

SCOTLAND SPECIAL

RAIL



- **THE RACE TO DELIVER ELECTRIFICATION ON TIME**
- **RAIL'S SIGNIFICANT ROLE IN THE SCOTTISH ECONOMY**

- **NEW CLASS 385: LONGER, FASTER AND GREENER**
- **FORECASTING THE DEMAND FOR NEW SCOTTISH LINES**

THE RACE FOR SCOTTISH SUCCESS

Up against a tight deadline, Carillion delivered electrification of the Whifflet Line on time, on budget and with its trademark flair for innovation and high principles. STEFANIE BROWNE finds out how it was achieved



Final installation and registration on the RACE project. CARILLION.

Ambitious plans to electrify a number of key routes in Scotland are part of a strategy to provide significant economic, social and environmental benefits for future generations. While several parts of the scheme will stretch into 2019 and beyond, portions of the work are already complete and delivering benefits to the Scottish network. One of those was delivered rather earlier than anticipated...

In May 2013, Scottish Ministers announced that electrification of the Whifflet Line (Rutherglen-Coatbridge) would be commissioned sooner and delivered ahead of schedule. Originally planned for completion in 2018/19, the new deadline would be in 2016.

With a value of £28 million, the project linked the West Coast Main Line in the Rutherglen area with the Scottish Central Line in the Coatbridge area, involving design and installation of 26 single-track kilometres of 25kV overhead line equipment. Aptly named the RACE project, it really did become a race to the finish line for principal contractor Carillion.

Despite the accelerated timescale, the benefits from the scheme were not compromised and the project has had a transformational effect on this part of Scotland. Electric passenger trains running over the Whifflet Line can now utilise the Argyle Line, giving passengers access to new service destinations. There is now a Sunday service, giving passengers greater freedom and flexibility. ScotRail has also benefited from improved network resilience, with a diversionary route for West Coast Main Line traffic, which has already come in handy for Caledonian Sleeper services during WCML blockades.

"The RaCE Project was a 'fast tracked'

“ The RACE project has set the benchmark for efficient delivery of electrification schemes. ”

Andy Stocks,
Engineering Services Director, Carillion

scheme which also took on-board the issues of Interoperability, Common Safety Method(CSM) and compliant installation of OLE to the Electricity at Work Act, the first electrification scheme in the UK to do so using Series 2 equipment," says Carillion Engineering Services Director Andy Stocks.

"This meant that the whole team of Network Rail, Carillion and Designer staff had to work together to achieve the correct technical and compliant outcome. This was achieved and is a credit to all those involved."



And the upgrades go beyond network improvements. Because of the option for freight customers to serve terminals west of Glasgow via an electrified route, the economic possibilities for the region are significant. And this will only improve, once the Grangemouth branch has been



Final installation and registration on the RACE project. The final view from Carmyle station. CARILLION.

Project timeline

Start: September 2013
Phase 1 commissioned: September 2014
Phase 2 commissioned: April 2015
Overall completion: March 2016

electrified as part of the Edinburgh-Glasgow Improvement Programme (EGIP).

It has also been a very Scottish project, delivered by the Scots, for the Scots. Most of the people involved in RACE permanently lived in Scotland's Central Belt - the most densely populated area - which also kept people movement costs to a minimum. Local plant hire companies were used to strengthen the supply chain, and some suppliers were given assistance to gain accreditation in the rail industry, opening up more opportunities for the future. At the design stage of the project, Hyder Consulting and Siemens were involved, both working from their Glasgow offices.

The project even provides wider benefits beyond Scotland. Skills gained by people new to the industry during the RACE project have qualified them to work on other projects around the UK. All this training was completed using the recently developed OLEC electrification qualifications and Carillion's depot at Shettleston, which is close to the RACE sites.

It is important to Carillion in all its projects that the work is sustainable, and RACE was no exception. The project complied with all the required environmental constraints, while Carillion went the extra mile by volunteering innovative solutions during the course of its work.

Key to this principled approach was the reuse of equipment recovered from other projects on the network. For example, two track section cabins due to be decommissioned in Glasgow were recovered and reused; 12 redundant booster transformers were relocated from Rugby; and a harmonic damper that counteracts interferences in the OLE supply pattern,

Key successes

■ **Intense delivery programme:** The main section of the route was completed within just 12 months, allowing driver training and rolling stock commissioning in time for the first passengers 15 months after the start of electrification.

■ **Delivery achievements:** An intensive and accelerated project was delivered on time, safely, and to budget.

■ **Benefits:** The work has achieved what was envisaged, with a new range of destinations provided for communities along the line, a Sunday service now operating, more capacity at Glasgow Central High Level station, much improved network resilience, and new routes for freight operators to benefit economic development in the region.

■ **Local delivery:** Carillion and the design team were all Scottish-based, with a locally sourced supply chain.

■ **Skills improvement:** New entrants to the rail industry were employed and locally trained, creating an enhanced future resource for the extensive planned electrification investment in the UK rail industry.

■ **Sustainability:** Redundant equipment was sourced from around the UK and reused on the project. Innovative equipment was used to achieve a variety of sustainable benefits and a reduction in future maintenance requirements.

caused by Pendolinos, was moved from Bourne End (allowing the line to be used as a diversionary route for Pendolinos).

The work itself included several innovations to enhance the long-term environmental benefits, as well as making the construction aspect easier and reducing the maintenance required.

All the hard work paid off in a short space of time. It has enabled electric haulage of existing passenger services, provided more seats on trains, new destinations for communities along the route, the opportunity to divert passenger and empty stock, and allowed freight operators to switch to electric operation. All-in-all, it's a better, more efficient and more flexible railway as a result.

Says Stocks: "The RACE project has set the benchmark for efficient delivery of electrification schemes, including the upgrades required to the railway infrastructure associated with electrifying an existing railway line. The rest of the UK railway industry, in an era when the affordability of electrification is being questioned, would do well to take time to learn why RACE was a success." ■

Delivering a plan of action



RICHARD CLINNICK analyses a Rail Delivery Group document discussing how the railway can support the Scottish economy

On September 13, ScotRail 314213 (second left) leaves Glasgow Central with a train for Neilston. Also in the station are (from left): SR 314204, 314205, 380104 and 158728. This is Scotland's busiest station, and capacity enhancements are needed to enable the city to develop the change in economy in the West of Scotland. STEWART ARMSTRONG.

North of the Border, the Rail Delivery Group (RDG) believes that the railway can play a significant role in the broader economic, social and environmental objectives planned for Scotland.

This means that despite the new trains currently on order, the planned cascade of High Speed Trains, the recent re-opening of the Borders route and the (albeit late-running) Edinburgh-Glasgow Improvement Programme (EGIP), more work is required.

Electrification, longer trains and infrastructure improvements to unlock capacity, designed to meet the expected increase in traffic, are all mentioned in the RDG in its Investing in the Future: Choices for Scotland's Railways 2019 and beyond document, released at the end of September (RAIL 811). The document seeks to discuss how an efficient transport network is essential to delivering a prosperous Scotland.

Having published its Economic Strategy last year, the Scottish Government is currently developing its own infrastructure priorities for the future, that will make its strategy a reality. Alongside the RDG document,

an updated High Level Output Specification (HLOS) and an updated National Transport Strategy, this will be used to inform how transport can help deliver the Government's vision.

Writing in the RDG document's foreword, Jo Kaye, Chairman, Planning Oversight Group RDG and Director, Network Rail Strategy and Capacity Planning, says:

SCOTTISH IMPROVEMENTS TAKING PLACE

- Edinburgh Glasgow Improvement Programme delivery.
- Highland Main Line improvements.
- Aberdeen-Inverness improvements.
- Electrification to Stirling, Alloa, Dunblane.
- Electrification of Shotts line.
- Introduction of HSTs to Scotland's seven cities.
- Recast timetable.
- New, faster trains on cross-border services.
- Improvements to freight capability.
- Clear progress on the strategy and activity required to support introduction and development of services that will operate to and from Scotland using High Speed 2.

Source: Rail Delivery Group

"The market for rail in Scotland has grown significantly. Passenger rail demand in Scotland has doubled over the last 20 years and although there is uncertainty about future demand, current forecasts reinforce the need for continued investment."

Kaye also highlights rail freight, noting that while coal is in steep decline, containerised traffic is rising. She states: "Ensuring that this adjustment in freight markets can be accommodated is a priority for both freight operators and Network Rail, as they are important for supporting sustainable economic growth in Scotland."

She warns that the railway is facing challenges in Scotland, and that it needs to show how it can overcome these by making the best use of its resources, while being seen to be innovating and partnering with stakeholders such as the Government. Customers should be at the heart of the industry, she says.

"Scotland's railway is well-placed to contribute to both internal and cross-border markets. Setting out a long-term context for managing and developing the network will enable their potential to be realised and continued success to be achieved."

RDG believes that the best way to improve is to make the best use of existing and future capacity, and to clearly determine which options best support these ideals.

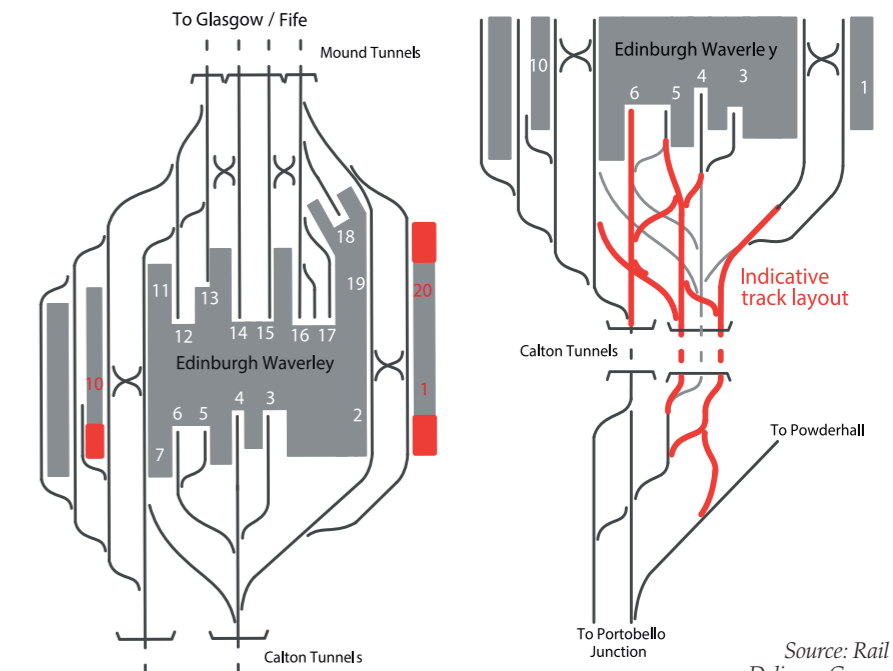
There are anticipated capacity changes. The Scotland Market Study highlighted that by 2018-19 seating capacity will be exceeded on some parts of the network. Trains between Glasgow and Edinburgh via Falkirk and via Shotts will be more than 80% full in the morning peak, as will

ROLLING STOCK

ScotRail will take delivery of 70 Hitachi Class 385 electric multiple units from next autumn, while 27 High Speed Trains will be cascaded from Great Western Railway with the first entering traffic in spring 2018. On cross-border trains, both Virgin Trains East Coast and TransPennine Express will introduce new fleets to Anglo-Scottish trains by 2020.

The Scottish Government recognises the value that new and refurbished rolling stock brings, and highlights an extensive refurbishment that is under

EDINBURGH IMPROVEMENTS



trains into Glasgow from the North East. Across at Glasgow Central, trains from East Kilbride and North Ayrshire will also be overcrowded.

In the east, commuter trains from the Lothians into Edinburgh are forecast to exceed seating capacity in the morning peak, although it is hoped that the planned introduction of longer trains in two years' time will help to alleviate that.

Scotland's busiest station is Glasgow Central. The West of Scotland's economy is adjusting to a long-term decline in manufacturing and primary industries, and to a more city centre and service-orientated economy. The city must be able to tap into this labour market, and that needs support from rail.

The Glasgow and Clyde Valley City Deal helps, but more trains are needed into Central, and RDG recognises this as a challenge. Changes to the operation

of the station is a short-term possibility, through timetable improvements and capacity investment, but longer-term major work is required, it says.

Electrifying the busy routes to East Kilbride and North Ayrshire is one option, while the industry will try to make the best use of the capacity available at the station. Longer-term the station will also be the access point for HS2, and the RDG notes that this must also be considered.

Across the Central Belt, there are suggested plans to improve capacity at Edinburgh through significant infrastructure improvements.

While the western end of Edinburgh Waverley was remodelled in 2008 ready for the re-opening of the Airdrie-Bathgate line (RAIL 592), RDG notes the need for further work to meet increased passenger demand. This involves grade-separating Winchburgh Junction, and creating a chord line and grade-separated junctions at Almond to connect with Winchburgh and Fife lines towards Edinburgh.

RDG says this would improve connections and resilience. It would "also help avoid larger-scale interventions closer to Edinburgh Waverley, and provide a route for larger gauge freight services". Costs for this range from £100 million to £300m.

At the other end of Waverley, remodelling the track layout from Calton Tunnels would "maximise platform capacity and availability at a congested network", the RDG says. This work is also predicted to cost in the range of £100m-£300m, and would complement proposed platform extensions.

Scotland's railways have suffered in recent months with delays to projects, but the RDG has a bold plan for the country. It is now up to the relevant authorities to see them through. ■

FASTER AND GREENER

Hitachi's forthcoming Class 385s promise big improvements for Scottish rail passengers. **RICHARD CLINNICK** reports



Hitachi's new AT200 electric multiple units are set to revolutionise the railways of Scotland.

The 100mph EMUs are being custom-made for Scotland. They will be longer, faster and greener than the trains they are replacing, and will enable passengers to travel in greater comfort.

Fully air-conditioned, and fitted with plug sockets and WiFi capabilities, the AT200 is the train for 21st century Scottish passengers. It will also add capacity to a line highlighted by the Rail Delivery Group as otherwise being full in the next couple of years (see pages 40-41).

The AT200 is the first commuter train delivered by Hitachi to the UK, following the successful introduction of Class 395 Javelins on High Speed 1. They are the first Hitachi trains delivered to Scotland, but will be followed in 2018 by Azumas for Virgin Trains East Coast, and in 2019 by the AT300s for TransPennine Express.

The AT200 trains will also bring a boost to the British economy by being built here. More staff are being recruited by the company, as a result of the extension of the contract for the number of EMUs to be manufactured at Hitachi Rail Europe's rail

vehicle manufacturing facility in Newton Aycliffe (County Durham).

This includes 50 apprentices in both engineering and manufacturing who will work on the trains, and Hitachi Rail Europe (HRE) hopes that they will be encouraged to stay and develop with the company.

HRE also points out that the supply chain for the trains has been localised, with 72% of the components sourced in the North East.

The Class 385s will offer almost double the capacity compared with trains currently running on the Edinburgh-Glasgow route. Being electric, they will reduce CO₂ emissions by up to 35%, and they are much quieter, both internally and externally. They will also offer a much smoother ride for passengers and are planned to bring

previously unheard-of levels of reliability following their order.

The trains will be introduced onto Scotland's railway system from next year, in a deal worth £370 million. And in an innovative funding agreement, after 25 years (2042) the trains can be acquired by Transport Scotland. This means that the AT200 fleet cannot be cascaded south of the border, and therefore is truly a train for Scotland.

The Scottish Government ordered the trains in October 2014, five months after Abellio was awarded the ScotRail franchise. The deal was formally signed in March 2015, and just nine months later (January 2016) the first AT200 was being tested in Japan.

Fourteen (ten fully assembled and four part-assembled) pre-series trains are being shipped to the UK from Hitachi's Kasado Works in Japan, with the remaining 56 trains built at Hitachi's Rail vehicle manufacturing facility in Newton Aycliffe.

Currently T1 is at the Velim test track in the Czech Republic (with T4 en route), and T2 and T3 have arrived in the UK for testing and are currently at Newton Aycliffe. A further two (T5 and T6) will be delivered to the UK and will be the first to be fitted with the full interior ready for traffic.

CLASS 385 ROUTES

- Glasgow Queen Street-Edinburgh Waverley (via Falkirk)
- Edinburgh Waverley-North Berwick
- Glasgow Central-Neilston/Newton/Cathcart Circle
- Edinburgh Waverley-Glasgow Central (via Shotts)

HITACHI RAIL EUROPE AT200: BASE SPECIFICATION

The Class 385 trains are formed from the Hitachi AT200 product platform, offering operators a wide variety of interior options for life-cycle flexibility.

Specification options include:

- **Train Configuration:** 3 - 12-car
- **Speed Range:** 100mph-125mph
- **Max acceleration:** 1 m/s/s
- **Nominal Vehicle Length:** 23 metres
- **Power Supply:** Dual Voltage (25kV AC/750V DV plus battery-hybrid)

■ **Door type/positions:** Sliding plug/one-third, two-third

■ **Cab Design:** Full Width/Gangway Cab

■ **Interior:** Cantilevered bay and unidirectional seating and table layouts, standard/wide intercar gangway, LED lighting throughout, power at every seat, passenger WiFi provision, passenger information system with seat reservation, First Class compartment with reading-lights, range of luggage and toilet facilities.

the past," he says, explaining that this keeps knowledge together and allows designs to evolve.

He cites the example of the traction equipment designed and manufactured by Hitachi, and which is fitted to Class 465s operating for Southeastern. Since being fitted the trains have covered for than 50 million miles in traffic, but there has yet to be failure as a result of the traction. And this is equipment retrospectively fitted to a 1980s-designed EMU, so in theory the '385' (with its evolved traction package) should be more reliable.

Another key component known to cause regular failures is the HVAC equipment, and again Hitachi Rail Europe has designed its own equipment that is fitted to its trains.

So far this is only on Class 395 Javelins in the UK, but it is also fitted to the Class 800-802 Intercity Express Programme trains to be introduced from 2017, as well as the AT200 fleet.

Again, this offers improved reliability, and is evolved from a design in widespread use on trains manufactured by Hitachi and in use around the world.

But what do the customers think? "This train will be truly transformational for customers, and proudly positions Scotland's transport at the apex of transport initiatives in the UK," says Abellio UK Managing Director Dominic Booth. "I am particularly pleased that Transport

Scotland and my procurement team in Abellio have negotiated such a great deal with Hitachi, which is underpinned by some of the finest engineering in the world.

"Our innovative finance package allows the Scottish Government and Transport Scotland to take ownership of the trains after 25 years, and will have long-term benefits for Scotland. This new fleet will be a major contributor to sustainable economic growth and ensure that the full benefits of EGIP are realised for passengers."

Phil Verster, managing director of the ScotRail Alliance, says: "These faster, longer, greener trains will mean more seats and shorter journey times with less impact on our environment. When we have them in service, they will transform travel between our two biggest cities."

Radford says that ScotRail has been engaged with Hitachi for "the entire way" on the Class 385 project, including changes to the cab and saloon interiors. Passenger groups have also been involved in the final designs for the trains.

This British-built train will truly transform the way people in Scotland travel. And for Hitachi, it is not only the first in what it hopes is a succession of orders for its commuter trains in the UK, it is also a chance to contribute to the UK supply chain and engineering staff shortage. Everyone will benefit from the introduction of the Class 385s next autumn. ■



Predicting the demand for new rail

The Borders Railway, the longest new domestic rail line to be built in the UK in the last 100 years, has been (by most measures) a huge success.

Far from being the white elephant that some prominent voices ominously warned about, demand for the 30-mile line between the Scottish capital and the Borders town of Tweedbank has outstripped most expectations. The trains and car parks are often crowded, and ScotRail has already had to increase some of the most crowded services from two-car to four-car sets.

How could the forecasters have got it so wrong? And was this a one-off flawed forecast, or a symptom of a general ingrained conservatism on the part of consultants and modellers?

While rail forecasts will always be subject to error, the recent track record of the appraisal of new rail lines and stations in the UK does not exhibit any clear tendency one way or the other. There is as much chance that the forecasts will over-estimate as under-estimate the out-turn values, although the discrepancies seen on the Borders Line appear to be higher than average.

The difficulty lies in the difference between forecasting developments that extend or alter existing transport provision and the trickier prospect of starting from scratch or re-opening services that have been long disused.

If you are thinking of increasing frequency, reducing journey times or reducing crowding, then well-understood and well-calibrated elasticity-based relationships can be used to predict the impact on passenger numbers (providing the competing modes are 'fairly typical').

Well-calibrated multi-modal transport models should be capable of getting close to correctly predicting the out-turn impact of both new and improved rail services when the underlying travel pattern is correctly represented, and the model only needs to predict the mode-choice response.

However, the problem becomes more difficult when the travel patterns change significantly as a result of the scheme - either due to a change in destination of trips made by existing residents, or as new residents

Systra Director for Technical Development **DAVID CONNOLLY** discusses the Borders Railway and new techniques being used to better forecast demand

move into an area owing to its improved accessibility to the jobs at the other end of the new rail service.

The difficulty in forecasting these demographic responses will be exacerbated if significant numbers of new houses (and/or new employment centres) are built in the relevant corridor having not been included in the planning forecasts used for the original patronage forecasts, especially since these new houses are likely to be disproportionately attractive to those who are likely to use the new rail service.

It would be interesting to see the extent of this bias in the forthcoming evaluation of the Borders Rail, to help calibrate and validate this type of land-use response in the sophisticated Land-use and Transport Interaction (LUTI) model which is now available for Scotland.

Predicting the demand for Park & Ride and rail-heading (for example at the new Tweedbank station) is also more difficult than the simple 'car vs bus vs rail' modal choice. This is due to the additional complexities associated with availability of the car, the parking space and the seat on the train and the additional choices available, since each station on the new line needs to be included in the choice-set.

Transport Scotland and the various Regional Transport Partnerships (RTPs) are working towards having a suite of up-to-date multi-modal and LUTI models, with the relevant level of sophistication to be used to take account of these various factors.

However, the level of sophistication and network detail required to cover all potential new public transport investment comes with the downside of long run-times. This makes it hard to use these national/regional models to test the large number of infrastructure, timetable, stopping pattern and land-use scenarios that typically need to be considered during the design and appraisal of a new rail scheme.

Additional tools are therefore needed,

especially in corridors at the edge of or between the main travel-to-work areas represented in Transport Scotland and the RTP's new regional models.

Systra has developed corridor modelling tools that can capture the specificity of local areas with a lighter touch than the detailed whole-network forecasting models allow, by applying a first wave of approaches that are less technically sophisticated (using spreadsheet-based mode choice, for example) but which are bespoke to the local

area and specific to the 'envelope' of local factors.

The users of these tools can quickly consider and understand a wider range of scheme variants than would be practical with the large off-the-shelf models. It is also easier to add specific local features of travel in a given corridor (for example, airport passengers using the proposed new station at Dalcross/Inverness Airport) to these bespoke spreadsheet-based models, than it would be to add and calibrate an additional traveller type within a full regional model.

Once the bespoke 'spreadsheet' has been used to appraise the broad business case, and rank and sift the numerous variants, the emerging 'preferred options' can then be tested in more detail using an appropriately

detailed regional network model.

This dual approach is more powerful than a single line of attack, and allows more of the 'imponderables' to be pondered. In particular, it makes it easier to consider and test the full envelope of potential future demand scenarios - typically including a no-growth in demand scenario, a high-growth scenario combining additional housing and jobs, and consideration of a competitive response from the competing modes.

However, as the legendary American baseball coach Yogi Berra famously said: Making predictions is hard, especially about the future. With the best will in the world, the out-turn patronage might still not match the forecasts, especially if the world changes

significantly between the forecasting and the minister cutting the red ribbon, which is why transport planning is never dull."

However, we need to ensure a willingness to evaluate past successes and failures, and the flexibility to make changes to the forecasting where they are needed.

The Rail Evaluation Guidance put out by Transport Scotland - and widely applauded within the industry - is a good example of how this can be done. And the response to it is evident in the innovative approaches being applied by companies such as Systra and others to new rail and transport projects throughout the country.

With a bit of luck, the uncertainties in the crystal ball forecasts will gradually disappear like the snow in a snow globe. ■

With Freightliner 66602 at the head, and with 66605 bringing up the rear, the first 3,000-tonne ballast train enters the Borders Railway at Newcraighall in October 2014. The new Borders Line opened in September 2015, with passenger demand in its first year far outstripping expectations. PETER DELANEY.



“ The level of sophistication and network detail required to cover all potential new public transport investment comes with the downside of long run-times.”

