



Editorial



Time to extend the smoking ban ... to trains

Electrification has been in the press recently. The Department for Transport (DfT), Network Rail (NR), and the Association of Train Operating Companies (ATOC) are reportedly all in favour of new electrification, at the right price of course. NR is actively looking into extending electrification to the 'tentacles' of existing electric routes. Yet, at a recent industry event, ironically at the Institution of Electrical Engineers, I heard a passionate speech which, taken to its logical conclusion, would have the industry implement an immediate de-electrification policy in favour of diesel traction. The audience was reminded of the perennial 'wires-are-down' problem on the cheaply-electrified East Coast Main Line, the flexibility of run-anywhere diesels, and how Joe Bloggs cares less about the type of prime mover than he does about the strength of the coffee in the buffet car. All logical stuff. Meeting the customer expectations is the mantra.

A recent walk through St Pancras International's long bright hall with its chic shops was quite refreshing. Until I reached the domestic part of the station that is. There, the smell of diesel fumes and the noise followed me to the ticket desk at the lower level. This is not what one expects from a modern customer-focused and comfortable railway. Of course, as an electrical engineer, I am by definition biased. Also, the decision to electrify may not be influenced by this author's discomfort, even though quality of ambience is now an obligation on operators. But what about the other customer expectations for a sustainable railway that will still be running, and affordable, for a long time in the future, for example when oil reaches maybe \$200/barrel, even \$300/barrel? Electrification is a strategic decision that is intertwined with the procurement of the other life-long assets, such as the rolling stock and signalling. It cannot be 'switched on' at the flick of a switch. Of course, an insipid discounted cash flow analysis would show that it's not worth immunising a recently-installed non-traction-immune signalling scheme. However, a political breath of fresh air and long-term planning with vision may well prove the electrification doubters wrong. In the same way that the recent ban on public smoking turned out not to be the disaster predicted by the doom mongers.

On a different note, I'd like to thank all those who have sent us comments since the start of our newsletter back in 2006. We look forward to receiving more of your feedback and suggestions.

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News

Lötschberg base tunnel line now open!

The Lötschberg Base Tunnel (LBT) is a 34.577 km (21.5 mile) long new railway tunnel on the Bern-Lötschberg-Simplon line cutting through the Alps of Switzerland. It is one of the longest land tunnel in the world, accommodating both passenger and freight trains.



Construction ended in March 2007 and the opening ceremony of the tunnel took place on Friday, June 15, 2007. As a major technical contributor to the project, ENOTRAC was present.

Traction power supply for the Lötschberg base tunnel line

For the Lötschberg base tunnel, ENOTRAC was entrusted with a wide range of engineering tasks covering the specification and rating of the 16.7 Hz traction power supply system, as well as that of the 50 Hz supply system. The list of tasks included:

- Load calculations,
- Electrical rating of overhead line systems, cables and network power supply,
- Concept design of earthing and return current circuitry,
- Protection, to limit short circuit currents, supervision of procurement and commissioning of rate-of-rise limiting inductors at the Frutigen substation,
- Investigation of network stability,
- Non-ionising radiation and other test measurements to validate the design.

In addition, expert advice was provided for earthing, switchgear, and loading gauge.

Safety case for the Lötschberg base tunnel line

Prior to commercial operations, BLS AG were required to apply for the authorisation to operate the Lötschberg base tunnel line from the Federal Office for Transport. BLS AG contracted ENOTRAC to manage the application process on its behalf. The assignment covered:

- RAMS plan according to EN 50126,
- Identification of safety requirements,
- System description and planning of the demonstration of compliance for the safety case requirements,
- Integration of subsystems in accordance with the demonstration of compliance processes,
- Presentation of the demonstration of compliance to the Federal Office of Transport



Daniel Fahrni joined the ENOTRAC team in April 2007. He is responsible for the sales and consulting services of our maintenance management system, VipsCarsis. He holds a degree in electrical engineering from the Winterthur Advanced Technical College, Switzerland.

Daniel particularly appreciates ENOTRAC's open and friendly work atmosphere, which allowed him to quickly immerse into the railway industry. His hobbies include snowboarding, jogging, swimming, surfing, travelling, and reading.

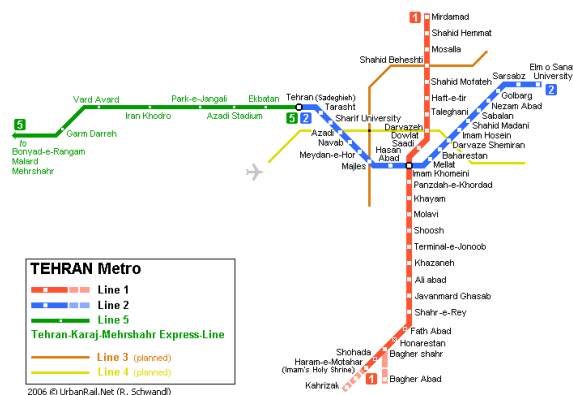


Simon Dummermuth joined ENOTRAC in September 2007 as an undergraduate. He is currently part-time studying electrical engineering at the Bern Higher Education College, Switzerland. Proving that technology and art are not mutually exclusive, Simon graduated from the Bern Musical Academy.

His hobbies include mountain climbing, diving, music and science. A few years ago, Simon went mountain climbing around the world and conquered the Nanga Parbat Mountain (8'125 m above sea level!) in the Himalayas.

Tehran Metro Line 3

ENOTRAC successfully supported Lahmeyer International on the concept design and preparation of tender documents for the power supply infrastructure of the planned Tehran Metro Line 3, a 37 km length of line with 32 stations. The scope of work included power equipment from 63 kV grid intakes through to traction supply at 750 V DC, as well as low voltage AC and DC supplies to other sub-systems.



Engineers used FABEL, ENOTRAC's multi-train simulator, to carry out power system studies and determine the optimal number and positioning of DC traction substations. Commercial and operating constraints were taken into account, in the form of planned timetables and the required level of transformer-rectifier redundancy.

Minimising mechanical braking in tunnels

Throughout the project, special considerations were given for the recovery of regenerated energy. This is due to the steep gradients (up to 5%) over substantial parts of the route. The eventual objective was to minimise the temperature rise in tunnels caused by kinetic energy transformed into heat when using conventional mechanical braking. Consequently, regenerative braking will be used exclusively in tunnels, above a certain speed threshold.

Energy efficiency at system level

The following text is an extract from the presentation given by Dr. Mounime at the 3rd UIC International Energy Efficiency Conference, September 2007, Portorož, Slovenia.

In a nutshell, a railway system is a combination of rolling stock, infrastructure, and operations. Together, those three elements determine the amount of energy consumed by a railway system.

Vehicle energy consumption drivers

For example, train mass varies significantly across the range of rolling stock vehicles. The kinetic energy of the train is proportional to its mass. Equally important is the energy efficiency of the traction chain in motorised vehicles, varying from 20% at low speed up to 90% at high speed. There is also the tractive resistance, modelled as a quadratic function of the train speed. The term "C times V²" corresponds to the aerodynamic component of the resistance. From the flat front of the British Class 455 to the sleek nose of the Japanese high-speed Nozomi, it is possible to more than halve C. Vehicles equipped with electric traction can also regenerate energy when braking, sending it back to the network (if receptive), or storing it in flywheels or super-capacitors.

Infrastructure energy consumption drivers

Infrastructure also has a role to play. For low voltage DC railways, replacing steel conductor rails with new aluminium steel composite rails can reduce power losses in the third rail by a factor of 2. Losses also occur in power converters at substations. A 3 MW transformer-rectifier unit typically has an efficiency of 98% at rated current. The relative losses (2% at full load) might seem low, but remember some of it permanently remains at no-load.

Operations energy consumption drivers

There are interactions between timetable, speed limit, signalling, and driver behaviour. One may want to adjust the top speed of a particular line since kinetic energy varies with the square of speed. So do losses due to aerodynamic drag. Driving policies, which minimise energy consumption, can be implemented by setting coasting points at various locations. By braking more gently, the regenerated power will remain within the limits of the on-board traction converter and the mechanical brakes will be less solicited.

Implications at system levels

One may want to save energy by using on-board energy storage devices. But, to have a decent storage capacity, one needs to carry half a tonne of super-capacitors increasing the train mass, its kinetic energy, and the damage to the track. One may want to reduce train mass by reducing the number of cars. However, this will reduce the payload per train and, eventually, require an increase in train frequency, which may require new signalling. One could also reduce top speed or deceleration to save energy. This would also reduce rail wear but lead to an increase in journey time and a reduction in train frequency. What about installing more efficient traction converters? But won't they need more cooling power? Aren't they heavier?

Assessing energy consumption at system level

To tackle the issue of energy evaluation in railways, one needs a system point of view. Sub-systems can rarely be studied in isolation. There are trade-offs to consider when changing a system and a cost/benefit analysis must be carried out. Energy engineering for railways is one of ENOTRAC's domains of expertise. We have a multi-disciplinary team of engineers who have developed a systems approach to solving technical problems. Our work is supported by state-of-the-art software tools used for the assessment of energy consumption and "what-if" scenarios.