Oliver Stewart
RAIB Recommendation Handling Manager

17 October 2023

Mr Andy Lewis
Deputy Chief Inspector of Rail Accidents

Dear Andy,

RAIB Report: Derailment of a passenger train at Carmont, Aberdeenshire on 12 August 2020

I write to provide an update[1] on the action taken in respect of recommendations 17 & 20 addressed to ORR in the above report, published on 10 March 2022.

The annex to this letter provides details of actions taken in response to the recommendation and the status decided by ORR. The status of recommendations 17 & 20 is **'Closed'.**

We do not propose to take any further action in respect of the recommendations, unless we become aware that any of the information provided has become inaccurate, in which case I will write to you again.

We will publish this response on the ORR website on 18 October 2023.

Yours sincerely,

Oliver Stewart

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

Recommendation 17

The intent of this recommendation is to reduce the risk of injury to drivers due to secondary impact during accidents.

RSSB should:

a) review its previous research on fitting secondary impact protection devices for train drivers (including seatbelts) in light of the circumstances of Carmont, future train accident risk (including derailment) and the capabilities of current technology

b) in consultation with relevant stakeholders, evaluate the case for fitting specific secondary impact protection devices into new and existing trains

c) where justified by a) and b), incorporate requirements for improved protection measures into standards for train driving cabs

ORR decision

1. RSSB carried out 'knowledge searches' Protection for Train Drivers Against Secondary Impact (S367[2]) and Deformable materials for drivers' cabs (S373[3]) in accordance with its established processes. This addresses part (a) of the recommendation. However, Carolyn Griffiths, chair of the Transport Scotland Carmont Rolling Stock Recommendations Steering Group, has expressed concern that the research work was inadequate because she identified a supplier of airbags used on tram vehicles that had not been included in report S367.

2. RSSB followed the knowledge search with an options analysis that compared the safety benefits of a range of proposals relating to improved protection of drivers with the cost of delivering those benefits. This drew on the 2009 research project Review of injury causation and human factors in vehicle accidents (T310) to identify the potential harm arising from collisions, and assumed that each option was able to eliminate 40% of the risk. This is an established value previously used when making a case for the passive safety provisions in Railway Group Standard GMRT2100 Rail Vehicle Structures and Passive Safety: Impact assessment 10-IA19.

3. The analysis considered the cost of making modifications to existing rolling stock. It demonstrated that the costs were grossly disproportionate to the safety benefits. The work was carried out as part of the industry's Carmont Rolling Stock Recommendations Steering Group activities (a different entity to the Transport Scotland Steering Group), which includes relevant stakeholders including individual RoSCos and operators. The work carried out here addresses part (b) of the recommendation. Carolyn Griffiths, who observes the industry steering group, has expressed the view that the cost assumptions for the wearable airbags identified by RSSB are too high and that it may be possible to reduce them.

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[2] https://www.rssb.co.uk/research-catalogue/CatalogueItem/S367

[3] https://www.rssb.co.uk/research-catalogue/CatalogueItem/S373

4. It may be useful to be aware that a sensitivity analysis carried out while developing the final submission indicated three cases where risk controls might be reasonably practicable if their effectiveness was greater than that assumed by the RSSB analysis. This led to further discussion of the characteristics of these controls. The first of these is the provision of a two-point seatbelt. There is concern about injuries arising from the use of the two-point seatbelt because this only provides partial restraint, and the unrestrained upper body may be subject to increased harm during a collision. The second is knee bolsters, which are already identified in the Railway Group standard as a protective measure but without a performance specification. While they are understood to provide benefit in a head-on collision, their contribution in other scenarios is unclear and would require significant research to develop. The third is the use of wearable airbags, such as used by motorcyclists and equestrians. The union representatives on the Transport Scotland Carmont Rolling Stock Recommendations Steering Group strongly opposed this option on grounds including restricting mobility of the wearer, and personal comfort in warm weather. These objections can be considered to be ‘trouble’, which is appropriate to take into account when considering the sacrifice associated with a risk control measure (Edwards v. NCB refers to the time, cost and trouble of safeguards). This further consideration of these three cases adds context to the potential of individual measures to make significant inroads into the current risk profile of the driving cab.

5. RSSB conducted a similar comparison exercise to conclude that the costs of revising standards to change the specification of new vehicles are grossly disproportionate to the safety benefits. While the three measures identified above may of themselves be reasonably practicable to implement, additional testing and simulation is required to establish the specifications for the implementation. RSSB has not explicitly incorporated these costs into the assessment but notes that simulation alone would not be sufficient, and that the anthropomorphic test device (‘crash test dummy’) developed and used in the past for the development of rail passive safety standards is now obsolescent and its updating will incur significant cost. This work addresses part (c) of the recommendation. However, while this testing may not be reasonably practicable, ScotRail has submitted a ‘request for help’ that may promote further work to feed into standards revision. Nonetheless such revision may still not be reasonably practicable.

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

- taken the recommendation into consideration; and
- taken action to close it.

Status: Closed.

Previously reported to RAIB

7. On 9 March 2023 ORR reported the following:

Work to address this recommendation is being coordinated by the RSSB Carmont Recommendations Steering Group.

RSSB has conducted a knowledge search of available relevant information on secondary impact within a cab in accidents. RSSB research shows knee bolsters and air vests were potentially reasonably practicable options, but we have asked for clarity on this point. If any options are demonstrated to be reasonably practicable, RSSB will update standards accordingly.

Update

8. On 24 March 2023 RSSB provided the following update:

As we have noted in our monthly Recommendations Tracking updates to ORR, RSSB has led the GB rail industry in preparing a response to the rolling stock-related Recommendations (12, 14-20) from RAIB's report into the derailment at Carmont in August 2020.

A steering group was established, together with a separate, but parallel, group in Scotland, to monitor and guide progress with each recommendation.

RSSB is not a 'duty holder' and therefore does not have the power to impose actions on the industry (except by making changes to standards, but these would generally only be applicable to new train designs). Recommendations addressed to RSSB have therefore been addressed by a collaborative compilation and evaluation of options available to the train owners and operators.

This report gives the response to Recommendation 17, which is as follows:

> ***RSSB should:***
>
> ***a) review its previous research on fitting secondary impact protection devices for train drivers (including seatbelts) in light of the circumstances of Carmont, future train accident risk (including derailment) and the capabilities of current technology.***
>
> ***b) in consultation with relevant stakeholders, evaluate the case for fitting specific secondary impact protection devices into new and existing trains.***
>
> ***c) where justified by a) and b), incorporate requirements for improved protection measures into standards for train driving cabs.***

In summary, RSSB has completed two Knowledge Searches (S367 and S737), which are complemented by an options analysis. This has concluded that the costs of any change, whether retrofit or for future standards, are generally grossly disproportionate to the potential benefits in terms of reduced injuries. Further testing and/or simulation is needed to understand whether any of the proposed options will

have a measurable benefit in reducing the risk of injuries to drivers in collisions and derailments.

The full detail of RSSB's review of previous research and its evaluation of the case for fitting specific secondary impact protection devices may be found in the attached document. Knowledge Searches S367 (Protection for Drivers Against Secondary Impact) and S737 (Deformable Materials for Drivers' Cabs) are also attached. All three documents will be published on the RSSB website shortly.

In light of this work, we consider Carmont Recommendation 17 to be closed.


2023-03-S367-train-driver-protection-v3.c


2023-03-S373-deformable-materials-for-c

Recommendation 20

The intent of this recommendation is to reduce the risk from train fires originating in or around batteries fitted to passenger vehicles, recognising the trend towards increased use of battery systems to store energy for motive power. To address this recommendation, it is envisaged that RSSB will investigate the fire-related properties of products used in other transport sectors.

RSSB should investigate alternative designs of batteries, and their casings, which may offer improved fire-related properties compared to those currently fitted to rolling stock. The output from this investigation should be shared with the UK train and tram industry

ORR decision

9. RSSB has carried out an investigation into the batteries in use on the rolling stock involved in the Carmont accident and other battery technologies. It has published its findings in Technical Note TN109 Fire-related properties of batteries on the RSSB website[4]. This work has been carried out in accordance with RSSB's established processes.

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

- taken the recommendation into consideration; and
- taken action to close it.

[4] https://www.rssb.co.uk/standards/using-standards/rssb-technical-notes/technical-note-fire-related-properties-of-batteries-tn109-iss-1

Status: Closed.

Previously reported to RAIB

11. On 9 March 2023 ORR reported the following:

RSSB has completed research into the design of batteries and casings and a technical note has been drafted. The content of the technical note will be reflected in amendments to relevant standards.

Update

12. On 31 March 2023 RSSB provided the following update:

As we have noted in our monthly Recommendations Tracking updates to ORR, RSSB has led the GB rail industry in preparing a response to the rolling stock-related Recommendations (12, 14-20) from RAIB's report into the derailment at Carmont in August 2020.

A steering group was established, together with a separate, but parallel, group in Scotland, to monitor and guide progress with each recommendation.
RSSB is not a 'duty holder' and therefore does not have the power to impose actions on the industry (except by making changes to standards, but these would generally only be applicable to new train designs). Recommendations addressed to RSSB have therefore been addressed by a collaborative compilation and evaluation of options available to the train owners and operators.
This report gives the response to Recommendation 20, which is as follows:

> ***RSSB should investigate alternative designs of batteries, and their casings, which may offer improved fire-related properties compared to those currently fitted to rolling stock. The output from this investigation should be shared with the UK train and tram industry.***

The battery by fire in the incident was shown during fire testing to have not reflected the current state of the art employed elsewhere on UK mainline rolling stock. The material used in construction of the battery casings (polypropylene) did not have flame retardant properties, and the type of battery configuration employed (vented, wet cell) meant that more of this material was present for a given capacity than more recent designs of battery (valve regulated, gel / AGM).

RSSB's investigations found that there are current ranges of otherwise identical batteries used on UK mainline rolling stock that have casings with flame-retardant properties. Replacement of vented, wet cell batteries with valve regulated, gel / AGM has been undertaken on some UK fleets, although this has not been predominantly for reasons of fire performance. The arguments for and against retrofit of these technologies are set out in the attached report and are summarised in its conclusion. The factors noted should be considered as part of any proposal for new or modified fleets which employ battery technology, especially where use of larger batteries for

traction purposes is proposed. The attached Technical Note (T109-Issue 1, Fire-related properties of batteries) reflects this situation.


TN109-Fire-related properties of batteries


carmont-rec-20-fire-related-properties-of-t

Work under way at RSSB will further elaborate on the particular issues to be overcome when deploying large traction batteries on rolling stock in the future, including how the factors impacting fire performance may be addressed.

In light of the above, we consider Carmont Recommendation 20 to be closed.

Previously reported to RAIB

Recommendation 17

The intent of this recommendation is to reduce the risk of injury to drivers due to secondary impact during accidents.

RSSB should:

a) review its previous research on fitting secondary impact protection devices for train drivers (including seatbelts) in light of the circumstances of Carmont, future train accident risk (including derailment) and the capabilities of current technology

b) in consultation with relevant stakeholders, evaluate the case for fitting specific secondary impact protection devices into new and existing trains

c) where justified by a) and b), incorporate requirements for improved protection measures into standards for train driving cabs

ORR decision

1. Work to address this recommendation is being coordinated by the RSSB Carmont Recommendations Steering Group.

2. RSSB has conducted a knowledge search of available relevant information on secondary impact within a cab in accidents. RSSB research shows knee bolsters and air vests were potentially reasonably practicable options, but we have asked for clarity on this point. If any options are demonstrated to be reasonably practicable, RSSB will update standards accordingly.

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

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

Status: Open

Information in support of ORR decision

4. On 23 June 2022 RSSB provided the following initial response to recommendations 15, 17 & 20:

Thank you for your letter of 30 May 2022, requesting a response regarding Recommendations 15, 17 and 20 in RAIB's report on the Carmont accident. As you will be aware from ORR colleagues, RSSB is playing a wider role in delivering progress against the requirements of RAIB's recommendations.

Following a meeting on 6 April 2022, it was agreed that the eight recommendations relating to rolling stock (i.e. 12, 14, 15, 16, 17, 18, 19 and 20) would be rolled into the

existing, Angel Trains-led, "Carmont Seniors Group", which was considering the four recommendations applicable to owners/operators. The group is to be renamed the Carmont Recommendations Steering Group (CRSG), and this revised approach to delivering the industry response will be chaired by RSSB, supported by industry.

CRSG will include one representative (and one alternate) from each relevant organisation, and ORR as an observer. It will provide the overarching leadership of the response, and ultimately provide the industry responses to the recommendations.

Each of the recommendations will be managed by a working group, where required, noting that some items (such as RSSB project work) will not require a direct working group, but may request representatives to be part of the project stakeholder group. Each working group will have a lead individual and consist of relevant stakeholders. The working group will be tasked with collating, analysing, and delivering a response. This may require external support, and this will be managed by the working group as required.

Each working group will develop a plan or route map, agreed by CRSG. Reporting will be via a scorecard supplied to each CRSG meeting. It is proposed that RSSB will lead the working groups for Recommendations 15, 17 and 20 and – jointly with RDG and Network Rail – Recommendation 12.

Although the structure of the various recommendations varies, the approach to each recommendation, except for RSSB projects, is expected to consist of three main stages:

- *Stage 1. A knowledge search or collation of available information*
- *Stage 2. A cost benefit or ALARP analysis/development of a solution*
- *Stage 3. A response to the recommendation*

Ultimately it will be for the CRSG to decide the required approach, but the quantified safety risk underpinning much of this work was supported by a database of injuries based on the accidents at Southall, Ladbroke Grove, Hatfield, Great Heck, Potters Bar, Ufton Nervet and Watford. RSSB will investigate whether this database can be updated with data from Carmont and Grayrigg, so that working groups have the most current and complete information to develop their ALARP analysis, supported by resources such as the Safety Risk Model.

The working groups are detailed in the attached document, along with relevant RSSB work already completed or soon to be under way.

5. On 11 January 2023 RSSB provided the following update covering period 5-10 of 2022/23:

Period 5 (2022):

25/08/22: As noted in our email of 23 June 2022, Recommendations 12, and 14-20 are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 17,

Knowledge Search S367 (Protection for Train Drivers Against Secondary Impact) has been published on the RSSB website. A further knowledge search has been requested, and will review deformable cab desk material.

In addition, Recommendation 12 (on RDG and Network Rail in conjunction with RSSB) will be delivered by RSSB project T1316, for which a project plan is being formed.

Period 6 (2022):

26/09/22: As noted in our email of 23 June 2022, a number of recommendations are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 17, Knowledge Search S367 (Protection for Train Drivers Against Secondary Impact) has been published on the RSSB website. A further knowledge search has been requested, and will review deformable cab desk material.

Period 7 (2022):

20/10/22: Drafting of the knowledge search on deformable cab desk material has been completed and is being reviewed by the Steering Group.

Period 8 (2022):

17/11/22: The knowledge search on deformable cab desk material has been reviewed by the Steering Group. Comments received are now being actioned.

Period 9 (2022):

14/12/22: An options analysis is in preparation, including a cost-benefit assessment. This will be presented to the Steering Group during December 2022.

Period 10 (2023):

11/01/23: The options analysis is nearly complete. The knowledge search (S367, protection against secondary impact) report and executive summary are being prepared and will be presented to the Steering Group on 9 January 2023.

6. On 15 February 2023 RSSB provided the following update:

In anticipation of RAIB's report, RSSB completed Knowledge Search S367, which has subsequently been revised and updated, with a further Knowledge Search S373 looking at options from other industries.
The two Knowledge Searches are now complemented by an analysis of potential options for both retrofit and changes to standards for new vehicles.

Similarly to Recommendation 15, these options need to be thoroughly assessed to determine their effectiveness in reducing potential injuries. It is anticipated that such investigations would need to include testing as well as simulation, bringing the cost to around £250,000 per option and taking between 12 and 15 months to complete. Therefore series production of any changes to vehicles is unlikely to start within two years.

An exception to this could be for the 'wearable' airbag; as this uses a modification to an existing off-the-shelf product it is considered that simulation alone would probably suffice, and timescales would likely be of the order of 6-9 months. However, it is understood that this option is likely to be challenging in terms of industrial relations.

The options are set out in Appendix B (see below) with indicative costs and quantifiable benefits in terms of reduced injuries. The conclusions of the options analysis are that:

1. For retrofit, the above suggests that the costs are grossly disproportionate to the potential benefits.

2. Without testing, there is currently no justification for change to standards.


Appendix B.docx

Recommendation 20

The intent of this recommendation is to reduce the risk from train fires originating in or around batteries fitted to passenger vehicles, recognising the trend towards increased use of battery systems to store energy for motive power. To address this recommendation, it is envisaged that RSSB will investigate the fire-related properties of products used in other transport sectors.

RSSB should investigate alternative designs of batteries, and their casings, which may offer improved fire-related properties compared to those currently fitted to rolling stock. The output from this investigation should be shared with the UK train and tram industry

ORR decision

7. RSSB has completed research into the design of batteries and casings and a technical note has been drafted. The content of the technical note will be reflected in amendments to relevant standards.

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

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

Status: Open

Information in support of ORR decision

9. On 23 June 2022 RSSB provided the following initial response to recommendations 15, 17 & 20:

Thank you for your letter of 30 May 2022, requesting a response regarding Recommendations 15, 17 and 20 in RAIB's report on the Carmont accident. As you will be aware from ORR colleagues, RSSB is playing a wider role in delivering progress against the requirements of RAIB's recommendations.

Following a meeting on 6 April 2022, it was agreed that the eight recommendations relating to rolling stock (i.e. 12, 14, 15, 16, 17, 18, 19 and 20) would be rolled into the existing, Angel Trains-led, "Carmont Seniors Group", which was considering the four recommendations applicable to owners/operators. The group is to be renamed the Carmont Recommendations Steering Group (CRSG), and this revised approach to delivering the industry response will be chaired by RSSB, supported by industry.

CRSG will include one representative (and one alternate) from each relevant organisation, and ORR as an observer. It will provide the overarching leadership of the response, and ultimately provide the industry responses to the recommendations.

Each of the recommendations will be managed by a working group, where required, noting that some items (such as RSSB project work) will not require a direct working group, but may request representatives to be part of the project stakeholder group. Each working group will have a lead individual and consist of relevant stakeholders. The working group will be tasked with collating, analysing, and delivering a response. This may require external support, and this will be managed by the working group as required.

Each working group will develop a plan or route map, agreed by CRSG. Reporting will be via a scorecard supplied to each CRSG meeting. It is proposed that RSSB will lead the working groups for Recommendations 15, 17 and 20 and – jointly with RDG and Network Rail – Recommendation 12.

Although the structure of the various recommendations varies, the approach to each recommendation, except for RSSB projects, is expected to consist of three main stages:

- *Stage 1. A knowledge search or collation of available information*
- *Stage 2. A cost benefit or ALARP analysis/development of a solution*
- *Stage 3. A response to the recommendation*

Ultimately it will be for the CRSG to decide the required approach, but the quantified safety risk underpinning much of this work was supported by a database of injuries based on the accidents at Southall, Ladbroke Grove, Hatfield, Great Heck, Potters Bar, Ufton Nervet and Watford. RSSB will investigate whether this database can be updated with data from Carmont and Grayrigg, so that working groups have the most current and complete information to develop their ALARP analysis, supported by resources such as the Safety Risk Model.

The working groups are detailed in the attached document, along with relevant RSSB work already completed or soon to be under way.

10. On 11 January 2023 RSSB provided the following update covering period 5-10 of 2022/23:

Period 5 (2022):

25/08/22: As noted in our email of 23 June 2022, Recommendations 12, and 14-20 are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 20, this will be rolled into an existing project. A knowledge search report will also be compiled.

In addition, Recommendation 12 (on RDG and Network Rail in conjunction with RSSB) will be delivered by RSSB project T1316, for which a project plan is being formed.

Period 6 (2022):

26/09/22: As noted in our email of 23 June 2022, a number of recommendations are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 20, this has been rolled into an existing project. A knowledge search is now in progress.

Period 7 (2022):

20/10/22: Drafting of the knowledge search has begun.

Period 8 (2022):

17/11/22: The draft knowledge search has been shared with the Steering Group for comment. Responses received so far have been positive.

Period 9 (2022):

14/12/22: The comments received from the Steering Group on the draft knowledge search are being processed to produce the final report.

Period 10 (2022):

11/01/23: The knowledge search report and executive summary are being prepared and will be presented to the Steering Group on 9 January 2023.

11. On 15 February 2023 RSSB provided the following update:

RSSB has investigated alternative designs of batteries, and their casings, which have the potential to offer improved fire-related properties compared to those currently fitted to rolling stock. As part of a wider scope of work addressing alternative traction power sources for rail, RSSB has looked at the risks and benefits of using batteries on trains, current and emerging battery technology, and the factors that must be addressed when considering the management of fires on rolling stock employing batteries.

To share the results of these investigations with the UK train and tram industry they will be published in an RSSB Technical Note, the content of which will be absorbed into the relevant standards as and when they are updated