

NETWORK RAIL SUMMER TRACK ENGINEERING CONFERENCE

THE INSTITUTION OF ENGINEERING & TECHNOLOGY, LONDON
JULY 2019

AUTHOR: CHRIS PARKER, PWI CONFERENCE REPORTER

Conference delegates were welcomed by the Conference Chair, Pablo Forteza, Engineering & Innovation Director, IP Track, Network Rail (NR).

PRESENTATION 1

TRACK DELIVERY UPDATE

STEVE FEATHERSTONE
PROGRAMME DIRECTOR
IP TRACK, NETWORK RAIL

Steve ran through an enormous amount of detail very rapidly, and those who wish to get the full benefit of his presentation should refer to the electronic copy of it that will be distributed by the PWI and will be available on the PWI website.

He concentrated on three main areas, beginning with "Our Journey so Far". In this part he described how IP Track had come from being the worst performing function in the company to being the best today and for the last 2 years. Major reductions in lost time incidents and over-runs, together with improvements in many areas have contributed to this success. Examples of improvement include safety, plant reliability, compliance, delivery of cost and volume and many more. High speed handback has been a terrific achievement, built upon sound engineering principles and practices.

After celebrating past success, Steve moved on to look to the future. He said that CP5 had been about specialist teams getting the detail right, but in future alliances and a system engineering approach will be essential. The contract form in future will be rail system alliances. The "Putting the Passenger First" programme means a matrix organisation and will require a three-stage process; transaction, transition, transformation. Steve looked in

some detail at the new organisation envisaged, with three alliances covering the network; North, Central and South. He described how these would fit with the new Region and Route structure of the company to provide services to them. Each alliance will be run by a Capital Delivery Director, and he described how responsibility will transition to them from the current organisation.

Finally, Steve emphasised that some things will not change. The focus on safety, sustainability and putting passengers first will remain foremost. In support of these, high speed hand-backs will continue, installation quality will be a priority, and handing back on time will remain essential. Steve listed many other matters that are currently priorities and will continue to be so. Customers, TOCs and FOCs were obviously included.

Steve finished with a personal thank you for the contributions everyone has made during the journey so far.

PRESENTATION 2

S&C REFURBISHMENT; STANDARDS & CONTROLS

LIAM JACKSON
SENIOR PROJECT ENGINEER
NETWORK RAIL

BETHANY QUAYLE
PROJECT ENGINEER
NETWORK RAIL

Liam began by setting out the background to the subject, talking through the problem statement and looking at a case study.

First, he defined what he meant by S&C refurbishment; "Targeted replacement of one or more component types in the S&C system, with the aim of extending the service life of the whole S&C asset." Heavy refurbishment is intended to provide a 50% life extension, medium 20%. In CP5, the planned volumes were not achieved, particularly those for heavy refurbishments.

One problem is that there is no standard or control mechanism for S&C refurbishment. Many issues arise from this; failure to treat root causes consistently, variable quality and a failure to track the outputs and quality achieved. Finally, it was not possible to show compliance with NR Track Asset Policy.

The case study was a refurbishment which had been undertaken at Welwyn Garden City. The RT60 S&C, laid in 2004, showed very poor geometry due to formation issues and was being maintained by stoneblowing.

The project was handed to IP Track at GRIP 4, so they had no involvement in the development of the specification, which called for a 300mm reballast with a geotextile. Success was defined as handback at 80 mph and no worsening of SD values.

It was decided to carry out the excavation using RailVac and to use the DTS as part of the handback preparations. The latter required sign-off from Safety, Technical and Engineering (STE).

When the excavation began on the first weekend, (24/25th February 2018), it was found that the undersides of the concrete

bearers were significantly damaged, possibly by Kango packing, and that the rail clips were badly strained. Installing the geotextile was very difficult and slow, losing time such that the DTS was applied only to the Up Fast. Four point ends were treated, the remaining four being planned for the following weekend, but having to be deferred due to the severe weather of “the Beast from the East”.

Upon completion the track geometry results for the February 2018 work looked good. It seemed that the specified outcome had been achieved. However, both Up and Down Fast lines deteriorated rapidly, the Down being significantly worse. The customer was unhappy. Voiding occurred in critical areas of the layout and a cast crossing cracked by October 2018.

Liam said that this exemplified the requirement for proper standards and controls, to prevent the wastage of funds and resources on such unsatisfactory projects.

Bethany took over the presentation at this stage, to talk about the development of these standards and controls. First, she explained why it was that IP Track is involved, saying that the department is being engaged more frequently to undertake refurbishment works. As refurbishment is not for them “the day job”, they feel in particular need of a proper process and guidance. IP Track therefore approached STE.

The process used to develop the required documents was the common safety method (CSM), recognised by RSSB & ORR, a hazards based approach widely accepted in many industries. The Track Standards & Controls Group approved the remit for the development of a Level 3 standard. The process was begun in May 2018 with the aim of publishing the standard in December 2019. The hazard identification process involved over 30 people from a wide range of backgrounds.

TEF3255 is to have three parts, covering respectively: scoping, specification and the review of outputs against specification. It has been recognised that good scoping is difficult, requiring competent people and a PWI course has been developed which takes account of the new standard.

A review by stakeholders is under way now, with the intent to publish at the planned date later this year.

DISCUSSION

As is normal at these conferences, a Q&A session followed every so often, and at this point it featured the speakers from presentations 1 and 2.

PRESENTATION 3

TRANSITION DESIGN DEVELOPMENT

BRIAN WHITNEY
ENGINEERING EXPERT
NETWORK RAIL

BARNABY TEMPLE
HEAD OF ENGINEERING
RHOMBERG SERSA

Brian began the presentation by speaking about the need for track stiffness transitions at points where the track stiffness would otherwise change sharply. This may happen for many reasons, typical cases being at the change from slab track to ballasted, where track crosses and under-line structure or at the ends of a direct-fastened bridge.

He spoke about the importance of stiffness and settlement, and how consistency is vital to maintaining good track geometry and avoiding problems like rail failures. He mentioned some of the past efforts at providing transitions, such as those used at the ends of some BR PACT track slabs.

Brian also talked about the issue of broken rails, the past success that has reduced annual numbers from almost 1000pa a few years ago

to around a tenth of that currently, and the challenges we now face, as the numbers have stopped falling while the demand for further reductions continues. With ever increasing rail traffic and decreasing opportunity for engineering access, reducing the failure rate to 50pa or lower is going to be a challenge. In that context, he considered the consequences that follow from the absence of proper stiffness transitions, and showed examples of rail failures which have resulted. Other problems also arise from this, such as strained clips, voiding and the need for packing of the track and more. Clearly this is an issue that needs attention if we are to meet our aspiration for fewer rail breaks and better reliability/performance.

Barnaby took over at this point, describing in more detail some of the traditional solutions that Brian had mentioned. He also pointed out that the problem is more severe at the edge of a fixed structure than at a weld or a joint, since the affected length is roughly doubled in the case of weld/joint, halving the rate of change. Modern means of ameliorating the situation include sleeper soffit pads, geowebs/grids, piling, ballast gluing and confinement of the ballast by means of walls or gabions at the sides of the trackbed. Deutsche Bundesbahn (DB), for example, uses a combination of these and other methods such as strap rails on special sleepers at the transitions between ballasted and slab trackforms.

None of these solutions have been a total success, he said, and Rhomberg Sersa offer a solution called the V-TRAS, which the

company believes gives superior results. It is a prefabricated steel ladder structure, two longitudinal beams running under and parallel with the rails, carrying support platforms over which the sleepers sit. The beams are tapered with their full depth ends supported on a bearing shelf built onto the end of the slab or underbridge deck and the shallow ends supported in the ballast remote from the structure. Ballast extends right up to the stiff structure, around and under the V-TRAS and sleepers, and the whole thing can be tamped, stoneblown or manually packed.

Benefits claimed are reduced differential settlement, reduced frequency of maintenance intervention, and a reduction in risks like rail breaks, whilst there is no interference with normal maintenance methods.

One example where V-TRAS has been used in the UK, is in Queen Street in Glasgow, where the transitions have been installed in the cutting at the slab/ballast transitions. Another possible site might be at Kings Cross where slab track is being reintroduced to Gas Works Tunnel. The transition zone at the north end will need to be managed appropriately.

Barnaby suggested that a system solution for transition zones needs to deal with the settlement risk by a combination of bridging the transition, confining the ballast laterally, and giving additional support to the less stiff track. Formation and drainage need special attention in these areas and precautions against twist and buckles need to be taken seriously.

PRESENTATION 4

RUNNING RAILWAYS FOR PASSENGERS

ANDREW COOPER
NON-EXECUTIVE DIRECTOR
PWI

Andrew began by explaining his background, starting as a BR graduate trainee, and finishing as Chief Executive of Cross-Country Trains and serving the PWI as a non-executive director. This gave him an unusual perspective of rail infrastructure and qualified him to make some valuable comments about the industry. He began by saying that we are working in particularly interesting times for the industry, with the move away from lineside signals to in-cab signalling and automated train control. With signalling moving away from the track, a significant shift is going to occur in the relationships between the different parts of the rail infrastructure system.

Nevertheless, the first priority of the rail system will remain safety. He spoke of some of the concerns that he has about this, mentioning recent train incidents at Waterloo and Cardiff which could have had far more serious outcomes and must stand as wake-up calls

for the industry. He talked about the risks of the train/platform interface, emphasising how vital it is that engineers consult train operators when proposing works affecting platforms and platform interfaces. He also referred to some recent incidents where plant or materials had been left at the lineside and not adequately secured against unauthorised interference. In one of these a wood chipper had ended up under a train after an attempted theft had left it abandoned on the running lines. A train had been out of service for a significant time after this incident, and it was fortunate that that was the worst consequence of the occurrence. A continuing theme of Andrew's presentation was the essential requirement for co-operation and collaboration between infrastructure people and train operating people. Together we can avoid service disruption. If we do things unilaterally, all too often problems result. An example was when the "Gotcha" wheel force measurement system was introduced without sufficient involvement of train operators, causing disruption when it was implemented. Operators expect infrastructure owners to know their assets and support their customers. So delays in gauge clearance of trains are not acceptable, for example.

Andrew was pleased that there have been improvements in the use of major possessions. It has been good to see the re-introduction of line-speed handbacks on plain line jobs, and, he said, the achievement of line-speed handbacks on S&C jobs has been a real achievement.

The loss of many diversionary routes in the past has made life harder today, but substitution is disliked by customers and so infrastructure working is more challenging than it might have been. On the other hand, he praised the customer friendly possessions being tried in some places, such as the mid-week ones taken to install a flood protection culvert at Cowley Bridge Junction not long ago. He challenged the industry to be more innovative over such issues, holding discussions to explore possibilities such as doubling the length of possession time available to high-output teams in order to get the work done faster overall and reduce unit costs. He accepted that managing freight traffic would be challenging but suggested that it would be worth exploring possibilities.

Andrew praised the way in which exceptional engineers avoid route closures in emergencies, as at the Unstone slip site in 2014, where good engineering kept the line open despite severe challenges. But, he also accepted that sometimes this just isn't possible, as was the case with the Harbury slip the following year. He ended by saying that he sees the engineering focus now is better on passengers, customers and costs. There is, he said, a good story to tell if we do it right. We should celebrate the benefits from the money and effort invested in our industry, and he gave the example of the celebratory train from New Street to York that ran on 31st March 2019.

PWI PRESIDENT'S UPDATE

JOAN HEERY
PRESIDENT
PWI

Joan began by showing the Presidential Chain of Office, that she is currently proud to wear. She showed how the pendant on it contains engraved details of every President of the PWI right back into the early days of the Institution in the 19th century.

She also mentioned her unusually rapid ascent to the post of President that followed from organisational changes at the Institution. Instead of serving a year as Vice-President Elect, she had gone almost immediately into the post after Stephen Barber moved from the Presidency to become Chief Executive.

Joan then moved to her aspirations for her time in office. She acknowledged that there is too much to do for her to do it all and thanked her

great team at the Institution for the hard work that they put in on the Institution's behalf.

She will be concentrating particularly on two key areas; the first of these being the establishment of stronger relations with the corporate members. Steve Featherstone did great work in recruiting over 40 of these organisations, and Joan intends to build upon this by visiting each one personally, to find out how the PWI can best support them.

Secondly, she intends to help the Sections of the Institution to be the best they can be. The Chairs and Secretaries of the Sections do a great job with limited resources, but need help to do even more. A key priority is the recruitment of more, younger Institution members.

Following this she discussed the results of a survey of PWI members which was carried out in 2017. Details will be in the full presentation, but suffice it to say that one strong message to emerge from the survey was the imperative to get more young, active people into membership.

Finally, Joan finished by saying a few words about Steve Featherstone, as he approaches the end of his post-presidential year as a Deputy President and retires from the PWI Board. She praised him, in particular for being a fantastic advocate for the PWI, for having been instrumental in the drive to become a professional registration body recognised by the Engineering Council, and for having increased significantly the corporate membership of the Institution. In addition, he has been responsible for developing this series of very successful technical conferences. He has visited most Sections of the Institution personally, and has made very active contributions to the PWI Board, all whilst continuing to carry out an intensive, 7 day/week job.

DISCUSSION

At this point the second Q&A session took place with the presenters of papers 3, 4 and 5.

RECOGNITION & AWARDS

STEVE FEATHERSTONE
PROGRAMME DIRECTOR
IP TRACK, NETWORK RAIL

The first session after lunch, as usual, involved a lot of people getting up and moving around as the meeting celebrated success.

Steve Featherstone had the pleasure of presenting awards and books to numerous people who, in the six months since the last NR TEC, have attained the PWI diploma in Track Engineering or other engineering qualifications

including CEng ICE, CEng PWI, FPWI, and EngTech PWI. He also presented some PWI Journal Awards.

As always, it was great to celebrate with colleagues who have achieved such meaningful and worthwhile targets.

CONGRATULATIONS!

To everyone who received their Diploma and other qualifications at the Network Rail Track Engineers' Conference



Andy Hibbert



Benjamin Zuliani



Chrisopher Ford



Erik Kodjie



Ewan Morrison



Harry Williams



Imtiaz Dada



James Featherstone



Joe Frank



John Mansfield



Luke Taylor



Matthew Davies



Nick Matthews



Nick Round



Pablo Forteza



Patrick White



Steve Goddard



Thomas Aldous



Tyrone Williams



Vivek Vilay



William Stephenson

If you spot a mistake in any of the names, please do let us know! journaleditor@thepwi.org

PRESENTATION 5

SNAKES UNDER A TRAIN

(MAP PROJECTIONS & TRANSFORMATIONS)

COLIN MCATEER
PROGRAMME MANAGER
BIM, NETWORK RAIL

DR JIM TURNER
BIM SPECIALIST, HS2 LTD

Colin began this talk by illustrating why the subject matters. Showing Greenland and Africa as they are commonly represented on maps, he pointed out that whilst it appears from the maps that the former is comparable in area with the latter, in fact Africa is roughly 14 times larger than Greenland. This distorted

understanding is caused by the distortions inherent in the commonly used methods of projecting the Earth's curved surface into a plane surface. An idea of what that looks like was given by asking volunteers from the audience to attempt to wrap spheres in paper! Similar distortions affect surveys of large features like railway lines that exist on the curved surface of the Earth.

Jim took forward the presentation from here, and he explained the size of the problem. The Ordnance Survey (OS) National Grid, the UK's standard co-ordinate system, has an inherent distortion of 20cm per kilometre in London. Elsewhere it can be worse, being 40cm in Birmingham for example.

For track engineering and similar purposes, we require a co-ordinate system that is continuous over hundreds of kilometres but with low distortion of engineering grids. The OS Grid is not good enough.

HS2 has developed the HS2 Survey Grid Snake Projection, a route specific snake grid that achieves the required low distortion. In fact, it has a distortion of very much less than 20 ppm at ground level along the grid. Using

this to measure the distance from London to Birmingham produces a dimension about 60cm greater than if the OS Grid was used, and the Snake Grid result is the correct one.

Jim went on to explain more about how this is used in practice. There is an HS2 system in Bentley Microstation, for example, which converts OS data into a format compatible with the HS2 Survey Grid, making it possible to use such data in the HS2 system accurately.

He also explained how it is necessary for the OS to regularly update their network of survey stations to reflect geodetic changes. Without this, changes in the surface of the Earth, (continental drift and so on), would cause errors between earthbound surveys and satellite navigation system data. HS2 has to account for these changes in its work. HS2 has developed a distortion free co-ordinate grid for high speed rail design and construction, HS2 Survey Grid NTv2, which complies with all the requirements described. The company plans to submit this to the EPSG Geodetic Parameter Registry, making it widely available.

PRESENTATION 6

CHIEF ENGINEER TRACK, SWITCHES & CROSSINGS UPDATE

JOHN EDGLEY
CHIEF TRACK
S&C ENGINEER
NETWORK RAIL

John asked how we meet the performance challenge; are we doing enough? Performance is generally falling against a trend of traffic increase. There is an industry wide challenge to be met; we have missed our targets.

Looking at seasonal variations in PPM, there is regularly a big performance drop in autumn, with smaller ones in summer and winter.

Do we prepare for these as well as we could? Perhaps, but we still need to do more and differently to do better. That asset reliability is improving is good news, but assets only affect 25% of train delays. Train delays per incident are increasing, negating any reductions in incident numbers. The average age of track assets is also increasing.

How do we meet this challenge? John looked at five areas where we are trying to improve:

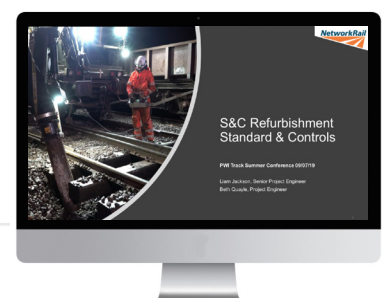
- Infrastructure projects: renewals delivery innovation, induction welding, trackbed modelling, BIM, use of geocells, high-speed handback, progressive assurance, DTS on S&C, high speed temporary joints, intelligent compaction.
- Workload & Competence: competence framework, analysis of how actual TME workload compares with what was expected.
- Technology & Assets: improvement of the gauging process, improved tools & materials.
- Process: identification & sharing of best practice, standards updates.
- R&D: additive manufacturing, intelligent infrastructure.

More is still required: examples include whole system safety & performance, collaborative engagement to do the right thing for the industry, and targeted improvements, such as seasonal performance focus. John also mentioned several individual items such as the managed lineside, the use of under sleeper pads, wheel-slip protection & sanding and on-train flange lubrication.

Finally, he spoke about the need for changes in culture and values, discussing some of the key points he perceives.

DISCUSSION

Once again time was taken at this point for a Q&A session with the presenters of the most recent talks.



Presentations from this seminar can be viewed in the PWI Technical Hub.

www.thepwi.org/technical_hub/presentations

PRESENTATION 7

ELECLINK PROJECT
OVERVIEW

CHRIS HARLER
DELIVERY ENGINEER
BALFOUR BEATTY

OLIVER SCHOLEY
DESIGN/DELIVERY ENGINEER
BALFOUR BEATTY

This presentation was introduced by Mike Barlow of the PWI London Section. Mike explained that the paper and its two presenters had won the 2019 Tech Factor contest, the Tech Factor being an annual opportunity for young rail engineers to make presentations in a competition for the Peter Coysten Award.

Mike and Oliver had been involved in the Eleclink Project, which was initiated in order to install a major new link between the British and French national power networks. The 1000MW link, which would increase the capacity of the links between the two countries by roughly 50%, was to be installed through the Channel Tunnel.

They described the design and installation challenges involved in preparing for the installation of this link. The cables of the link are to be installed on brackets attached to one of the side walls of one of the running tunnels. One major challenge was the limited maximum length of cable that could be delivered to the tunnel portals. The size of the cable drums that can be used is restricted, such that each can only carry 2.5 km of the cable. Jointing such large cables is complex and time consuming, and a key innovation made by the Balfour Beatty team was to propose that this work be carried out outside the tunnel. That made a crucial difference to the project because it significantly reduced the time needed for works inside the tunnel.

To facilitate this innovative approach the project team needed to devise a means of storing lengths of cable near the tunnel portals and drawing the cable into the tunnel, length by length, as the lengths were jointed together. Chris and Oliver described the design and installation of the cable brackets and of a monorail system attached to these that will permit the cables to be drawn into place. Each bracket needs to withstand at least a 25 kg force in any direction, and to avoid fatigue failure, they are fabricated without welds. In association with the monorail system, it was necessary to have a cable storage system at each tunnel portal, each of these needing to store a kilometre of cable whilst fitting into

the very tight space available. They devised a helical cable rack system for this purpose. The brackets each require four bolts to secure them to the tunnel wall, and the holes for these bolts need to be drilled very precisely at every bracket location. Once again, time in the tunnel was at a premium, and so the adopted solution to this challenge was a 12 wagon train carrying 36 drilling units, one for each bracket position and each carrying four drills correctly spaced for a bracket. This system allowed simultaneous drilling of all of the bolt holes for 36 brackets, covering a 240m length of the tunnel.

A bespoke lifting system on the train was used to lift the hexagonal rails of the monorail up to the brackets after they had been installed. Electronic records were used to confirm the correct installation of each component of the system, so that any problems were reported immediately and could be readily followed up and rectified.

At the time of the conference presentation, the monorail was fully in place, and the cable storage systems at either end of the tunnel were loaded with cable, with cable extended from them to the tunnel portals, ready for the cable haulage to commence when access to the tunnel for this becomes available. Four bespoke cable haulage trains are ready to carry out the installation of the cables.

PRESENTATION 8

MIND THE
GAP, GAUGING
IMPROVEMENTS

ROBERT LACEY
PRINCIPAL ENGINEER
TRACK & LINESIDE
NETWORK RAIL

Gauging has three principles, Robert said; ensuring that trains do not hit the infrastructure, ensuring that trains do not hit each other, and ensuring that passengers can enter and leave trains safely at station platforms.

Critical to all this is knowing what “capacity” the infrastructure on a route has, and maintaining that capacity through renewals works, maintenance works and the introduction of trains new to the route. He said that currently this is being managed totally through renewals and train introductions. Maintenance is not managing gauging effectively through its works. He went on to discuss what it may be that is preventing maintainers from doing their bit on gauging. Perhaps there isn’t the money, or perhaps the system does not exist

for it. Possibly Group Standards are to blame because maintainers feel unable to achieve compliance. Currently each Route has a Route Gauging Engineer, but how the new organisation will affect this is not known. In any case, TMEs need training and systems to enable them to manage.

A new module of Track 001 is to be introduced, requiring a baseline gauging and survey of the whole network every 5 years. All sub-normal and non-compliant clearances will require risk assessment and the production of an appropriate action plan to manage each of them. However, datum plate surveys will no longer be mandatory.

Robert continued by discussing the high-level programme of gauging development. There is research and development going on, with external funding, to look at alternative means of gauging. He talked about the perceived over-conservatism in gauging, which seems to be based upon the idea that “a foul” may have existed for some time, but has never resulted in a collision. He looked at some of the reasons why such a situation may arise:

- The original vehicle gauging model may have been over-conservative
- Over-conservative assumptions about infrastructure movement
- Poor data quality e.g. affected by vegetation

- Conditions required for the “foul”, such as crush loading or suspension deflation, have never occurred
- Inaccuracies in the gauging measurement system itself

A tactical response to all this is “probabilistic gauging” or the “Avoidance of infrastructure change project.” This has been described already by others, particularly Dr David Johnson, and is to be trialled on the Scotland Route. In-depth analysis of pinch points is required, and it is likely to necessitate an enhanced maintenance regime. Industry benefits are likely to be high, but direct benefits for Network Rail will probably be low, while its risk and costs are likely to increase somewhat. The strategic, longer term response is an alternative gauging methodology. This will mean new vehicle dynamics, improving the vehicle models for all vehicles on the network. It will require a much better understanding of track fixity, likely to be derived using “big data” from track monitoring systems, so as to reduce the uncertainty about infrastructure movement. Finally, new gauging survey techniques will be needed, to increase accuracy and reduce the tolerances in calculations. Robert gave a brief outline of where things are currently in respect of each of these requirements.

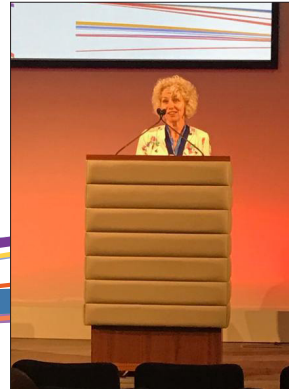
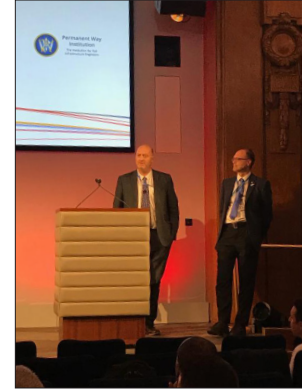
DISCUSSION A final Q&A session took place, covering the last two presentations.

CLOSING REMARKS

STEVE FEATHERSTONE

Steve said that he considered this to have been one of the very best in this conference series, and thanked the presenters for making it so. He also gave his thanks to the organising team, the PWI and the IET.

After mentioning that he hoped that the conferences would be continued after the reorganisation of Network Rail and mentioning some forthcoming PWI events, he closed the conference.



“

Feedback from our delegates

One of the strongest agendas that I can remember. All presentations were relevant to current issues and topics in the industry and I didn't feel like people were trying to sell me anything.

The networking opportunity the PWI conferences provide is invaluable. Those of us operating in the rail engineering community will often converse via email or conference call, so the chance to talk face to face in a non-working environment is a positive one.

S&C Refurbishment Standard and control presentation. Also the venue and lunch was exceptional.

Quality of the speakers was superb and the topics were focused on problem solving.

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TECHNICAL ARTICLE

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