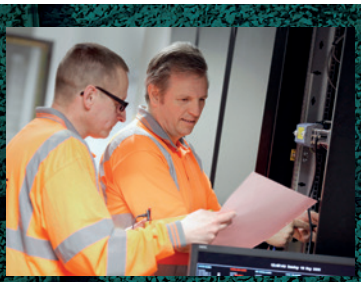
SIEMENS MOBILITY

KEEPING THE UK MOVING

VELARO NOVO HIGH-SPEED



SIGNALLING AND ELECTRIFICATION

NEW FACTORY IN GOOLE

INVESTING IN PEOPLE

A SPECIAL Modern railways PUBLICATION IN ASSOCIATION WITH SIEMENS Ingenuity for life

20 AWARDS WON BY SIEMENS MOBILITY FLEETS AT GOLDEN SPANNERS

OVER 170 YEARS OF UNITED KINGDOM TRANSPORT HISTORY

200 GRADUATES AND APPRENTICES IN THE UNITED KINGDOM

OVER 450 TRAINS IN DAILY PASSENGER SERVICE ACROSS THE UNITED KINGDOM

OVER 4,000 SIEMENS MOBILITY EMPLOYEES IN THE UNITED KINGDOM

OVER 5,000 SIEMENS MOBILITY EMPLOYEES IN THE UNITED KINGDOM

22,000 UNITED KINGDOM SUPPLY CHAIN JOBS SUPPORTED

£1.8bn SPENT WITH SUPPLIERS IN THE UNITED KINGDOM

A **Modern Railways** supplement in association with SIEMENS Ingenuity for life

Celebrating the railway of today… and tomorrow

I recently read a comment piece by a journalist working outside our industry with a focus on 'what's wrong with our railways'. As someone who has worked in the transport sector for many years, and also as Industry Chair for the Rail Supply Group, it made me quite cross.

Now, I won't deny that there are improvements we can make to our railways, and that there are challenges we all face day-to-day. To do so would be akin to burying your head in the sand. What I do think we should recognise is just how much progress we've made (and continue to make) for our industry, and how hard everyone works to provide an essential service for the travelling public, for business and for our country's economic benefit.

I'm not going to focus on the 'B' word and what could be the effects on the rail industry. There are far cleverer people than me looking at scenario modelling and considering the financial implications of every variable. And you only have to switch on the radio or TV, or open a newspaper, to find yourself drowning in opinion and assumption. What I will focus on is my previous statement of 'essential service'. These days travelling by train isn't a luxury, it's a necessity.

- Going to spend holiday time with family and friends – travel by train.
- Making your way to a business meeting – travel by train.
- Moving goods from one part of the country to another, or even overseas – send them by train.

Rather than look at what is wrong all the time, maybe we should look at what is right? Look at all the technological advancements and innovation in our industry. Celebrate our hard-working railway family who do their best day and night to keep things running. That's not to say we should ignore opportunities to make things better, or take learnings and best practice into future projects, but we shouldn't always look at the negative.

I have a feeling I am preaching to the converted here, but I think it is still worth saying. We are quick to judge and focus on the things that aren't going quite as well as we'd like, but the British way is to be modest and not linger on accomplishments. That can't be right. Let's shout to the world about how great we are. We achieve world firsts. We are committed to taking on large (and even supersized) projects and making them a success. We work together to achieve greatness.

Let's keep moving forwards, pushing the boundaries and exploring the art of the possible and let's take this essential service on a journey that never stops. Just like our 24-hour, 365-day railway.

GORDON WAKEFORD
CEO, Siemen Mobility Limited
@gordonwakeford

Providing an essential service: Nos 707029/023 work South Western Railway's 09.54 London Waterloo to Windsor & Eton Riverside service at Feltham on 10 March 2019. **Jamie Squibbs**

CONTENTS

Contributors: James Abbott, Roger Ford, Philip Sherratt, Ian Walmsley
Design: Matt Chapman
Advertisement Manager: James Farrell

Published for Siemens Mobility by Key Publishing Ltd. Registered Office: Units 1-4, Gwash Way Industrial Estate, Ryhall Road, Stamford, Lincolnshire PE9 1XP

Cover photo: No 700150 overtakes No 717005 arriving at Oakleigh Park on 25 March 2019. **Antony Guppy**

UK signalling success

ROB MORRIS reflects on the proud heritage of Siemens Mobility's Rail Automation business, in conversation with **JAMES ABBOTT**

Siemens Mobility is a true British success story when it comes to railway signalling. Equipment has been manufactured in the UK for over a century from its site in Chippenham, supported by numerous offices across the country and two other manufacturing sites in Poole (the site for GSM-R railway communications) and Ashby-de-la-Zouch (a centre for Systems Control & Data Acquisition – commonly known as SCADA). With complete project lifecycle abilities all possible from the UK, Siemens Mobility is a formidable force in railway signalling and telecommunications.

'The business has been a hotbed of innovation' relates Rob Morris, Managing Director for Rail Automation at Siemens Mobility. 'We have made four generations of signalling: mechanical interlockings, relays, solid state and now – with European Train Control System – digital signalling. Research and development is important for us: for example, the world's first use of ETCS overlaid with Automatic Train Operation, on the core of the Thameslink network in central London, comes from the UK with global expertise.

'The Thameslink project provides an example of the strength of Siemens Mobility globally, with international colleagues supporting the development of the ATO over ETCS solution. Over 1,000 people work in R&D worldwide – this experience and expertise can be applied to projects all over the globe.'

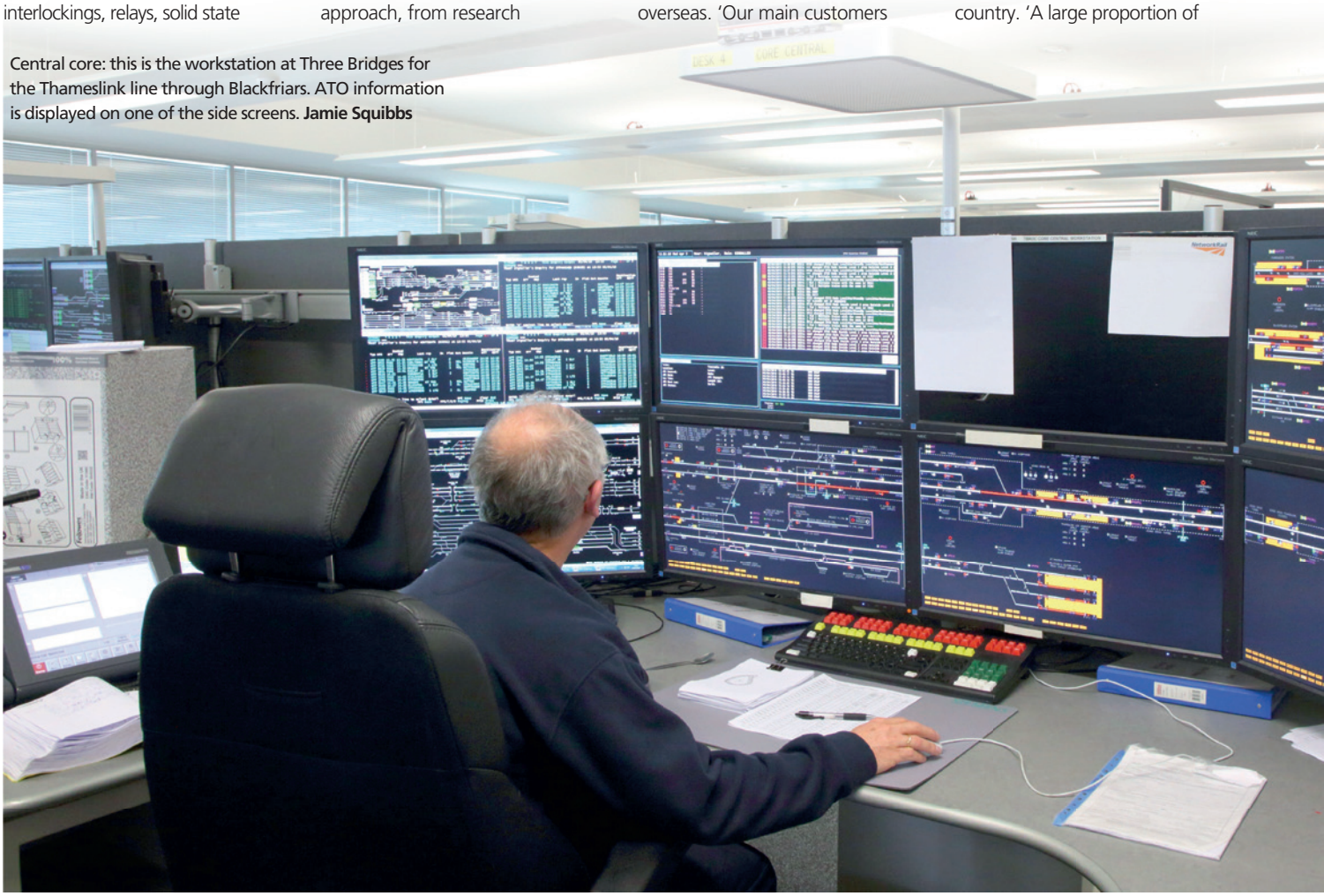
The company has 11 main offices spread around the country, placing Siemens Mobility personnel close to customer operations. 'We've got a cradle-to-grave approach, from research and development, systems architecture, systems design, civils work for signalling projects, equipment manufacture, testing and commissioning – through to aftercare and obsolescence management' explains Mr Morris.

He contrasts this offering with some competitors who only offer some of the items on that list – adding that the comprehensive coverage has served the company well, making Siemens Mobility the largest provider of signalling in the UK. As well as designing and executing its own projects, the company fills in the gaps for others – for example Siemens Mobility provided signalling control on a recent project in Stafford for another contractor.

The firm is also an export powerhouse, with about half of the UK's production going overseas. 'Our main customers are in those parts of the world where there are rail systems with signalling systems designed along British lines, such as Australia and Hong Kong' says Mr Morris.

KNOWLEDGE-BASED BUSINESS

Rail Automation accounts for about half of Siemens Mobility's 4,000-odd employees in the rail industry in the UK. The company has established links with research bodies and academia and is a keen recruiter of graduates and apprentices; it now has 37 graduate engineers working on signalling projects. It is at the 'soft' end where most of the value-added is derived nowadays, with UK-produced hardware accounting for only around 10% of turnover. But the contribution to the economy should not be underestimated, as about 40% of Rail Automation's revenue is spent in the supply chain, bolstering the signalling sector across the country. 'A large proportion of



Central core: this is the workstation at Three Bridges for the Thameslink line through Blackfriars. ATO information is displayed on one of the side screens. **Jamie Squibbs**

that is with small and medium-size enterprises' says Mr Morris, 'so we've got British skills and capability supporting a UK supply chain.'

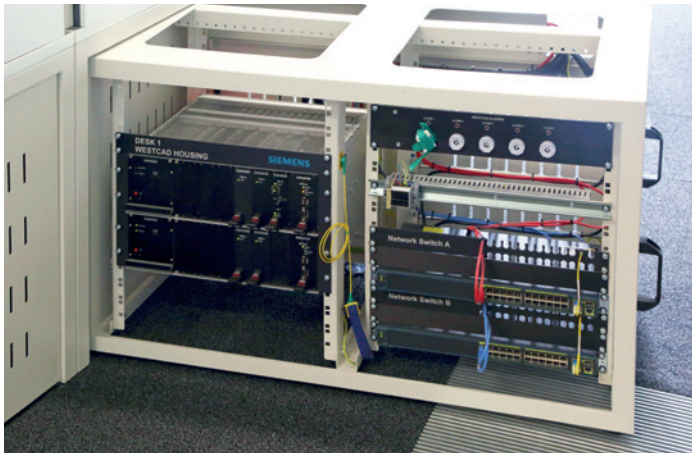
RANGE OF PROJECTS

Rail Automation's projects in the UK stretch across the whole gamut of rail operations. At one end of the scale are highly-intensive urban operations, such as the pioneering system on the Thameslink core (discussed overleaf) and the distance-to-go signalling on the Victoria Line – at 36 trains per hour in the peaks, this supports the most intensive service level of any line on the London Underground system.

For less intensively-used lines, Siemens Mobility has developed a low-cost, digital-ready option, based on the system developed for the pioneering Welsh Marches project on the Shrewsbury to Crewe line a few years ago. An evolution of this system has recently been applied in the North Wales coast line resignalling, where Siemens Mobility met Network Rail's aspirations for containing costs.

Other work includes Easter 2019's Angerstein project, covering an area of the inner-suburban railway on the approach to London Bridge: signalling control on this busy section of track is now from a single Siemens Mobility Controlguide Westcad workstation at the Three Bridges Rail Operating Centre (ROC). The Angerstein Route Relay Interlocking (RRI) has been replaced by Siemens Mobility Trackguard Westlock Computer Based Interlocking (CBI). Meanwhile, a recent project in Yorkshire saw Controlguide Westcad in York ROC taking control of the north trans-Pennine route from Huddersfield and Healey Mills signal boxes: altogether, a total of 109 Controlguide Westcad control systems have now been installed around the country.

New equipment: a roadrailer assists a team installing a new signal post at Banbury in 2016.



Controlguide Westcad: well over 100 installations are now in place. This example is at Three Bridges Rail Operating Centre. **Jamie Squibbs**

This gives just a flavour of the sort of projects the company tackles. 'At any one time we're dealing with up to 200 projects in the UK' says the MD.

'We're recognised for certainty of delivery' maintains Mr Morris, adding that Rail Automation achieved 100% success in delivery in Control Period 5 (2014-19). 'In the past 18 months we have achieved Supplier of the Year status with Network Rail, Transport for London and Transport Scotland, so we must be doing something right!' A slew of industry awards has also been won, including the Operations & Performance award in the 2018 Railway Industry Innovation Awards for the Thameslink High Capacity Infrastructure programme, featuring the pathbreaking ETCS with ATO overlay.

THE FUTURE

Siemens Mobility intends to maintain and expand its position in the UK signalling market, both for urban and main line railways. It has been quiet for the company recently as regards Transport for London work, 'but we've got a strong desire to grow' says Mr Morris. 'We're interested in Crossrail 2, as well as deep tube signalling renewal – the Piccadilly, Bakerloo, Central and Waterloo & City Lines.'

Shortage of funds has recently prompted TfL to shift Piccadilly resignalling to the right, but Mr Morris urges that there are possible solutions. 'We're keen to see the broader capabilities of Siemens Mobility, including project financing, come into play.' He adds that current trends, where technology is shifting from the trackside to the train, favours full-system providers such as Siemens Mobility, with both rolling stock and signalling in the portfolio. Additional in-house capabilities such as electrification, traffic monitoring and ticketing systems give further opportunities for one-stop shopping.

On the main line railway, one of the big questions at present concerns the affordability of signalling projects. 'I'm confident we can find a way of reducing costs with digital signalling' says Mr Morris.

There is a problem in that a bow-wave of renewals is building up, with the signalling on many lines reaching life expiry around the same time. 'We aim to address that by building up the skills base in the UK. The most efficient way forward is to have a constant volume of work – and by the end of Control Period 6 (2024) there should be a plan in place to achieve that. The Rail Sector Deal agreed with Government at the end of last year set the groundwork and I am confident that with the co-operation of the Department for Transport, Network Rail, HS2, Transport for London and the supply chain we can overcome the challenges.' mr

Signalling for tomorrow's railway

ROGER FORD explores Siemens Mobility's cutting-edge signalling technology

It was the industrialist Percy Barnevik who, back in the 1970s, came up with the strategy for industrial conglomerates of 'think global, act local'. I've always had problems visualising how this works, but Siemens Mobility's Rail Automation business has finally provided the practical example I have been seeking.

Rail Automation is the classic example of the modern global industrial group, with all that means in terms of support for its national operations, but as Mark Ferrer, Operations Director Digital Railway, emphasised several times during the interview for this feature, the biggest strength of the business when it comes to signalling is its UK capability. As Mr Ferrer puts it, 'delivered in the UK for the UK'.

This applies across the board, from business and systems development, product design and systems integration to manufacture and commissioning. 'We have people who understand how UK systems work and how they are migrating to new forms of operation because we talk to our customers and understand their objectives.'

THAMESLINK PIONEERS

Network Rail's decision to signal the Thameslink central core with the European Train Control System Level 2 (ETCS L2) and overlay the cab signalling with Automatic Train Operation (ATO) seemed high-risk back in 2010. Siemens Mobility delivered this radical combination on time with the first passenger-carrying train running under ATO control in March 2018.

But already technology is overtaking the Thameslink ATO system. Siemens Mobility is now developing ATO Track Side (ATO TS), one of the projects under the Shift2Rail European research programme, with test track operational testing due to commence this year in collaboration with Network Rail.

Taking Thameslink as an example, currently each Class 700 has a map of the ATO network stored in memory on board. ATO TS would transmit the current map to the train, avoiding the need to update stored maps on each train when the infrastructure changes.

GLOBAL MARKET

Which is where we come to the 'think global'. Many railway operators have been showing interest in Thameslink on the basis of 'now we know it can be done, we want it'.

And Mark Ferrer is keen to ensure the export potential of this technical lead should not be lost, as has been the case with British innovations in the past. This overseas interest centres on ETCS plus ATO for main-line trains that run around or across cities.

Classic ATO on metros is a proprietary closed-loop system. What Siemens Mobility has achieved on Thameslink is to create an open system which provides metro functionality. Asked for countries showing interest in a Thameslink-type solution, Mark Ferrer instances Australia, where, of course, Siemens Mobility is long-established through its Westinghouse heritage.

As ever, the national railway is the showcase for exporters and while Thameslink is an excellent reference, momentum needs to be maintained. The immediate opportunity is the Moorgate branch: this is due to be the next application of ETCS L2 under the resignalling of the East Coast main line (ECML) south of Peterborough, which is currently being procured.

TRACTION

Meanwhile, Siemens Mobility is already heavily involved in the UK ETCS programme, having won the contract for the cab fitment of the rail freight traction fleet. Potentially worth up to £150 million, this is at the 'first in class' development stage.

Installation will be undertaken at locations around the country. Siemens Mobility and Network Rail will also support the freight operators with driver training on the new equipment, 'It is', says Mark Ferrer, with a touch of

MAINTAINING THE LEAD

'The UK has a privileged position in the world of global train control and we've got to maintain that leading position. If we don't, then other countries will catch up and overtake' - **Mark Ferrer, Operations Director, Digital Railway, Rail Automation, Siemens Mobility**

ETCS L2 with ATO overlay: a Class 700 passes an ETCS marker board in the six foot at St Pancras International low level on 16 December 2017. **Keith Fender**

understatement, 'a big job', with completion of first in class work due for 2022. Siemens Mobility is also leading on ETCS cab fitment for several passenger fleets.

TRAFFIC MANAGEMENT

Reflecting the overseas interest in ETCS Level 2 with ATO for trains running around cities, similar potential exists in the UK, for example the Great Western main line east of Reading, the East Coast main line south of Peterborough and the West Coast south of Milton Keynes.

While ATO provides consistent driving, such high-intensity railways also call for Traffic Management (TM) to improve regulation and minimise the impact of service perturbations. Up to now Siemens Mobility's involvement with TM has been limited to third party suppliers interfacing with its Controlguide Westcad control centre work stations.

However, Siemens Mobility has now developed its own TM system known as Controlguide Westcad Insight, a digital conflict detection and resolution system. This system is complemented by the Dynamic Route Setting (DRS) facility for Westcad – Siemens Mobility's name for Automatic Route Setting (ARS).

Previously Westcad workstations have been equipped with a third-party ARS. The first DRS System was commissioned in mid-2017 on the East Nottingham Workstation which resulted in the user workload reducing by 86%.

According to Mark Ferrer, development of DCR 'is going well'. The pilot application, covering selected Westcad work stations at Derby Rail Operating Centre (ROC), is due to be installed shortly, with trials starting later this year. Incidentally, the Derby resignalling contract included the 100th Westcad work-station to be commissioned.

TECHNOLOGY

Siemens Mobility has two established interlockings, compatible with each other and with ETCS. Trackguard Westlock is backwards-compatible with the existing SSI data links and Trackside Functional Modules (TFMs). This is a valuable feature for relocking schemes which retain existing trackside hardware.

The company also still supplies TFMs for resignalling schemes, for example the recently-commissioned Angerstein scheme in south east London. However, technology is moving on.

Trackguard Westrace Mk II can be used as a standalone interlocking system, or interface to a wide range of existing equipment. Siemens Mobility's new WTS (Westrace trackside system) uses this technology to replace TFM functionality with high speed, modern, network-connected modules, and can be used with either Westlock or Westrace central interlocking processors.

New workstation at Manchester Rail Operating Centre: Siemens Rail Automation's Dynamic Route Setting product has been installed here. **Courtesy Network Rail**

IMPROVED DATA LINK

The first application of Siemens Mobility's Trackguard Westrace Trackside System (WTS) was on Thameslink, where it has proved to be very reliable. Other recent applications include the Weaver to Wavertree scheme, Liverpool Lime Street, Derby resignalling, Huddersfield – Bradford and Sutton.

Mark Ferrer notes that reliability brings its own challenge – that of 'skills fade'. 'How do you ensure that people, working on equipment that rarely needs attention, can maintain their knowledge of the product?'

Westrace was the basis of Siemens Mobility's original 'Modular Signalling' solution, which featured on the Crewe – Shrewsbury pilot scheme. A further evolution of this system was commissioned on the North Wales Coast Upgrade Programme, and the company is keen to identify further schemes where this low cost, digital-ready solution would be appropriate.

ETCS

While ETCS Level 2 is Network Rail's long-term resignalling policy, linked to existing asset life, conventional renewals will continue to be necessary for some time. Some CBIs in the market are described as 'ETCS ready', but Siemens Mobility prefers the term 'digitally sympathetic solutions'.

This is where resignalling doesn't implement ETCS, but the 'conventional' replacement is sympathetic to an easy migration to ETCS in future. A simple example is the use of WTS.

At recent conferences I have detected a more pragmatic approach to ETCS from European speakers. Cost and technical issues have seen European railways implementing variations on the basic concept.

In the UK, Network Rail has been working on 'Hybrid' Level 3 and demonstrated the concept over a year ago. Siemens Mobility was involved in this work and successfully demonstrated its prototype HL3 radio block centre (the trackside processor used by ETCS) and HL3 with ATO. Pure Level 3, also known as 'moving block', calculates the Movement Authority given to a train based on the location of the train ahead.

Implementation of Level 2, using existing fixed block signalling, has proved challenging enough: Level 3 increases the degree of complexity. Hybrid Level 3 retains the axle counter or track circuit, but divides the railway into a series of data-defined 'virtual' blocks. This enables more than one train to move within a train detection section.

Siemens Mobility has its own development programme and Mark Ferrer believes that Hybrid Level 3 is 'potentially a game-changer for the industry because it starts to bring main line technologies closer to metro technologies'. It would enable greater capacity and flexibility within the existing railway infrastructure, while also reducing costs and trackside equipment.

Apart from cost, fewer trackside assets mean fewer potential failures, which in turn increases reliability and availability.

BIG DATA

Finally, maximising availability brings us to Siemens Mobility's involvement in the application of real-time diagnostics and 'big data' to predict potential failures, allowing pre-emptive interventions. Data Capture Units (DCU) can be fitted to a wide range of equipment, from S&C to signalling power supplies. The DCU is a data gateway which enables data, whether it is diagnostic, state of the railway or any other data for that matter, to be securely sent from assets to real-time analytic systems providing greater insight into the health and state of the railway.

Siemens Mobility has just won a contract from Network Rail to upgrade the GSM-R radio in 11,000 driving cabs. Each train will be equipped with Siemens Mobility's Nexus v4 cab radio, which not only provide improved communication quality and performance but also the potential to benefit from additional applications on a separate processor card within the radio.

This most recent cab radio represents a real step change in technology and capability, with the system able to support applications such as a Connected Driver Advisory System (C-DAS) and Remote Condition Monitoring (RCM). Providing the opportunity for targeted and preventive maintenance, rough ride/defect detection, improved passenger experience and energy consumption from predictive and efficient journey profiling, RCM is a sustainable and inexpensive way of monitoring track assets.

The upgrade has been designed to support current 4G technology providing the building blocks to the Future Rail mobile Communications System (FRMCS). mr

Smart maintenance keeps the trains rolling

IAN WALMSLEY reports on cutting-edge maintenance practices for the Desiro City

The Government-sponsored Thameslink Programme has heralded one of the biggest capacity increases the UK rail industry has ever seen. The summer timetable change sees still more services and will require 93% of the Class 700 fleet available. This can only be achieved with reliable trains and a top-flight support system, especially when the trains end up in remote sidings at the ends of the system come night time.

PHONING HOME

I could write 'Remote Comms', but I don't want to bore you, so ET it is. The 'phoning home' technology has allowed this fleet of complex trains in eight- and 12-car fixed formations to progress towards 20,000 miles between failures and will one day will see Class 700 Desiro City engineers returning to the Golden Spanners stage. The one-time novelty of equipment phoning home with its status has evolved into its own science, with over 7,000 possible status messages coming from 115 trains as they occur: that is a lot of data. The science is sorting it out and making it work for you rather than you for it.

Nerve centre for the Thameslink fleet: front entrance to Siemens Mobility's Three Bridges traincare facility.

Thameslink works by units being in the right place for the morning rush – you don't want to be driving empty stock all over the system when it could be being maintained. Although there are sidings at the likes of Horsham, Gillingham, Peterborough and Cambridge, there are only 'proper' depots at Three Bridges and Hornsey. While in my maintenance days it was common to write 'FHD' (For Home Depot) in a Class 47 repair book and send it back to Bristol, today the fitter is more likely to go to the train; in fact, one out of every three of the Desiro City maintenance people is based away from the main depots.

It would be impossible to test everything or spend time fault finding in those few precious hours the train can be worked on, so accurate and clear instructions from the system are vital. Driven originally by the need to clear all floor space in the vehicle, most electrical equipment is located in the ceiling. This later proved a great advantage as attention in sidings needs no external facilities and there are no safety risks from ground conditions or passing trains.

DEPOT ENGINEER

The best job on the railway has not been replaced. Although the system will automatically generate work orders, there is still a human eye setting priorities and thinking how the same problems can be avoided the following night. Work order generation is automated to a degree, although human intervention sets the trigger points based on available resources and an assessment of how urgent the repair is. For example, today's processing power of door operating condition has led to some dramatic improvements in how incidents related to doors are handled. With the wealth of data coming from all 4,500 doors, the system knows the difference between an obstruction on a busy train in the centre of London and an imperfect door setup in need of adjustment. The system can create a work order to investigate any one of 30 scenarios. In any of these cases, the driver is instructed to lock the door out of use, which can be done without leaving the

Clean and safe environment: visitors see the way modern trains are maintained at an open day at Three Bridges depot.

driver's cab and continuing in service without causing a delay.

Of course, what you tell the driver to do also influences the reliability figures, since reading instructions and working through a flow chart will turn a little delay into a big one. For example, across the fleet 4,500 doors are being monitored and with all that data it is possible to see problems coming. All the driver needs is a simple instruction such as 'Isolate door B on vehicle X', which he can do on the driver's display without leaving the cab.

Rather than expecting someone to drive a train and manage defects it is far better to watch the information offline (in the control room, the depots and by the software engineers in Erlangen, Germany) and make recommendations with the knowledge of what the train is doing for the rest of the day. While remote comms were once designed just for fault finding they are now used much more to make real-time decisions on the fleet operation.

DON'T CALL US...

The systems can be used by the social media team. So, rather than a stock response, how about this for a reply: 'Thank you for contacting us, the vehicle you are travelling in is indeed eight degrees too warm and we apologise for that. The fault appeared at 12.30 today and will be rectified when the train comes out of service this evening at Cricklewood. We apologise again for this problem, but I can assure you our engineers are doing everything they can to eliminate this failure mode. In the meantime, our system indicates that the second vehicle from you towards the front of the train is at the correct temperature and is not heavily loaded.'

Introducing Junipers on South West Trains was my experience of a battle from 2,000 to 115,000 miles per casualty, and involved software, hardware and human issues. But the biggest delay savings came from how you told the driver to react to different faults, and limiting the advice given on their screen to a 'need to know' basis. On the Desiro City only about 4% of possible condition updates are advised to the driver.

THERE'S AN APP FOR THAT

The great thing about being Depot Engineer is that it holds power and responsibility. Big fish, small pond. But as befits the modern railway, Captain Kirk would be lost without his first officer Spock, in this case a Data Scientist. The job of the Data Scientist is to use the unprecedented mass of data streaming in and devise means of predicting or managing failures. This can be done by using Siemens Mobility's Railigent software, which brings in data from various systems on the train to manage a problem.

One of my stock phrases on reliability is 'there is no such thing as a one-off failure', and Fleet Delivery Manager Ian Macleod agrees 'If it can happen once it can, and will, happen again' he says. If you want spanner-winning reliability you need a plaster for every sore, so engineers are on to every failure looking at how to prevent a recurrence, or at least mitigate the effects to avoid a delay. The word then goes out to the outbased teams, with their box of electronic plasters.

THE NEXT GENERATION

Being retired, I think of the '700s' as a new train, but then I also remember Class 50s being built. We should remember though that the '700s' were a response to the Department for Transport's Thameslink tender specification in 2007 with the first bid in 2009, so their technology is about 10 years old. While that doesn't make a lot of difference with bodyshells or bogies, it is a lifetime in communications equipment. How many new phones have you had in the last 10 years?

The future will bring yet more data, but less of it will be output for human consumption. Already more than 30% of works orders are automatically produced and Ian Macleod wants to increase that while moving into digital spares, automating the supply chain. Sixteen major suppliers already tie in to Siemens Mobility's Railigent system, with data coming in from fleets all over the world.

In case you should think this is all a machine-learning environment I should point out that the scheduled examination is not dead, there is still no substitute for the human carrying a torch. They have spotted things I never would and will continue to do so, but they need to do it less often and the routine stuff like wheel checking is now done automatically as the trains roll into the depot.

The top priority is, and will be, to make a safe and reliable train; but there will always be some failures. For years the top of the charts on nearly every fleet were doors and traction equipment, yet now neither feature in the top 10 – well done Faiveley and Siemens Mobility respectively.

In a world where everyone involved has the facts at their fingertips, surely similar success will be achieved across the board? But then someone finds a cheaper supplier and the game starts again: 'Won't Siemens Mobility do that too?' I asked. 'No we won't' came the reply. mr

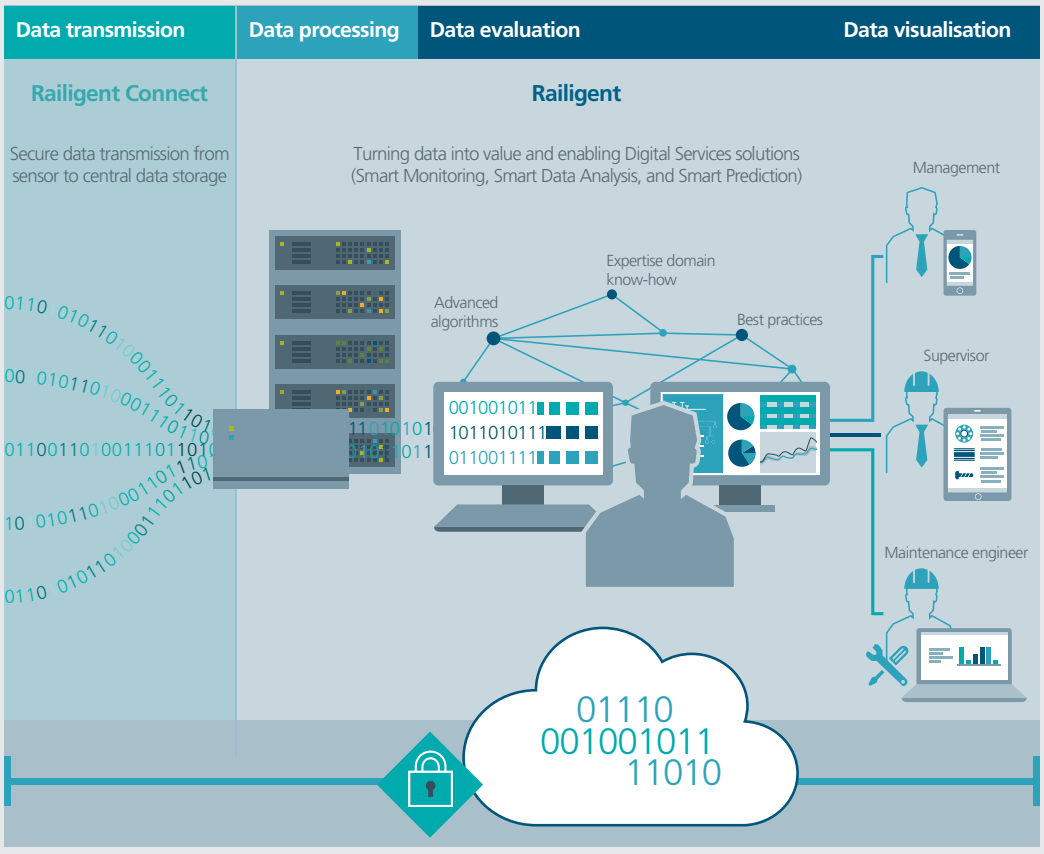
MAKING SENSE OF DATA

Railigent is the Siemens Mobility platform that provides a set of standard tools for data processing, storage and analytics. A key requirement is reliable train-to-shore communication: this is Railigent Connect, which enables real-time, automated data transmission from any rail system to landside operations.

Once all the data has been collected, Railigent leverages advanced analytics and expert domain know-how to convert the variety of data into an intelligent, customised user interface.

Targeted, role-specific information and expertise for operation and maintenance are derived from the same underlying data: output ranges from highly-aggregated Key Performance Indicators for managers to detailed root cause analysis for maintenance staff in the depot.

Railigent facilitates a range of useful outputs: increased availability, reduction of operational risk, life cycle cost reduction and increased utilisation rate, as well as condition-based and predictive maintenance.



Site for a new factory: sign board at Goole.

A new rolling stock plant for the UK

WILLIAM WILSON tells **JAMES ABBOTT** about exciting plans for a new factory

Siemens Mobility is set to become a fully-fledged manufacturer of rolling stock in the UK, with a new assembly plant in Goole in East Yorkshire being planned. Not only will Goole feature vehicle assembly, but also warehousing of spares for the Siemens Mobility rolling stock fleet in the UK and several ancillary activities in a 'Rail Village'.

The new plant is all part of a changing scene for Siemens Mobility in the UK rolling stock sector. The arrival of the last of the 25 Class 717s for the Moorgate line is the latest in a series of orders for the rolling stock business over the past three decades. Following a toe in the water in the 1990s with the Heathrow Express Class 332s and Leeds triangle electrification Class 333s, for both of which it teamed up with a Spanish supplier for body assembly, Siemens Mobility's entry into the UK main line market as sole supplier began with the Class 360s for the Great Eastern in 2002.

In the years since, Siemens Mobility has grown into one of the largest suppliers of new trains in the UK, building trains for routes from Dorset to Scotland. This has included the 1,140-vehicle fleet of Class 700s for the Thameslink route, the busiest in the UK. In the May 2019 timetable this fleet is tightly-diagrammed with 106 units required in service in the peak, from a fleet of 115 units. The eight-car Class 700s in particular have a high requirement, with just two spare sets in the peak timetable. 'They're steadily gaining in reliability and climbing up the MTIN (miles per technical incident) tables' reports William Wilson, Managing Director of Siemens Mobility's Rolling Stock business unit.

UNDERGROUND

The Goole factory hopes to open with trains for Siemens Mobility's most recent UK customer for new trains: London Underground. The company beat off competition from established suppliers to the Underground to win the order for Piccadilly Line replacement stock, with an order for 94 'Inspiro London' trains. While having a UK factory was not a precondition of winning the order, Siemens Mobility sees itself as committed to the UK market for the long term and considers a British plant will be a useful asset.

If the options to the order are executed, which would see new trains for the Bakerloo, Central and Waterloo & City Lines added to the Piccadilly Line order, there is 12 years of manufacturing ahead on this one project alone. With the possibility of winning orders for HS2 trains and other projects, Goole could be busy far into the future.

While work on planning the Goole operation gets underway, with ground-breaking scheduled to take place in the spring of 2020, Siemens Mobility's established metro car team in Vienna is playing a large part in the Piccadilly Line ramp up.

'The Siemens Deep Tube Upgrade Programme (DTUP) team brings together engineering and design expertise and project management delivery from across the Siemens Mobility organisation with people from Austria, Germany and the UK' says Mr Wilson.

'This "one team" approach has mobilised a team of over 100 people. The design and engineering is being led by our expert metro team in Vienna with specialist engineering support from teams in Germany and Graz, Austria. The programme and stakeholder management is being led by a team based in London who are working closely and collaboratively with the London Underground customer team.'

The first few trains will be built at the company's plant in Vienna, with later trains in the build being assembled in Goole using bodyshells from Vienna and bogies from Graz. The aim is to start production in Goole in 2022, by which time the Piccadilly Line

fleet will be about 15% complete. 'We have to get the quality right and technology transfer right, then we'll bring it across to the new plant' reports Mr Wilson.

The new digitally-enabled train will represent a step change for the deep tube, with air cooling and walk-through car connections like the new sub-surface stock.

'It's a challenging project, as we have committed that from the outset the new stock will be at least as reliable as the trains they replace' explains Mr Wilson. Readers familiar with the bathtub curve of reliability, where it takes some time to get on top of failures of new trains while teething problems are ironed out, will recognise the challenge. On top of that, although the 1973 stock in use on the Piccadilly today is some of the oldest on the system, it is also one of London Underground's most reliable trains, featuring basic electro-mechanical equipment with few complex systems to go wrong.

RAIL VILLAGE

The recent boom in rolling stock orders for UK franchises has led to a plethora of train assembly plants and proposals, with one view being that nowadays a rolling stock plant is a disposable item that can be closed when the industrial scene changes. Siemens Mobility's William Wilson is adamant that this is not how he sees the company's £200 million Goole plant, with plans in place for the long term.

'The purpose is to assemble rolling stock in the UK for the UK market, employing about 700 people on the site' he says. But it won't just be assembly taking place in the Rail Village. At 66 acres, it is a big site, and will include a commissioning hall as well as an assembly hall, along with warehousing and space for sub-suppliers to set up next to the factory. Another possibility is a modification hall – Siemens Mobility currently has roads at Bletchley on which it can do rolling stock mods, but a newly-built alternative would be useful. A 1km test track and a building for traction drive and gearbox refurb work, which in 2023 is moving across from an existing factory at Leeds that Siemens Mobility is outgrowing, will complete the setup.

The recently-established £8.5 million Siemens Mobility bogie service centre in Lincoln, currently working on Class 374 e320 Eurostar bogies and Desiro bogies, will remain there. This is a discrete activity, and the plant is within easy reach of Goole.

One reason why Goole was selected is because of good communications: 'It is near the M62, has a connection to the main line railway and a dock on the river. The area offers a willing workforce and it is just two hours from London by train' says Mr Wilson. The MD is intending to build on that last point by integrating the operation of the Yorkshire manufacturing plant with Siemens Mobility's London HQ. 'I intend that members of my team should regularly be in Goole' he says. 'Furthermore, we intend to base all the digital analysis of running information for the Siemens fleet, a 24/7 activity currently undertaken in London, at a new digital operations centre in Goole.

'I see this as a long-term commitment to the area and it is my ambition that Siemens Mobility will be the best employer in the region. We want to establish a creche and make it as easy as possible for women and other groups that perhaps have not traditionally entered rail engineering as a career to work here.'

Inspiro London: impression of new train for the Piccadilly Line.

Desiro City: new train for the Moorgate inner-suburban route.

A MODEL EMPLOYER

'The diversity agenda is high up in the whole of Siemens Mobility' states William Wilson, Managing Director of the company's Rolling Stock business unit.

It is an uphill struggle to recruit more women to the rail engineering sector, with outdated images of the industry common in the public at large. 'When we hold open days at our depots, visitors are amazed at the cleanliness – they're expecting grease and oily rags, whereas the reality today is computers and data analytics' says Mr Wilson. 'We've got to get the message across that engineering is for everyone, and that means starting early and convincing girls in schools as well as women already in the workforce.'

Practical help goes a long way: for example, a creche at Siemens Mobility's signalling factory in Chippenham in the summer holidays has proved a key attraction in retaining women at the plant.

Siemens Mobility has worked with the charity for single parent families, Gingerbread, in a bid to attract the heads of one-parent families, as well as groups such as LGBTQ equality campaigning charity Stonewall. As a signatory of the Armed Forces Covenant, Siemens Mobility provides schemes for service leavers to join the rail industry. 'Our aim is to create equity, so that minority groups feel we offer an environment where they get a chance to progress' says Rob Morris, MD of Siemens Mobility's Rail Automation business.

The strategy extends to detail such as closely examining the job descriptions in recruitment ads to ensure they are not subliminally appealing to the sorts of groups that have traditionally been associated with the rail sector, to the exclusion of those that haven't.


Bringing on young people: open day at Siemens Mobility's rolling stock depot at Three Bridges.

Much of the emphasis is on bringing on young people, with extensive graduate recruitment and apprenticeship programmes that see Siemens Mobility paying for education and training for people seeking a career with the firm. Underlining the commitment is the company's role as industry partner with government in the National Training Academy for Rail in Northampton, a facility which offers a range of courses to introduce people to the rail industry and burnish skills for those already in it.

Velaro Novo: visual of Siemens' new high-speed design.

VELARO NOVO RAISES THE BAR

Reduced whole life cost is a key feature of Siemens Mobility's new high-speed offering, as **PHILIP SHERRATT** reports

In time even the most successful product platforms need changing. So it is for Siemens Mobility's high-speed offering; four generations of the manufacturer's Velaro are now in service, including on Eurostar services between London and continental Europe, where the trains are branded by the operator as 'e320'. Velaros have been in service since 2006, and in addition to the Eurostar fleet are currently operating in Germany, Spain, China, Russia and Turkey, together covering one million kilometres a day.

But last year, ahead of the InnoTrans trade fair in Berlin, Siemens Mobility announced the development of a new high-speed platform, the Velaro Novo. Designed for service at speeds of between 250km/h and 360km/h, the company said the Velaro Novo 'sets new standards for efficiency and sustainability and at the same time offers the highest passenger comfort and convenience'. The product was the result of development which began five years earlier.

A key consideration in developing the Velaro Novo has been attention to reducing whole life cost, where there are some striking changes. The classic Velaro design has progressed over the past 13 years, with each iteration representing an evolution of the design. With Velaro Novo, Siemens Mobility took the opportunity to look at the platform again, throwing out constraints entwined with another iteration of an existing design and taking a fresh look at the possibilities for a high-speed train.

LOW ENERGY, LOW WEIGHT

The headline statistics are impressive – running at 320km/h, the Velaro Novo uses 30% less energy than previous Velaro models, while the train's weight is reduced by 15% and available space for passengers is increased by 10%. This last point is an important consideration with operators worldwide seeking to maximise capacity whilst simultaneously maintaining good standards of passenger comfort, HS2's Train Technical Specification for the initial fleet of conventional-compatible trains being no exception.

Maintenance costs are set to be reduced thanks to the integration of state-of-the-art measurement and sensor technology. In the modern age everything is going digital: Siemens' existing classic Velaro fleets are digitised trains, producing over one billion data points which

can be used to improve reliability, particularly of the gearboxes and traction motors. With Velaro Novo the benefits expected from further digitisation go much deeper into the efficient operation and maintenance of the trains. Specific diagnostic use cases such as passenger door sacrificial wear trending were incorporated into the requirements specification for the product.

DEVELOPMENT

'The Velaro Novo development was led by a cross-functional team' explains Kevin Clark, Siemens Mobility's HS2 Service Bid Manager. 'We had people from the service side and the engineering and procurement side, working together through the requirements specification process using field experience from the classic Velaro. For the Velaros in Spain and Russia we're directly involved with the maintenance, so we're very close to issues about what the key drivers are. That experience helped us put ease of maintenance and lower life cycle cost at the heart of the Velaro Novo's design.'

Mr Clark says some of the new ideas resulted in 'the kind of opportune alignment of benefits that can only occur with a radical and innovative development step'. One example is the adoption for the Velaro Novo of a permanent magnetic traction motor. 'This contributes to reduced energy consumption and maintenance costs and a significant reduction in mass, with higher traction performance reducing the number of motors to 12' explains Mr Clark.

This particular change has been a result of the ongoing development of the Velaro concept, with benefits carried from one programme to another. The first use of permanent magnet motors was undertaken as a trial on the classic Velaro operating in Russia; the motors were not providing a tractionised solution but were used to test the mass and dynamics effects. 'This is a key evolutionary step – moving from laboratory testing to fitment on rolling stock in regular use' says Mr Clark. 'They performed much as expected, but there were lots of learnings, which has led to further evolution of the concept.'

Key to the focus on whole life cost has been underlying knowledge of where the main cost drivers are, with Mr Clark noting the importance here of the braking system components. 'Brake pads and discs are significant contributors to the cost of maintenance' he explains. 'Having a more efficient traction motor means we can regenerate more of the time, leading to a direct cost reduction and further energy efficiency benefits.'

LONGER VEHICLES

Another key change has been to the train architecture. Traditionally, a standard 200-metre-long high-speed train has comprised eight vehicles or more, but for the Velaro Novo Siemens Mobility has opted for a seven-car design. Clearly this brings benefits in terms of additional passenger space, but it has other advantages too. 'There is a reduction in maintenance costs too' says Mr Clark. 'The train architecture has driven the work to reduce mass, as the train's weight is spread over fewer axles, which informed work on the in-board bearing bogie.' But with running gear accounting for nearly 50% of direct maintenance costs, there is a significant saving here through having fewer maintainable components with the seven-car variant.

Aerodynamics has also been a focus with the Velaro Novo, where again significant savings are promised – the new concept will see a 30% reduction in drag associated with the design compared to the classic Velaro, thereby contributing to reduced energy usage. Methods of improving the aerodynamic characteristics include the adoption of a fully enclosed underframe and significant changes on the roof of the vehicle, notably to the pantograph well, which has an optimised footprint with the high voltage equipment enclosed to smooth airflow.

Mr Clark notes there is an important balance here between aerodynamic characteristics and ease of maintenance. 'Aerodynamic panelling has the potential to hinder technicians in accessing parts of the vehicle's underframe if panels hinge across the pit in the depot' he says. 'Our solution for Velaro Novo is to have two panels which hinge longitudinally, which means for the majority of maintenance tasks access is not impeded, with only the biggest jobs requiring these panels to be moved. This is an example of the level of detail and thinking going into the design, and the consideration for how the trains will be operated.'

TESTING THE CHANGES

To assist with the development of the Velaro Novo, Siemens Mobility produced a test car, which has been integrated into a Deutsche Bahn ICE set operating within Germany since April 2018. Siemens' aim is to amass some 100,000 kilometres of performance data to assist with the new train's development. 'Each component on the test car has been manufactured as if it is a serial part – so it's to the same standard and design as it would be in serial production' Mr Clark explains.

All this could come to fruition as soon as 2023, subject to Siemens Mobility receiving orders for the design. After much development, Siemens Mobility is now ready to take the Velaro Novo into production. mr

Reducing whole lift cost: the Velaro Novo is designed to be cheaper to operate and maintain.

Classic Velaro: Eurostar Class 374 'e320' set at St Pancras on 14 March 2018. **Philip Sherratt**

Leading the cost reduction challenge

ROGER FORD profiles developments in Siemens Mobility's Rail Electrification business

Following the cancellation or truncation of several high profile schemes, such as Cardiff – Swansea and the Midland main line north of Kettering, it might be thought that the UK electrification market was in decline. In fact, Siemens Mobility's Rail Electrification business is busy on a range of contracts, both upgrades to existing installations and new schemes.

One project has a particularly high profile – the Power Supply Upgrade (PSU) for the East Coast main line (ECML). To handle the impact of current diesel fleets being replaced with electric traction plus more frequent services, the original 1989 electrification equipment must be upgraded.

Siemens Mobility is a member of the alliance responsible for the upgrade, which is in two parts. PSU1 covered the southern end of the ECML from King's Cross to Doncaster, and the key Office of Rail and Road milestones for this phase have been achieved. Now the focus is on the northern section, where PSU2 is vital to the introduction of the new high frequency timetable in 2021.

East Coast Power Supply Upgrade: Siemens Mobility is part of the alliance responsible for upgrading equipment on this key artery. **Courtesy Network Rail**

NEW TECHNOLOGY

When the alliance of Network Rail, Siemens Mobility, VolkerRail and J Murphy & Sons was appointed to the project, the outline proposal for PSU2 had been based on the installation of auto-transformers which effectively double the line voltage. However, it was clear that accommodating the timetable would, as Head of Engineering Danny Aisthorpe puts it, 'need more volts and amps to run increased electric services'.

As a result, Siemens Mobility investigated a range of options and came up with technical solutions which would provide the extra power while significantly reducing the capital cost and programme. The selected option is centred on new 80MW feeder stations at Hambleton Junction south of York and Marshall Meadows near Berwick. This system design strategically supports not only future requirements for the ECML but also future electrification of the Trans-Pennine and Hull routes.

In parallel, Siemens Mobility will be replacing switchgear at a further 25 locations along the route. And work is also underway on enhancing electrical protection systems. Detecting and interrupting fault current more quickly improves overhead line reliability and may reduce severity of injury in the rare event of trespassers accessing OLE.

Siemens Mobility's ASG25 switchgear is a classic example of a change in policy bringing multiple benefits. Network Rail set the supply industry the challenge of replacing conventional gas insulated switchgear, previously employed on electrification schemes.

Siemens Mobility's solution was its Sitras ASG25 25kV AC switchgear using air-insulated technology providing significant environmental benefits. This is supplied as a containerised unit, assembled and tested in the factory and then transported to site ready to be connected to the supply system.

With ASG25 the only site requirement is a cast foundation on which the pre-commissioned containerised unit is placed, ready to be connected. This approach has already been successfully employed on recent Scottish electrification schemes such as Holytown to Midcalder on the Shotts line.

Currently ASG25 switchgear is being supplied for eight substations on the Bedford – Kettering – Corby Midland main line scheme. For one of the largest of these, Siemens Mobility delivered the switchgear in two containerised sections. These were united on site to form the complete unit.

LOCALISATION

ASG25 provides another example of Siemens Mobility's commitment to UK localisation and value add. The basic product had been developed and manufactured in Germany and was substantially re-engineered for the UK market.

To serve the UK market, a new ASG25 production unit was opened at Siemens Mobility's Hebburn plant on Tyneside. The first UK manufactured units were delivered for PSU1 and Hebburn will now be supplying PSU2, including the new Durham feeder station. 'You can't have a factory much closer to the application than that' says Head of Products & Services Mike Barnby.

With ASG25 now an established product, the focus has shifted to improving its performance by exploiting digital technology. An obvious example is digital condition-based monitoring linked to Siemens Mobility's Mindsphere cloud-based application, either directly or via the SCADA system. Virtual reality is also being used for training technicians on ASG25 maintenance.

INNOVATION

A recent innovation has been the introduction of static frequency converters (SFC). Railway electric

traction requires a single phase 25kV AC supply, but the electricity supply from the grid is three-phase.

Traditionally the railway has taken power from two phases, creating what is known as an 'unbalanced load'. An SFC eliminates this compromise by converting the three-phase input into the single-phase traction current.

Siemens Mobility's product is the Sitras SFC Plus. A distinguishing technical feature is the use of Integrated Gate Bi-polar Transistors (IGBT) for the power switching. Transistors have lower losses than the thyristors used on older SFCs. This higher efficiency translates into cost savings and a reduction in rail's carbon footprint across the equipment's service, while its self-healing technology improves system reliability.

Similar technology is used in Siemens Mobility's static VAR compensator (SVAR). These are used to regulate voltage, power factor, harmonics and stabilise high-voltage electricity transmission networks. Siemens Mobility has recently won its first contract from London Underground for a Sitras SVC Plus. An important factor in the Siemens solution was the smaller size, which provided greater flexibility on installation.

SYSTEMS

So far, the emphasis has been on Siemens Mobility's electrification hardware. However, the hardware is complemented by the ability to model electrification systems. Modelling includes the timetable, traction types and other parameters and optimises the electrification system from the location and rating of supply points and feeder station to the position of neutral sections. The ECML PSU was modelled in this way and has resulted in significant reductions in capital cost and programme.

As Mike Barnby argues, the key to a successful project is to look at the electrification system in its entirety and make best use of proven technology. While ASG25 and SFC Plus were new to the UK, they were derived from designs already in service. Similarly, surge arrestors and the company's Overhead Line Electrification Equipment (OHLE) are proven products. 'When you bring this all together you get a robust electrification system which is deliverable at minimum risk' says Mike Barnby.

OHLE

Which brings us to Siemens Mobility's Sicat OHLE system. This was used on the Milngavie to Larkhall and Shields to Gourock OHLE renewal programmes. 'That was 10 years ago, and we never hear about it – there have been zero failures' notes Mike Barnby.

Subsequent Scottish electrification schemes have used Network Rail's Series 2 OHLE, effectively a modernised British Rail Mk 3b design. However, a major departure from the Mk 3b philosophy has been the use of proprietary custom-designed cantilevers.

Siemens Mobility's Sicat, in contrast, perpetuates the Mk 3b concept of fabricating the cantilever from a standard aluminium tube assembled with a small range of fittings. The cantilever supports conductors in a traditional arrangement, which in comparison reduces the mast height when compared with cantilevers with top support arms.

This use of standard materials enables the cantilevers to be both locally sourced and assembled. It also results in a lighter assembly arrangement benefiting from easier installation and reduced mast and foundation loadings.

Another benefit is the ability to procure OHLE cantilever components in the early stages of the programme without impact from site deviations such as built location of foundations and masts, in comparison to factory preconstructed type cantilever arrangements.

First application for Sicat on the ECML could be the OHLE for the new turnback platform at Stevenage. The intention is to evaluate the introduction of lightweight aluminium cantilevers on the route, but off the main line, with the prospect of it becoming the standard equipment for renewals.

MASTER SERIES

Network Rail has now adopted the Master Series (MS) OHLE for new schemes. This is basically Series 2 with some Series 1 features. Siemens Mobility is working with Network Rail to add Sicat to the range of approved cantilevers. However, the Sicat SA variant also offers the opportunity to further optimise the Master Series by increasing span lengths from the standard 65 metres to in excess of 70 metres, reducing installation and materials costs.

In traditional UK electrification the catenary is staggered to the left or right between masts. As seen at the pantograph, the contact wire moves from side to side, providing even wear on the current collector.

SUSTAINABLE

'We are fully committed to driving the delivery of sustainable electrification in the UK, enabling the shift from diesel to electric rolling stock, which in turn reduces the UK rail carbon footprint. Our overall capability to design cost-effective electrification systems using proven technologies along with development of future products for UK Rail Electrification projects is certainly going a long way to meeting our objective.' - *Shaun Cooper, Managing Director, UK Turnkey Projects & Rail Electrification, Siemens Mobility*

With Sicat SX the supporting catenary wire is staggered the opposite way to the contact wire. The resulting offset means that the dropper wires, supporting the contact wire from the catenary, are at an angle rather than vertical. This provides a more rigid catenary, allowing the distance between masts to be increased to 100 metres, as seen in Denmark.

TRU CHALLENGE

Siemens Mobility is closely involved in the Trans-Pennine Route Upgrade (TRU) cost challenge. Experience with clearances on the Great Western electrification and other recent schemes resulted in the Department for Transport proposing partial electrification for TRU to cut costs. However, following publication of the McNaughton report on electrification costs, Network Rail and the supply industry have taken up the challenge of fully electrifying the route for the same money.

Several of Siemens Mobility's cost-saving technologies have already been mentioned, but it is worth highlighting surge arrestors. These can reduce electrical clearances, avoiding costly route clearance interventions.

SAFER ACCESS

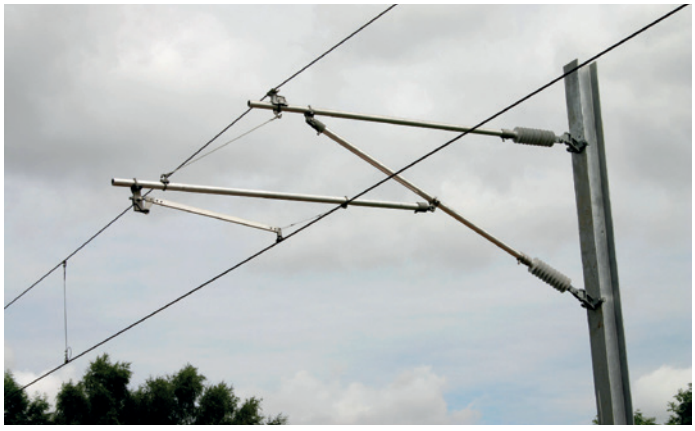
While AC electrification has dominated this review, Danny Aisthorpe reminded me that Siemens Mobility is currently developing a DC short-circuit device. Existing DC switchgear on Network Rail has a circuit breaker to turn off the current. However, for safe access to the track an isolation is required, and staff have to be sent out to separately connect the conductor rail to the running rail.

Building on a unit in service in Sweden, Siemens Mobility's proposal is to provide DC traction power switchgear with an integrated short-circuit device which can be used to short the conductor rail to the running rail remotely. Clearly the driver for this is workforce safety – taking people off the track. However, there will also be benefits from reducing the time needed to take a possession in DC electrified territory.

Siemens Mobility has over 700 DC switchgear panels in Network Rail's South East and Wessex Routes. The earthing device has been designed for retro-fitment as part of a midlife refurbishment. Additional functionality could be provided at the same time.

There are similar requirements for isolation on AC electrified lines. Following our interview Siemens Mobility was due to demonstrate a new digital Remote Secure Isolation concept to Network Rail. Using an iPad, an electrical isolation can be applied remotely to a section of line and an 'electronic padlock' put on circuit breakers from the worksite.

This typifies what Danny Aisthorpe describes as Siemens Mobility's role as an 'end-to-end solution provider: a product manufacturer who understands the needs of the system and can reshape the product base to meet the customer's requirements'. mr



Zero failures: Sicat equipment installed on the Larkhall branch line.


SIEMENS
Ingenuity for life
When intelligent infrastructures don't just react but anticipate. That's ingenuity for life.
With a growing need for mobility, advanced software solutions help to meet the demand for increased availability, optimised throughput and enhanced passenger experience. With over 160 years of experience in passenger and freight transportation and our IT know-how, we are constantly developing new and intelligent mobility solutions to provide greater efficiency and safety. These include prescriptive monitoring systems, dynamic control systems and electronic information and payment systems. With tomorrow's innovative solutions driving us into the future, urban living becomes modern living.
siemens.com/mobility