

Oliver Stewart
Senior Executive, RAIB Relationship and
Recommendation Handling

9 August 2018



Mr Andrew Hall
Deputy Chief Inspector of Rail Accidents
Cullen House
Berkshire Copse Rd
Aldershot
Hampshire GU11 2HP

Dear Andrew,

Derailment due to a landslip, and subsequent collision, Watford, 16 September 2016

I write to report¹ on the consideration given and action taken in respect of the six recommendations addressed to ORR in the above report, published on 10 August 2017.

The annex to this letter provides details in respect of each recommendation. The status of recommendations 1, 5 and 6 is '**insufficient response**'; the status of recommendation 2 is '**implementation on-going**'; the status of recommendation 3 is '**progressing**'; and the status of recommendation 4 is '**implemented**'.

ORR will advise RAIB when further information is available regarding actions being taken to address these recommendations.

We will publish this response on the ORR website on 10 August 2018.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Oliver Stewart', written in a cursive style.

Oliver Stewart

¹ In accordance with Regulation 12(2)(b) of the Railways (Accident Investigation and Reporting) Regulations 2005

Initial consideration by ORR

1. All 6 recommendations were addressed to ORR when the report was published on 10 August 2017.
2. After considering the recommendations ORR passed recommendations 1, 2, 5 & 6 to Network Rail, recommendation 3 to Rail Delivery Group and recommendation 4 to Siemens asking them to consider and where appropriate act upon them and advise ORR of its conclusions. The consideration given to each recommendation is included below.
3. ORR also brought recommendation 4 to the attention of all TOCs and FOCs as it was agreed it was useful learning for them.
4. This annex identifies the correspondence with end implementers on which ORR's decision has been based.

Recommendation 1

The intent of this recommendation is to mitigate the risk of a future slope failure at this historically vulnerable location. Effective implementation of the drainage work described in paragraph 144 is likely to contribute to implementation of this recommendation.

Network Rail should implement measures to improve surface drainage (eg by provision of a suitable drainage system encompassing the crest), in the vicinity of the 2016 Watford tunnel landslip. It should also investigate whether it is necessary to take steps to manage sub-surface flows which were observed during this accident and could reoccur during a future event

ORR decision

5. Network Rail have not formally responded to this recommendation. Our understanding is that Network Rail have a plan to put in surface drainage at Watford Tunnel in the next few months. We are also aware that Network Rail are not planning to progress work on sub-surface flows and have asked to see the risk assessment that supports this decision.
6. In accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:
 - not provided a response setting out how the recommendation will be delivered.

Status: Insufficient response. ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.

Information in support of ORR decision

7. Network Rail have not provided a response to the recommendation. From informal discussions with Network Rail we are aware they have a plan to install

surface drainage at the incident site, but have chosen not to take forward work on sub-surface flows.

Recommendation 2

The intent of this recommendation is to determine whether other Network Rail locations have an unrecognised washout risk for reasons found at the accident site. Implementation is expected to comprise verification that the current processes identify risk at locations similar to the accident site and a check to find any other sites omitted from washout studies for reasons similar to those at Watford.

Network Rail should review, and if necessary, improve its process for identification of localised water concentration features which can channel significant amounts of water onto the railway with the consequent risk of slope failure. This review should include:

- a. using current Network Rail processes to analyse the washout and earthflow risk for the slow lines cuttings at Watford to determine whether this correctly identifies the landslip site as a high risk location; and
- b. verifying that the process has been applied to all relevant track alignments including those such as at Watford where there are closely spaced multiple alignments

ORR decision

8. We are content with the approach Network Rail are taking to address this recommendation and the aim of completing work before the start of the examination season.

9. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:

- taken the recommendation into consideration; and
- is taking action to implement it by 30 September 2018.

Status: *Implementation ongoing.* ORR will advise RAIB when actions to address this recommendation have been completed.

Information in support of ORR decision

10. On 19 July 2018, Network Rail provided the following initial response:

Network Rail will:

Undertake a review of the second generation Washout and Earthflow Risk Model (WERM2), which was implemented in 2014 as part of the Soil Cutting Hazard Index (SCHI) and therefore Earthwork Hazard Category (EHC). The WERM2 outputs were generated by an offline modelling process and

attributed to Soil Cuttings in the asset inventory at that time. The review will consider, inter alia:

- *the Earthwork assets known to have failed by washout and earthflow mechanisms, including the tunnel approach cuttings at Watford;*
- *the performance of WERM2 in terms of whether or not this specific tool is a good predictor of such failures;*
- *whether WERM2 should remain a component of SCHI or form a standalone metric/control;*
- *the appropriateness of the update process for WERM, including frequency as well as linkage of outputs to Soil Cuttings; and*
- *any potential improvements that can be made to the source data or the algorithm.*

The outcome of the review may or not include recommendations for potential modifications that could be made to WERM2 in order to assist in better predicting washout and earthflow failures. This may lead to an improved calibration to failures, and potentially a national re-appraisal. In any case, WERM outputs will be re-calculated for each individual earthwork asset within the inventory, such that all relevant track alignments are captured. The intention is to complete this activity by the start of the 2018/19 Examination Season. That corresponds to 1 October 2018 so the proposed completion date is 30 September 2018

Recommendation 3

The intent of this recommendation is to identify and assess the effectiveness of design features that provide guidance to trains when derailed, so limiting the deviation of trains from the track and reducing the risk of collision with trains approaching on other lines. This could be achieved by the retention or strengthening of features already forming part of the bogie structure, or infrastructure measures such as guard rails. It is also intended that the learning from research in this area is used to derive meaningful design requirements.

The Rail Delivery Group (RDG), in conjunction with RSSB, should:

a. commission research into the ways in which guidance can be provided to derailed trains. This should include consideration of:

- how the design of bogies and bogie mounted equipment can assist in limiting the lateral deviation of passenger trains during a derailment;
- practice in other countries (e.g. Japan);
- how specially installed infrastructure features can achieve the same effect at high risk locations;
- potential design requirements for the retention or enhancement of such features on new trains or infrastructure; and
- the potential benefits and drawbacks of such measures. If such features, whether existing or additional, are shown to have a net beneficial effect in reducing risk by limiting lateral deviation, RDG/RSSB should:

- b. share this information with the relevant Standards Committees; and
- c. record and disseminate the design requirements with a view to their incorporation into future standards.

ORR decision

11. Following an RDG proposal, RSSB has agreed to undertake a research project into technical devices to guide derailed trains. The project is considering both vehicle-mounted and infrastructure-mounted devices and will consider measures in place on other railways with similar characteristics to the UK mainline.

12. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, RDG in conjunction with RSSB has:

- taken the recommendation into consideration; and
- is taking action to implement it, but ORR has yet to be provided with a time-bound plan.

Status: Progressing. ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.

Information in support of ORR decision

13. On 20 December 2017 the Rail Delivery Group provided the following initial response:

In your letter you state that this action has been placed on the Rail Delivery Group, but I feel the need to point out that Recommendation 3 of the RAIB report is a joint action on both RDG and the Rail Safety and Standards Board (RSSB).

I have therefore been working with the RSSB to address this recommendation and can advise the following progress:

- i) Once the RAIB report was published I submitted a 'Research idea' form to RSSB to request an industry research project be undertaken - that will attempt to address the issues identified by this recommendation.*
- ii) I attended the RSSB Rolling Stock Standards Committee (RSSC) on 8th December 2017 and sought support from industry to progress an RSSB research project. I am pleased to report that RSSC supported progressing my proposal.*
- iii) RSSB have arranged an 'Idea Development Meeting' on the afternoon of 29/01/18.*

In addition, I also plan to invite a representative from RAIB to attend the Idea Development meeting- since I think it would be helpful to understand more about their thinking in relation to the generation of this recommendation.

I hope that you also appreciate that this recommendation will take a considerable amount of time in order for the industry to implement any findings emerging from the research project.

14. On 13 July 2018, RDG provided an update on the actions they we're taking:

The Research Idea has progressed to the stage where a formal RSSB Project has been generated. It will be known as T1143: Devices to guide derailed trains.

We are planning to seek the endorsement of the cross-industry Vehicle / Track System Interface Committee at their meeting of the 26th July.

In support of this, I have reviewed and provided comments to RSSB on the draft 'Specification for research project' and 'Assessment of the case to undertake' for this project.

15. The research project defined the following objectives and work packages:

Devices to guide derailed trains can be split into two categories, rolling stock mounted solutions and infrastructure mounted solutions. It is proposed that the project is split into three work packages; the first two to address the two categories separately and the third to bring the findings together.

Work Package 1: Assessing the use of Rolling Stock Mounted Equipment for the Reduction in Risk of a Derailment.

Assessment of technical strategies and devices.

Identify, categorise and assess the rolling stock mounted systems, including those under development and those used outside GB intended to limit lateral excursion in the event of derailment. Define the mechanism of restraint and assess the potential effectiveness and limitations of each system. The study shall include descriptions of devices deployed in service and any others that have been described in academic research.

The behaviour of a derailed vehicle during and immediately after leaving the rails.

Through dynamic modelling, understand the geometry and forces relating to secondary engagement of bogie mounted structures on the rail following derailment. The modelling should estimate the direction and magnitude of potential restraining forces to be imposed by track features, and the resultant lateral deviation from normal running position. Modelling should be carried out for plain line track only, but the impact of Switches and Crossings (S&C) should be considered qualitatively. Variation from speeds up to 125mph should be considered.

Potential for bogie or axle mounted equipment in GB railways

Based on the constraints of GB Lower Sector Vehicle Gauge (LSVG) evaluate the options available to provide rolling stock mounted devices for limiting lateral deviation following derailment. This should consider the structures that came into play in previous derailments (see Appendix A) and the systems identified in 2.1.1. This evaluation should consider interactions based on the modelling carried out in 2.1.2, and interactions with S&C. From this evaluation, define and summarise viable options, and document options ruled out and reasons for doing so.

Note: There might be circumstances where there is a case for devices that exceed of LSVG, and where this is necessary the considerations should be presented.

Work package 2: Assessing the use of Infrastructure Mounted Equipment for the Reduction in Risk of a Derailment.

Understanding of Current Worldwide Solutions and approaches

The current use of guard rail systems in the UK is associated with the prevention of catastrophic disasters following a derailment. These are generally associated with structures over water, and high-level structures in urban areas.

Beyond this reasoning, the logic behind the positioning of these sites is perhaps not consistently applied and well understood, and it is unlikely, in the event of a track renewal, that an alternative solution would be implemented and therefore a like for like replacement would be implemented.

Network Rail is known to have analysed what means of containment have been applied by rail authorities in other parts of the world, and the starting point for this study would be to collate all work carried out by rail authorities in the UK.

Once the extent of those studies has been collated, then the scope of any additional research can be established. The study should seek to have discussions with selected rail authorities with comparable operating characteristics as the UK.

The study should also address any research that has been carried out to understand the mechanism of a derailed train and any associated linkage to speed. It is understood that some European rail authorities have found that any form of guard rail or derailment guidance is not effective above a certain speed and could then in fact increase the risk of harm.

The outputs from this research study will inform the next stage of this proposal.

Understanding of the Magnitude of the Risk within the UK and Development of a Risk Analysis Tool

It is clear that the accidents cited by RAIB have identified that there is a level of risk associated with the derailments that have occurred on the GB rail system. This risk needs to be evaluated to assess the appropriate investment for the industry to mitigate the risk.

For the Infrastructure system, it is clear that the wholesale installation of guard rails, or an equivalent system, has a high capital cost, and it will also increase the operational cost of the rail system. Therefore, it is suggested that this work focuses on the development of a risk analysis approach which gives the infrastructure manager the ability to target investment. Considerations should be given to both likelihood of an event and impact, and will likely include an assessment of the following:

- 1. Properties of the track including curvature, ballast depth, presence of parallel line and distance of the six-foot interval.*
- 2. Line speed*
- 3. Type, frequency and crashworthiness of traffic*
- 4. Presence of local structures, and height and condition of the structures*
- 5. Presence of cuttings and embankments, their geometry and risk of landslides*
- 6. Consequential risk in immediate area*
- 7. Dead load on the structure*
- 8. Clearances to structural members*
- 9. The existence of derailment-containment kerbs*

Work package 3: Review use of devices to guide derailed train

This work package will take a railway system view to establish the scenarios where a rolling stock solution, an infrastructure solution or some combination of the two would be appropriate. Considerations would include:

- The relative merits of Rolling Stock or Infrastructure solutions*
- Potential effects on other systems, inspection and maintenance regimes*
- Review of difference in risk profile between plain line and S&C*
- Review of contribution of other factors that affect outcome of derailed train trajectory*
- Implementation approaches*
- Identify situations where derailment guidance is not likely to be justified*
- Recommendations on which, if any, solutions would be appropriate for introduction to the GB network, and appropriate mechanisms for achieving deployment.*
- Costs*

16. On 31 July 2018 RDG confirmed that the research proposal was supported by the Vehicle/Track System Interface Committee.

Recommendation 4

The intent of this recommendation is to manage the risk caused by displaced emergency equipment located in the driving cabs of the class 350 and other classes of Desiro train, identified as a result of this accident.

Siemens, in conjunction with the relevant rolling stock owning companies (ROSCOs), should review and improve the physical security and/or location of emergency equipment (e.g. track circuit clips and detonators) carried in driving cabs. This is to minimise the risk of secondary injury to cab occupants during a collision

ORR decision

17. Siemens have reviewed the arrangements for securing emergency equipment in driving cabs of trains in the Desiro family. Having risk assessed a number of options, Siemens have decided to retain the existing arrangements as they did not consider any of the other options under consideration to be reasonably practicable.

18. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Siemens has:

- taken the recommendation into consideration; and
- has taken action to implement it

Status: Implemented.

Information in support of ORR decision

19. On 20 December 2017 Siemens provided the following initial response:

As requested within the recommendation, Siemens have undertaken a review and assessment in conjunction with representatives from the relevant rolling stock owning companies (ROSCOs), namely Angel Trains; Eversholt Rail Group and Porterbrook.

The review and assessment approach was completed in the form of a risk assessment. A copy of this assessment is attached as an addendum to this letter. The objective of the risk assessment was to assess the risks of secondary injury to cab occupants during a collision due to falling emergency equipment and also to consider and summarise options to improve the physical security and or location of the emergency equipment in the cab and reach a conclusion regarding the practicability and/or cost benefit of the options. The assessment addressed all Siemens' trains which use the same emergency equipment mounted in a similar position as to Class 350/2.

The following four options were identified and considered in the assessment:

- 1 – Retain existing design
- 2 – Additional fastening of the emergency equipment using Velcro straps
- 3 – Relocation of emergency equipment
- 4 – Redesign of flag & detonator case and track circuit clip bracket

The conclusion of the review and assessment, supported by the ROSCOs representatives, was that the existing design solution is considered ALARP. The details of the assessment and assumptions are contained in the risk assessment provided.

Options 2 to 4 were not considered reasonably practicable to implement:

- *Option 2, the provision of additional fasteners, is the only option where a full cost benefit analysis has been carried out. The conservatively calculated benefit cost ratio of 0.12 indicates the cost is grossly disproportionate to the benefit given that the risk does not result in fatality. Consequently, this option is not reasonably practicable to implement. The real benefit cost ratio calculated on a specific fleet basis and using less pessimistic assumptions would be even less.*
- *Option 3, the relocation of the emergency equipment is only be feasible on Desiro UK fleets with end gangways. It is demonstrated that the new location, where feasible, would introduce additional risks which would outweigh the benefits. Consequently, this option is also considered to be not reasonably practicable to implement.*
- *Option 4, redesign of the Unipart Rail parts, is considered feasible and advantageous in that it could reduce risks across all fleets using these parts and not just Siemens fleets. The option was not considered in detail within the scope of the Siemens assessment. However, since it can be reasonably assumed that the costs of redesign and replacement of such parts would be in excess of those calculated for option 2, this option can also be considered to be not reasonably practicable to implement. However, Siemens recommends that ORR encourage Unipart Rail to offer improved designs of these parts for future fleets.*

Having already shared this analysis with the ROSCOs, it is recommended to also share the details with the duty holding train operating companies (TOCs). This would allow the individual TOCs and ROSCOs to consider the implementation of the alternate options at their discretion and which may entail further risk assessment by the TOC. As such it is the intention of Siemens to share this review and assessment with its relevant TOCs accordingly.

Recommendation 5

The intent of this recommendation is to enable a prompt response by fire and rescue and ambulance services following an accident on Network Rail infrastructure. It is envisaged that liaison with the British Transport Police will be required to achieve part (a) and liaison with representatives of the fire and rescue services will be required to achieve part (b).

Network Rail should improve emergency arrangements for its infrastructure by:

- a. reviewing with relevant organisations and, where appropriate, improving its processes in order to minimise the time taken during emergencies to contact organisations providing fire and rescue and ambulance services (paragraph 135b); and
- b. considering and, where necessary, implementing liaison with the local fire and rescue service including participation in joint site inspections at access gates which may need to be used by the emergency services where appropriate

ORR decision

20. Network Rail have not formally responded to this recommendation.

21. In accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:

- not provided a response setting out how the recommendation will be delivered.

Status: Insufficient response. ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.

Information in support of ORR decision

22. Network Rail have not provided a response to the recommendation.

Recommendation 6

The intent of this recommendation is to support the completion of a full survey of drainage assets required to mitigate safety risk on Network Rail infrastructure.

Network Rail should develop and commit to a time bound plan to complete its planned survey of drainage assets to provide sufficient asset knowledge to adequately manage risk. This should include a desk study of archive records and current records, together with inspections on site

ORR decision

23. Network Rail have not formally responded to this recommendation. However, this is an area that we have been actively pursuing for some time, and we are aware of plans that are already in place in some Routes for completion of drainage surveys. We are also aware Network Rail have set an internal timescale of October 2018 for all Routes to complete a timebound plan to complete these surveys, which should

implement this recommendation (although we would need to continue to monitor the delivery of those plans.)

24. In accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:

- not provided a response setting out how the recommendation will be delivered.

Status: *Insufficient response*. ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.

Information in support of ORR decision

25. Network Rail have not provided a response to the recommendation. However, we are aware that some Network Rail routes have time-bound plans in place for the completion of drainage surveys and those that haven't have been asked to provide them by October 2018.