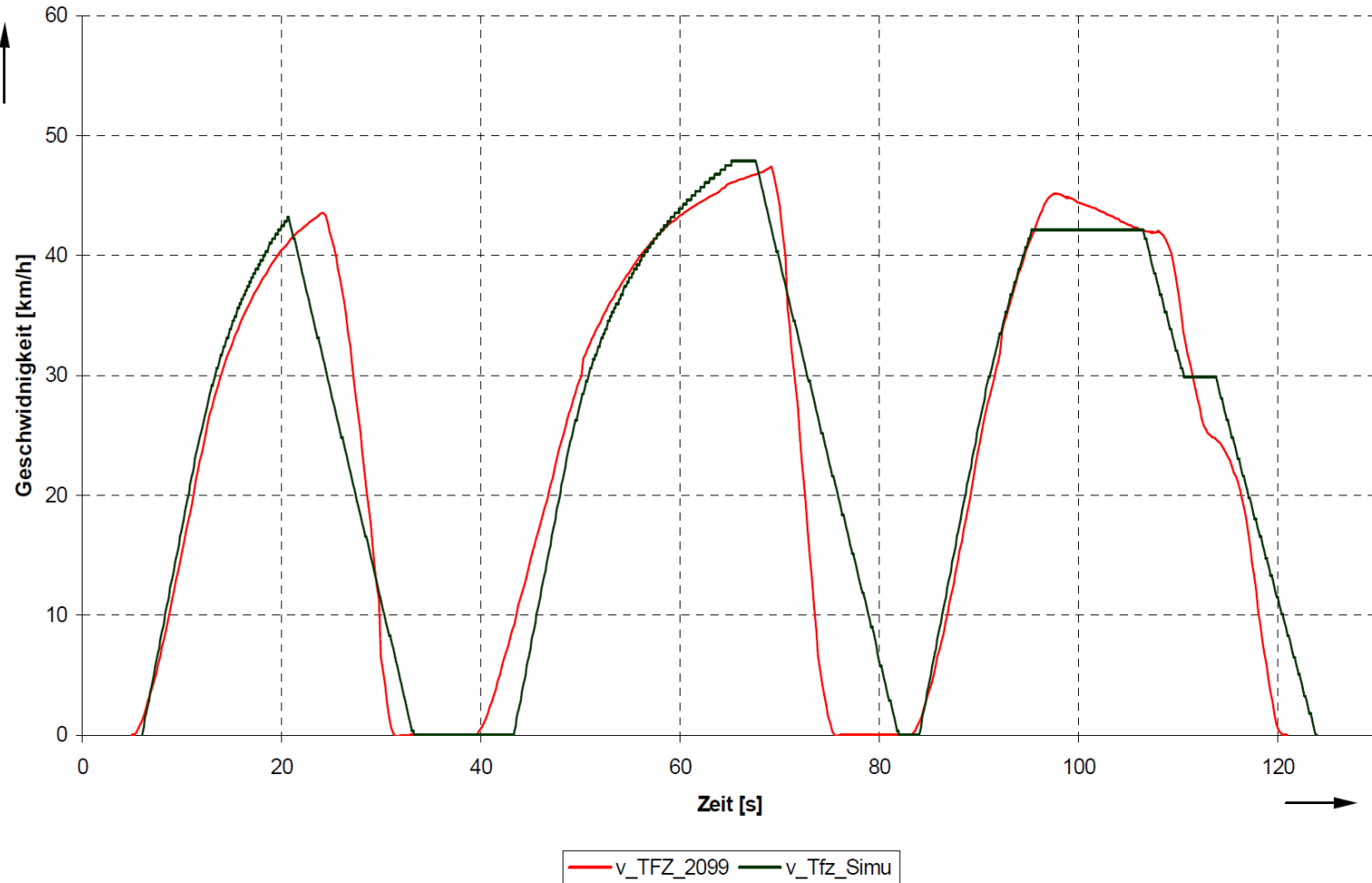




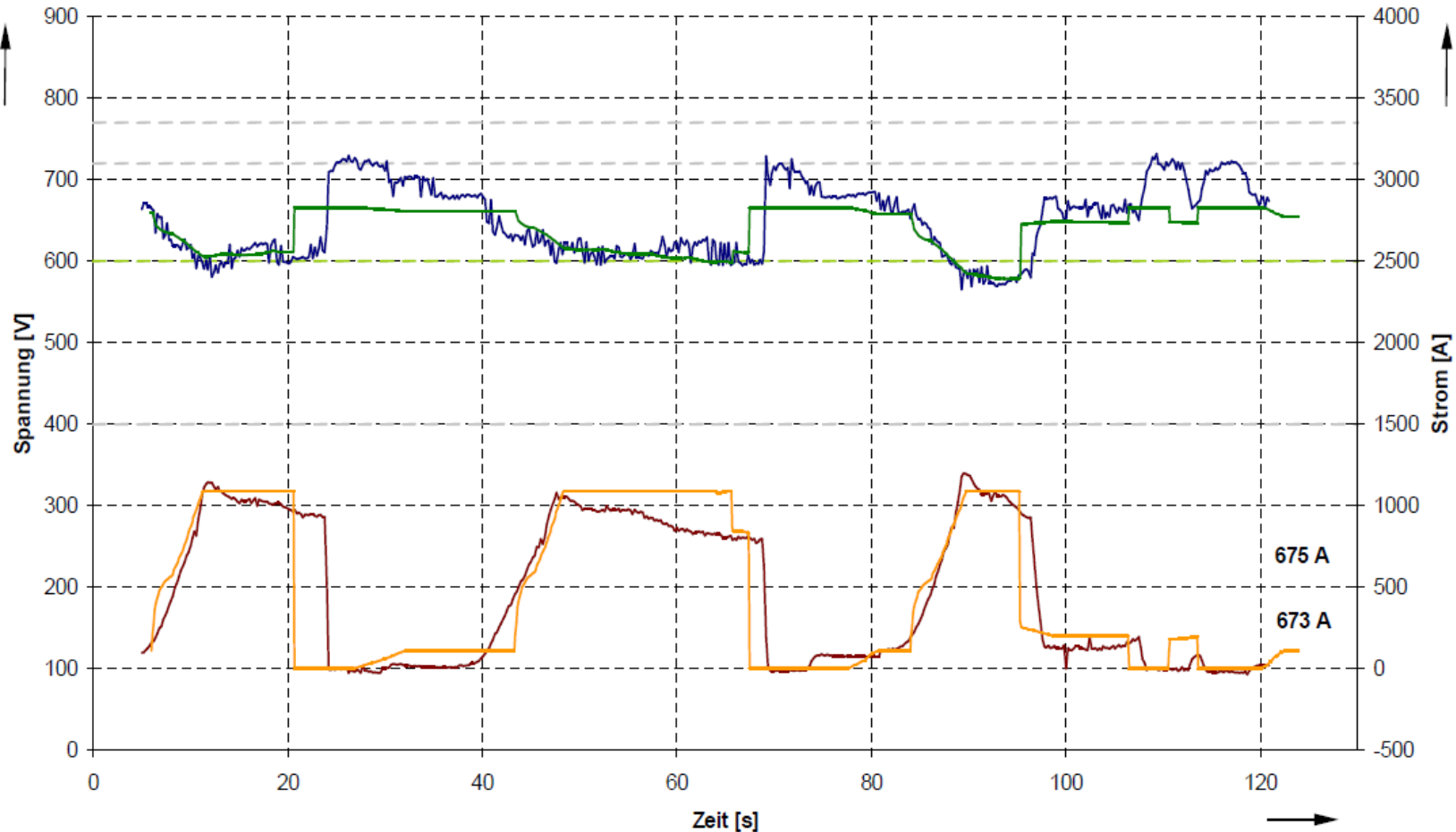
Vehicle modelling, Tram and Trolleybuses



Verification - speed profile



Verification – vehicle voltage and current



Toleranz U (EN 50163)
 U_nenn
 U_TfZ_2099
 U_Tfz_Simu
 I_TFZ_2099
 I_Tfz_Simu



Reference Letter

VBZ (Zurich Public Transport) reference letter translation

IFB Institut für Bahntechnik GmbH
Branch Office Dresden
Wiener Str. 114-116
D-01219 Dresden

Zurich, August 27th 2010

Confirmation of the OpenPowerNet Simulation Results compared to Measurements

To whom it may concern,

As part of the network study for the Zurich Public Transport (VBZ) a validation of the simulation software OpenPowerNet were agreed. The aim of the validation was to check the OpenPowerNet simulation results against measurements.

Three different line sections and one vehicle type was selected by VBZ. The IFB (Railway Technology Institute) modelled the electrical network as well as the vehicle and simulated typical driving characteristics. The simulated driving characteristics were the basis of the measurements by the VBZ on November 21st 2007.

Vehicle pantograph RMS currents of the measurement and simulation were compared and the maximum deviation was approximately 6%. For the comparisons it is to make the point that the auxiliary power during the measurement was not constant due to changing auxiliary and heating power but the simulation vehicle was modelled with a constant power. Furthermore due to friction problems it was not possible to drive exactly according to the driving characteristic of the simulation.

For the typical driving characteristic (vehicle with high power demand) the minimum pantograph voltage has congruence. During periods with identical currents the measurement and simulation charts almost the same. The deviation between both is always < 5%. This means the electrical network model is correct and in accordance with the agreed tolerance.

There are deviations during braking due to simulation constraints. While the vehicle control system always sets the pantograph voltage to 720V (due to other power consumer in the network or onboard) were the line voltage in the simulation set to nominal voltage because of none existing other power consumers. From the energetic point of view this is irrelevant due to network currents almost or completely zero.

Due to the successful validation the simulation software OpenPowerNet was qualified by VBZ for the network study and the simulation results accepted.

Best Regards

David Borschberg
Head of Project Planning Buildings

Institut für Bahntechnik GmbH
Berlin - Dresden



Eine Expertenrunde für das Gesamtsystem Bahn

The Expert Team for the Complete Railway System

IFB Dresden Branch, Wiener Str. 114-116, 01219 Dresden, Germany
Phone: +49 351 87759-0, E-Mail: ifb-dresden@bahntechnik.de, Web: www.bahntechnik.de