

INFORMED SOURCES e-Preview May 2018

For this month's column I decided to do what I enjoy most and write about technology. And the hot topics are the replacement of the diesel engine in rail traction and ATO on Thameslink

Bi-modes, batteries and fuel cells

Thameslink – putting ETCS to work

New Train TIN-watch

On 12 February, recently appointed Transport Minister Jo Johnson announced his ambition to 'take all diesel-only trains off the track by 2040'. According to Informed Sources, Mr Johnson favoured 2030, but was dissuaded by his officials.

He made no apology for the 'ambitious goal', since the Government was already committed to ending sales of petrol and diesel cars by 2040. 'If we can achieve that, then why can't the railway aspire to a similar objective', he asked?

For Mr Johnson the 'real prize', is the 'introduction of zero-carbon alternative-fuel trains to the network'. He looks forward to a hydrogen train trial 'in the next Control Period (2019-2024)'. As battery technologies improve he also expects to see the diesel engines in bi-modes 'replaced altogether'.

So what I do in the column is determine the power and energy requirements of the Class 800 bi-modes and other trains and compare them with the capabilities of batteries and hydrogen fuel cells. I found it an interesting piece of research where I had no expectations of what the outcome would be.

Starting point was to calculate the energy consumption of a range of trains in terms of kilowatt hours per kilometre. Having done that I looked at the energy density of batteries, based on three practical examples, the Hayabusa IC125, the Class 379 Independently Powered EMU and the Birmingham tram described in the April issue of Modern Railways.

That was an eye opener and provided the yardstick for an analysis of how much energy you could pack into a five car Class 800 if you replaced the three diesel engine power packs and fuel tanks with the same weight of Lithium-Ion batteries.

So what does this mean for Mr Johnson's aspiration to have the diesel engines in bi-modes 'replaced altogether' by batteries? Well, you might make Cardiff-Swansea under battery power provided you had a recharge for the return journey, but that is before allowing for heating or air conditioning and other auxiliary loads. As for the West Country or North of Edinburgh – forget it

Which doesn't mean to say that battery power isn't worth the effort. Vivarail is working on its first production battery-powered two-car unit. With lithium-Ion battery packs replacing the engine modules, the battery capacity is claimed to give a range of 40 miles, with an 8 min charge provide sufficient juice for the return journey.

You can see practical roles for such lightweight battery trains on captive services, like the Watford-St Albans Abbey shuttle. But if you are running through-services beyond the wires, every EMU in the fleet has to slug around batteries all-day every-day on the off-chance that it might be diagrammed onto the branch.

Hydrogen potential?

If batteries are niche in rail traction, what has the other alternative energy source – hydrogen – got to offer? Hydrogen is not a 'fuel' but a way of storing energy. And by the time you have produced the gas by electrolysis, compressed it for storage and then turned it back into electricity in a fuel cell, the inefficiencies mount up.

Transport for London is already running hydrogen fuel-cell buses on its RV1 tourist route. According to manufacturer Ballard of Canada, these have been in operation for more than 73,000 hours. The first fuel cell module to enter service has run for over 20,000 hours without failure.

However, it is power rather than energy capacity that is the issue. The two main manufacturers offer 200kW fuel cell 'stacks', which is not a lot of grunt.

Ballard is working with Siemens on a 200kW module, scheduled to be installed in a Siemens Mireo multiple unit platform for commercial service in 2021.

Meanwhile Alstom already has a prototype train running plus an order for 14 of its Coradia iLint fuel cell powered two car multiple unit trains. These are scheduled to replace diesel trains linking Cuxhaven, Bremerhaven, Bremervörde and Buxtehude from December 2021.

Strictly speaking, the Coradia iLint is a fuel-cell battery hybrid. The 390kW under-floor diesel engine for each car is replaced by a roof-mounted 200kW Hydrogenix fuel cell plus an under floor water-cooled 111kWh Li-Ion battery.

In operation, the direct current output from the fuel cell charges the battery pack. A DC-to-DC converter converts the battery output to the voltage required by the traction inverter which supplies the 320kW ac traction motor.

To minimise gas consumption, the operating strategy is to run the fuel cells at half load and use the battery for 'peak lopping' at times of high power demand, for example, when accelerating away from stations. So, once again not a contender for main line services and iLint is very much a classic German politically driven venture – the equivalent of the Birmingham Airport Mag-Lev link.

In energy terms the fuel cell is very inefficient and, depending on the energy mix of the power generation, not that green. On the other hand it does offer range and, in a hybrid configuration, can offer useful power, although not quite matching the 'grunt' of the diesel engines it replaces.

It may be worth noting that among the 'big-three', Bombardier is the odd-one-out with no plans for hydrogen power at the moment.

As for Mr Johnson's aspirations for replacing bi-mode diesel engines with batteries, dream on. If we are to get rid of diesels, the only practical solution is a rolling programme of electrification.

And that depends on the ability to make it affordable again.

Riding the real digital railway

Resignalling of the Thameslink central core has been a long running programme by any standards. But on 26 March the railway press assembled on Platform 2 at Finsbury Park station to take part in a world first.

While the Official Digital Railway bubble was expanding to bursting point, old-school signal engineers were putting in place a unique application of the European Train Control System. And on 26 March it ran its first timetabled train.

Thameslink's central core will have to handle 24 train/h. To achieve this the starting point was fixed-block four-aspect signalling, based on Siemens' Westlock Solid State Interlocking.

Overlaid on this foundation is the Level 2 European Train Control System (ETCS) with cab signalling. To increase capacity, additional intermediate ETCS 'block sections' have been installed within the physical track circuited block sections of the basic signalling system. These 'virtual blocks' allow a following train to move closer to the train ahead, minimising platform re-occupation times.

ATO

While manually driven trains could meet the schedule, to achieve the precision required for the peak service Automatic Train Operation (ATO) sits on top of the ETCS. When a Thameslink train arrives at the start of the ETCS area it 'signs in'. This, in turn, alerts the Automatic Train Regulation (ATR) system that it has a specified train with ATO operational entering the central core. The ATR then sends the train a message updating the running data.

With the train under ETCS, the ATO 'on' button starts flashing. When pressed the train enters ATO mode. In addition to accelerating and braking in line with the stored running instructions, the ATO also opens the doors automatically when the train makes the next scheduled station stop.

When the driver closes the doors, the ATO 'on' button starts flashing again. Pressing the button initiates ATO and the train departs.

With the advent of 'Professional Driving', plus the impact of the Train Protection & Warning System (TPWS), the classic manual driving approach of passing the platform ramp at speed and coming to a halt in a smooth deceleration is no more. Even outside leaf-fall time, trains arriving at my local station slow well in advance and then crawl the length of the platform at not much more than walking pace.

That may be acceptable on the main line, but to maintain the high frequency metro service through the Thameslink central core ATO has to drive hard. On the Thameslink press run, when leaving St Pancras under ATO, my notebook records 'hard acceleration' followed by 'hard deceleration to a sharp stop' at Farringdon. Several of us noted some slight juddering from the wheels at that first stop, as if the wheel slip prevention system on the leading bogie was intervening. Leaving Farringdon the acceleration was characterised as 'sharp'.

Traffic Management

There's no point in being able to run 24 train/h through the central core if you can't regulate the incoming trains to arrive at the portals on time and in the right sequence. This is the role of the Hitachi Tranista Traffic Management system at Three Bridges Signalling Centre, which was due to go live the day after the press trip.

Initially it will be supporting train planning by analysing the next day's timetable, looking for conflicting movements and proposing possible solutions. It is due to be providing real-time traffic management and route setting by 'the back end of the first quarter of 2019'.

Discussing the interface of Tranista with the Siemens WestCad-e workstations at three Bridges has raised some issues around the role of Automatic Route Setting (ARS) in traffic management which I intend to return to in a future column.

During the trip there was also the chance to catch up on the performance of Thameslink's new Siemens Class 700 Desiro City train fleet. In the column I cover the changing approach to developing reliability of this new generation of software enabled rolling stock - very different to the days of my youth at Finsbury Park. That said, we did have the first solid state torque control module to play with on DP2 - electronic if not 'digital'.

New Train TIN-watch

Period 12 2017-18 ran from 4 February to 3 March, which meant that the final week caught the 'Beast from the East'. So how did the new fleets cope with their first contact with snow?

GTR Engineering Director Gerry McFadden tells me that the Class 700s went well in the snow. While the period MTIN fell very slightly, another two units joined the fleet and the number of TINs went up by only six.

Only the horns had an issue. The protecting plastic dome was too close to the bell-mouth of the horn and snow built up clogging the narrow gap where the noise is supposed to come out. The simple solution was to move the dome further away, increasing the gap.

Meanwhile, at North Pole and Stoke Gifford, Hitachi are continuing to demonstrate the benefits of Keizen or continuous improvement. Three fewer TINs and an increase in fleet miles to 263,000 saw the Period MTIN top 5,000 for the first time.

Meanwhile the Table of Truth awaits for those fleets now starting to be photographed on test. TPE's loco-hauled Mk5A could be the next new entrant.

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Over the middle weekend of the Easter holiday we went to Norfolk where the granddaughters were taking part in the Cromer Dance Festival. Most of the Saturday was free and when the weather brightened up we abandoned Norwich Market for the delights of the seaside at Sheringham. It's a while since I visited the North Norfolk Railway and there was an impressive bustle and busy-ness at Sheringham Station which I hope was reflected in the weekend's takings. I even managed to identify a 'kettle' when a 9F drew in. The five driving wheels each side are a dead giveaway. I have to admit it is an impressive piece of kit, even if it does burn coal rather than diesel.

Since then there have been various meetings which I shall gloss over to protect the innocent.

Incidentally, recent weeks have seen the revival of an old fashioned means of confidential documentation exchange – the classic anonymous brown paper envelope arriving in the post!

Next week, of course, it is Infrarail where I will be pounding the aisles on the opening day, Tuesday. As ever, if you see me on the march, don't be put off by my look of fierce concentration and do say hello and have a chat.

The following week it is the Waterfront Partnership's annual conference on the European Train Control System. Apart from the quality of the speakers, Waterfront's conferences attract a wider range of delegates who are more willing to debate and challenge than those at more engineering-focused events.

It is also timely because, in response to requests from non-technical readers, I am working up a lay-readers' primer on current signalling and control technology and its applications. Infrarail will also give me the chance to catch up with the suppliers.

But for now it is time to get stuck into the Invitation to Tender for the West Coast Partnership which will run Intercity West Coast and HS2 services. It was fun writing about technology this month, but duty calls.

Roger