

Lots of techie stuff this month, in the 500th column since Informed Sources began. But there's also some light relief as I consider ways of bringing some fun into next year's celebration of the 200th anniversary of the opening of the Stockton & Darlington Railway. Plus some steam traction, of all things.

Battery train experience building

Siemens goes full discontinuous

Whither Rail 200?

How much is that train in the window

All steamed up

Analysis of Hitachi's experimental replacement of one of the MTU diesel Generator Units (GU) on a TransPennine Express Class 802 bi-mode with a battery, meant that I had to get up to speed on issues like battery capacity, weight, range and charging techniques. How this involved finding out the electricity consumption of a typical house is explained in the column.

Anyway, after a lot of back of the envelope design, I got a range for an all-battery-powered Class 80x Battery Electric Multiple Unit (BEMU) a little over the figure quoted by Hitachi, and I expect they were being a bit conservative.

However, this also explained why Hitachi's previous deal, announced in November 2021, for a similar trial replacing one of the GUs on a Great Western 5-car Class 802, was binned. As GW Managing Director Mark Hopwood explained to Modern Railways in August 2023, it transpired that battery traction 'would not be useful to GWR' - hence the transfer of the trial to TransPennine.

Once away from the wires, the multiple station stops en route to Penzance, each requiring acceleration back to linespeed, could have drained the battery before journey's end. The shorter TransPennine route will provide a much more practical, and less mission critical, test route.

But, overall maximum kudos to Hitachi for investing £15m in doing something practical with batteries rather than talking a good game. There are lots of 'battery trains' around, but nothing on the scale of the Class 802, where the battery is going to have to cope with very high discharge rates for prolonged periods.

Hitachi tell me that the vehicle will be able to regenerate, braking energy into the battery and also recharge when running under the wires - although this is likely to be more of a trickle compared with the 2 MegaWatts from the static battery banks which provide power for GWR's Vivarail fast charge BEMU.

At first sight, charging the traction battery in a BEMU from the 25kV Overhead Line Equipment (OLE) seems such a simple concept as to not need further consideration. But when Eversholt was looking to convert the Class 321 Renatus to a BEMU, it emerged that recharging on the move would be restricted to when the train was coasting, because of the limit on current through the pantograph and transformer.

Of course, you would design a new train with the necessary capacity to handle recharging while under power, including a bigger and heavier transformer. But would the OLE power supply be able to cope? Even the simplest things can be difficult. But, see later.

Meanwhile, on Sunday 30 June, the GWR Fast Charge battery train, ran an all-day trial on the Greenford Branch - a total of 28 round trips. The aim was to see how the performance of the train and the fast charger at West Ealing Station Platform 5 compared with the computer modelled/predicted behaviour. The system performed as expected, with the charging system filling the train with the same energy used for the return trip. According to Informed Sources it was all 'boringly reliable'.

Siemens goes full discontinuous

Perhaps feeling left out of the emerging battery bubble, Siemens opened a new front in June, offering reduced-cost rail decarbonisation through a combination of BEMUs and discontinuous electrification.

Personally, I regard promotion of discontinuous electrification as handing the Department of Transport a new strain of bionic duckweed. When electrification has already lost momentum, discontinuous electrification gives DfT civil servants and their Ministers, not to mention the Treasury, an attractive way out of facing up to the need for a rolling programme.

It was, in retrospect, clearly a mistake for the industry to jump on Rail Minister Jo Johnson's off-the-cuff challenge to remove diesel-only traction from 2040 as an opportunity to promote an electrification programme. The resulting 2019 response on 'how the rail industry will decarbonise', put electrification in a box of options labelled 'decarbonisation' rather than 'better railway'.

Since then, the mood music has changed and, at industry electrification conferences, this column's mantra 'an electric railway is a better railway however you define 'better', is quoted regularly. Reduced emissions are, of course just one of the 'betters', but some way down the list.

Having established where I am coming from, in the column I analyse Siemens' proposal that, away from the wires, BEMUs, would recharge their batteries at intervals from 'small sections' of OLE at key points on route. These would be fed by fast-charging sub-stations supplied from the domestic grid via Siemens' innovative Rail Charging Converters (RCCs).

Potential operators of this BEMU/discontinuous electrification combo 'within the next decade' are listed as Chiltern, Great Western, Northern, ScotRail, TransPennine Express, Transport for Wales plus East-West Rail.

My standard route when it comes to getting rid of diesel traction is the Far North Line from Inverness to Wick. As with Hitachi, Siemens also claims commercial confidentiality when it comes to the capacity of their battery.

Working round this, I reckon two sections of OLE would be needed for the Inverness-Wick line, representing 18% of the route. This is bang in the middle of Siemens quoted typical '15-20%' of route miles for its proposal.

Clearly, the concept is both deliverable and doable. But is it realistic? Well, in the case of the Far North Line I estimate you are looking at spending over £50 million to save 5 tonnes of CO2 from the current four diesel trains a day each-way.

That much money spent as part of a rolling electrification programme - Julian Worth's freight in-fills, for example, would give a far greater benefit, including decarbonisation.

Of course, the Far North Line is an extreme example, and in the column I look at some the other potential operators mentioned by Siemens.

As reported last month, Chiltern's new train aspirations include BEMUs. Some quick sums suggest that a single length of discontinuous electrification would probably make Marylebone-Moore Street a feasible application.

But, 20 minutes charging time at 75 mile/h, increases the length of OLE required to 80 single track km. While writing this piece, the thought 'business case' kept nagging away in the background.

That, plus the likelihood that Government would ever provide funding for both a mainline electrification programme and discontinuous electrification at the same time. It may be heretical, but while you are rolling out the wires on the un-electrified main trunk routes, the emissions from DMUs on secondary lines will be insignificant both in global terms and when compared with the much greater reduction from more electric passenger and freight traction replacing main-line diesel mileage.

Discontinuous electrification's time will come when main line electrification reaches the limits of affordability. Then BEMUs could ensure that those travelling beyond the electrified network can enjoy all the 'betters' of the electric railway.

Railway 200 ideas

In 1975 I was still working in the normal world when the 150th anniversary of the opening of the Stockton & Darlington Railway was celebrated. Not being an enthusiast the occasion passed me by.

Times were even harder then than today. According to a Modern Railways editorial in September 1975 British Rail's promotional budget for Rail 150 had had to be cut, and some senior executives had 'seriously questioned' whether BR should be directly involved at all.

In the event, the cavalcade of 30 steam locomotives at Shildon was a great success, with a reported attendance of 250,000 along the route. And BR made some money running 17 special trains taking spectators to the event.

So what about the 200th anniversary of the S&D next year? According to the organisers of Railway 200, the event will have four main themes:

Education & Skills.

Innovation, Technology & Environment.

Culture, Heritage & Tourism.

Celebrating Railway People.

All very 21st Century. And, of course, having a railway in organisational turmoil will not make organising event any easier. But, I have to ask, where's the fun, the excitement, the sheer joy?

In the column I make two suggestions - one simple, one, probably impractical. Both are aimed at bringing the celebration to the attention of travelling public.

Two spread-sheet exercises in the Notebook this month. The first is yet another example of ferreting out numbers that aren't available officially.

In last month's column, the table comparing the costs of ex-British Rail rolling stock and their modern equivalents was missing a vital piece of information. What would be the impact of the pandemic and the war in the Ukraine on the cost of an electric multiple unit ordered today.

Annoyingly, the very day after we went to press we got a pointer to the likely answer, with the order for another 10 Class 345 trains for the Elizabeth line. This established the current price.

Comparing it with the cost of the original Class 345 order in 2014 took some financial detective work. But the result suggests that industry forecasts of £2m a vehicle for a plain vanilla EMU ordered today are correct.

However, as last month's review of up-coming invitations to tender showed, plain-vanilla is not on the menu. Batteries are now de-rigueur, which is going to add to the cost. Add in level boarding and gap filling gubbins, and I can see prices creeping up to the £2.6m per vehicle of Merseyrail's Stadler Class 777s.

And what will that do for business cases? Southeastern will be the first to find out.

Turbomotive revival

Back in 1935, London Midland & Scottish Railway Chief Mechanical Engineer William Stanier converted a Princess Royal Class locomotive to steam turbine power. Why do I, a noted diesel-head when it comes to traction, mention this?

Well, Eversholt is funding the experimental conversion of a Class 60 locomotive to steam turbine power using technology provided by Steamology. This company's origins date back to the drive developed for a successful attempt on the World Speed Record for a steam powered car.

At the heart of the Steamology system is the steam generating module which burns hydrogen in oxygen to produce steam. In the Class 60 conversion, 20 steam generators will feed four 500kW steam turbines. These will drive the existing alternator.

Why do it? It's more decarbonisation distraction.

As Eversholt explains, 'electrification and use of electric heavy-haul freight locomotives, is the most energy-efficient way to move goods on land. However, large parts of the national rail network remain un-electrified, and this project will provide a complementary means of zero-emissions goods transportation by rail'.

This, of course, assumes a hydrogen economy, with abundant supplies of renewable energy electrolysing carbon-free hydrogen. But even on the sunny day when I was writing Informed Sources, the carbon density of the National Grid was 137g of CO₂ per kWh.

According to my calculations, Eversholt's Turbomotive II, burning hydrogen and oxygen electrolysed using power from the grid, would have been chucking out the same amount of CO₂ per kWh as the existing Mirrlees engine in the Class 60.

Engineering is all about efficiency. My fellow engineering writer David Shirres has developed what I call traction 'efficiency chains'. These show how much energy you need to start with, to get 1kW at the wheel.

Electrification is 83% efficient, fuel cell traction 29%. The Class 60 'well to wheel' figure is 28%. I make the steaming Class 60 21%.

Still we all need a bit of fun in these hard times. And I can't wait to see how you connect and regulate the output of four steam turbines to a single alternator.

Roger's blog

Yes, this is the 500th Informed Sources - the column which has brought you boiling frogs, bionic duckweed and imperilled kittens.

Not to mention the oft quoted 3rd Law. To mark the event here is the full list of Laws to photocopy and keep handy.

Informed Sources Laws

First Law: 'Never assume railways are rational organisations'.

Second Law: 'You can't have too many spanners'

Third Law: 'Always mistrust schedules based on the seasons'

Fourth Law: 'When in doubt - build a demonstrator'

Fifth Law: 'Any change to a prototype will be for the worst'

Sixth Law: 'Don't engage in joint ventures with the French'

Seventh Law: The attractiveness of technology is directly proportional to the square of the distance of its factory of origin from London'

Eighth Law: Nothing works out of the box.

Ninth law Do not try to solve physical design short comings with software.

Tenth Law. If something has to be claimed or declared 'world beating' it probably isn't.

Eleventh Law. A claim that 'safety is our first priority' or 'safety is paramount' usually follows an event that proves it isn't and ignores the reality of ALARP.

Twelfth Law. If an innovation is categorised as First Of A Kind it almost certainly isn't.

Meanwhile, there is no shortage of material to keep me more than busy. Freedom of Information requests have provided fresh information on that perennial topic, East Coast Main Line capacity. Initial analysis of Royal Mail's decision to dispose of its in-house fleet of Rail-Mail EMUs has produced some worrying numbers and I must get to grips with drivers' Terms & Conditions as the new Transport Secretary opens 'peace talks' with ASLEF.

Then, of course, there's the King's Speech, with two rail Bills. The second reading of the Passenger Railway Services (Public Ownership) Bill has already started. Its purpose is to get rid of the current requirement in the Railways Act to franchise passenger operations - hence the urgency. The second is the Rail Reform Bill establishing Great British Railways - although I hope the name will be changed.

Roger

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