Informed Sources e-Preview March 2021

Informed Sources e-Preview March 2021

This month's column highlight's the Government's revival of the 2007 'bionic duckweed' argument against electrification, details the latest EMU conversion to fuel-cell power and covers the second issue raised in the RAIB report on the Neville Hill Collision. Plenty of meaty technical detail, hopefully in an accessible form for the general reader if I am doing my job properly.

Electrification – Shapps goes full duckweed
Scotland joins the fuel-cell demonstration race
Neville Hill collision exposes 26m vehicle limitations*

It has been clear some time that the campaign to revive a rolling programme of main line electrification has been losing momentum. It had been assumed that reinstatement of the Midland Main Line electrification, truncated at Kettering/Corby following the Hendy Review of November 2015, would signal the Government's intent. However, it is now clear that East-West Rail (EWR) has, all along, been the most accurate indicator of the government's, or rather the Department for Transport's and the Treasury's, attitudes to electrification.

When the second round of consultation on EWR began in June 2017, Network Rail revealed that it had been instructed to remove electrification from the scope of the project at the behest of the then Transport Secretary Christopher Grayling. But, responding to a written question on the status of electrification of EWR in 2019, Transport Minister Paul Maynard, replied 'DfT is driving forward the development of policy on the decarbonisation and sustainability of rail and the case for the electrification of EWR is under consideration'.

However, three months later, in January 2020, the Decision Letter confirming the Transport & Works Act for EWR Phase 2, noted that 'some objectors and supporters' had expressed concern that Phase 2 would not provide for the electrified service which has been included in the original specification for the project'. Some measures to enable the Scheme to be electrified were 'no longer part of the Scheme, following cost and viability challenges'.

DfT noted 'The Secretary of State agrees with the Inspector's conclusion that, based on the evidence provided, the benefits of the Scheme are not reliant upon it being electrified and can be achieved with a diesel-only railway'.

It gets worse. Questioned recently by the BBC on why EWR would not be electrified, Transport Secretary Grant Shapps argued that although the line would be operated by DMUs, he hoped more environmentally-friendly trains, 'for example powered by hydrogen or new battery technology, would replace them in the future'. As for electrification, EWR 'might potentially bypass the overhead wire technology altogether'. Mr Shapps added 'we're building it in such a way that we can use, probably, the very latest technology, potentially, in the future'.

Shades of 2007, when DfT ruled that the potential of hydrogen produced from what I termed 'bionic duckweed', meant any electrification scheme would have to pay back the investment within 15 years.

As you may have noticed, the Government has become hydrogen crazed. For example, its 'Ten Point Plan for a Green Industrial Revolution' published last year has two mentions of 'electrification', both referring to road vehicles. 'Hydrogen' had over 50 mentions.

Here in the real world, current analyses of rail traction decarbonisation have allocated a minor role to hydrogen fuel-cell power. This is not surprising because it is a horribly inefficient way of getting electricity to traction motors.

As truck maker Scania, which has supplied both battery and fuel cell powered road vehicles, has pointed out, 'going forward the use of hydrogen for such applications will be limited since three times as much renewable electricity is needed to power a hydrogen truck compared to a battery electric truck. A great deal of energy is namely lost in the production, distribution, and conversion back to electricity'.

Renewable

Proponents of fuel cell traction, reflecting the Prime Minister's ambition for Britain to become 'the Saudi Arabia of wind', argue that this inefficiency doesn't matter because we will have a surfeit of zero carbon electricity produced from renewable sources. Well, perhaps, but with 32 million cars to be replaced by electric vehicles, electricity might not be so freely available that we can afford to waste it hydrolysing water to power small trains.

Plus, of course, currently, only 4% of UK production of hydrogen is the 'blue' variety produced by electrolysis, let alone true 'green' hydrogen from renewable electricity. The bulk of hydrogen (Brown Hydrogen) is produced by Steam Methane Reforming (SMR), which releases CO_2.

Those trying to sell hydrogen powered multiple units press the urgency of eliminating DMUs ahead of electrification. But there are DMUs and DMUs.

Traction decarbonisation analysts are agreed that the Far North and Kyle Lines are typical applications for fuel-cell multiple units to replace DMUs. But what do the cold numbers say on how this will affect CO_2 emissions?

First, how important is replacing the small fleet of DMUs on these lines within the overall task of decarbonising the railway? According to my calculations, the DMUs on these ScotRail services generate just over 7 tonnes of CO2 a day.

Without context that doesn't mean much. Nor does the fact that in 2016-17 the passenger railway emitted 3 million tonnes of CO2 equivalent.

But, how about this? A Cross Country Voyager DEMU making an Edinburgh-Plymouth return journey emits just over 10 tonnes of CO2. That's right: one Voyager round-trip produces 40% more CO2 than the whole of the Far North and Kyle services in a day.

In a rational world expenditure on decarbonising the Far North and similar services could wait until Cross Country was running electric trains under the wires From Edinburgh to Plymouth. And much of this Cross Country route would be an early candidate in the rolling programme of electrification.

But if the aim of the Scots Government is to 'decarbonise' its lightly used lines for bragging rights, egged on by train manufacturers and Rolling Stock Companies with equipment to sell or lease, what are the implications of hydrogen power? In the column I have an interesting table comparing emissions of the various traction options.

Don't get me wrong. Fuel cell traction is likely to have its place on lightly used lines, where even the lowest cost electrification may not be viable and batteries may lack range.

My concern is that, as Grant Shapps' comments on EWR show, 90% of the focus on railway decarbonisation is currently being applied to 10% of the solution. And being blinkered folk, politicians probably really do believe that hydrogen is the solution to powering transport. Unfortunately their civil servants see it as a way of avoiding electrification for the foreseeable future.

Scotland to show Class 314 conversion at COP26

Latest to enter the fuel cell demonstrator stakes is Transport Scotland with the announcement at the end of December 2020 that, in conjunction with Scottish Enterprise and the Hydrogen Accelerator, based at the University of St Andrews, they have appointed Arcola Energy to deliver Scotland's first hydrogen powered train. The initial priority is a working train to show to delegates at the United Nations Climate Change Conference (COP26) opening in Glasgow on 1 November.

Leading the project is hydrogen fuel-cell integration specialist Arcola Energy, which has practical experience of fuel-cell powered road vehicles, including an 18 tonne bus, and is currently equipping a 26 tonne bin lorry. The donor train for the conversion is an ex-ScotRail Class 314.

Arcola Energy's Chief Executive Dr Ben Todd took me through the project which is based at, and will operate on, the Scottish Railway Preservation Society's Bo'ness & Kinneil Railway. Ben emphasised that this is a technology demonstrator and not, like Porterbrook's Hydroflex Class 319 and Eversholt's Breeze Class 321 conversions, a prototype for commercial fleets.

I have to say that Dr Todd was a breath of fresh air, hype-free and willing to go into considerable technical detail, such as design features, ratings and capacities which the other conversions keep close to their chests. He was also happy to go into the technical constraints and challenges of converting the donor train to fuel cell traction.

We also had an interesting discussion on something that has been concerning me, the 'driveability' of fuel cells: in other words, how quickly they can respond to changes in power output. Drawing on Arcola's practical experience with road vehicles Dr Todd explained that there are types of fuel cell which can respond quickly. He instanced the fuel cell in the Toyota Mirai car. This is a large stack mated to a small battery and can be cycled quite aggressively.

However, this comes at the price of shorter life. For the Class 314 Arcola wants a long service life, so the aim is to protect the fuel cell and let the battery 'take the beating' when handling transient power changes. This was just one of the insights from our conversation which I hope readers will find interesting.

Now we look forward to COP26, which looks to be turning into the Rainhill Trials of 2021. In addition to the Arcola Class 314, it is rumoured that Porterbrook may be sending an improved version of its Hydroflex Class 319 as part of the UK rail presence at the conference. And, naturally, you would expect Viva Rail to be in on such an important shop window for its battery technology.

Of course, in the real world it would make more sense for Alstom to display their electrification train. Or even for Network Rail to get HOPS out of storage!

IEP specification at heart of Neville Hill derailment

In the January 2021 column I analysed the role of human factors in the low speed collision between a Class 800 train and the IC125 it was following entering Neville Hill Depot. The IC125 was running at about 5 mile/h and the Class 800 at 15 mile/h.

Despite this low closing speed, the trailing bogies of the second third and fourth vehicles of the Class 800 derailed. The first two vehicles intruded on the 'six foot' to the extent that they would have been hit by a passing train on the adjacent track.

Post-accident testing of the Class 800 and the track failed to find any defects which could explain this large displacement from such a low speed collision. Clearly some aspect of the Class 800 design could have been a factor in the derailment. It was time for some computer modelling.

At the speed of the Neville Hill collision, Hitachi's 3-Dimensional (3-D) modelling predicted correctly the observed vertical and lateral displacement of the trailing bogies. Changing different parameters in the model highlighted two 'strong influences' in the derailment: the high collapsing strength of the inter-vehicle couplers and their large freedom of movement.

In the column I describe the design decisions which were the key factors in the Class 800's propensity for low speed derailment, plus the external considerations which constrained the design, notably, the emphasis in the Intercity Express Programme on 'maximum furnishable space' which translated into a 26m long vehicle. However, when this ideal met the Network Rail train/track interface specification, the seeds of Neville Hill were sown. The die was cast when DfT encouraged a 26 m long vehicle without considering the effect off bogie centres and throw-over on curves.

Something I have tried to do since I started writing for Modern Railways is to make technical issues comprehensible to our general readers. If I've got it right, you should enjoy this story of accident investigation detective work.

COVID cuts fleet mileages

Each month I try to add value to the raw data in the reliability statistics behind the New Train TIN-watch table in the column. This month I have analysed the change in the mileage run by all train fleets since the pandemic started. As you might expect the impact varies with service type, with similar reductions across, say 'InterCity' or London & South East operators.

Roger's blog

Lockdown has taken the fun out of this part of e-Preview. Instead of looking ahead to where I'm going and who, or what, I am going to see, I don't think readers would be interested in which webinars I will be watching or which Teams meetings have been arranged.

But one Zoom event I am looking forward to is an up-date at the end of the month on the Water-Trak adhesion improvement project which I wrote about in August last year. This sprays small quantities of water onto contaminated rail which, counter-intuitively, improves adhesion.

Despite not getting out and about, there is no shortage of things to write about . While I have really enjoyed researching and writing the technical items for this month's column, there are some wider commercial and policy issues bubbling away at the top of next month's contents list.

Roger