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

Dear Andrew,

RAIB Report: Passenger trapped and dragged at Notting Hill Gate station on 31 January 2018

I write to report¹ on the consideration given and action taken in respect of the recommendations addressed to ORR in the above report, published on 3 September 2018.

The annex to this letter provides details in respect of the recommendations. The status of all 5 recommendations is '**Implemented**'.

We do not propose to take any further action in respect of these 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 14 August 2019.

Yours sincerely,

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

Oliver Stewart

Initial consideration by ORR

1. All 5 recommendations were addressed to ORR when the report was published on 3 September 2018.
2. After considering the recommendations ORR passed all 5 recommendations to London Underground Ltd 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. 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 reduce the risk of a train departing with something trapped in the doors, by improving the detection of small objects by the train's door systems.

London Underground should ensure that the door systems on its future rolling stock possess an improved capability to detect small objects, by reviewing available technology to achieve this (such as those used on its more recent fleets) and developing a process to implement solutions as appropriate (paragraph 97b).

ORR decision

4. As far as can be established, London Underground's standard for detection of trapped objects (LUL's variable sensitivity door edge) is the most rigorous in the world. LU has mandated this standard for all future trains. We therefore conclude that London Underground are taking all reasonably practicable steps to reduce the risk of a train departing with something trapped in the doors and are fully compliant with the Health & Safety at Work Act.
5. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, London Underground Ltd has:
 - taken the recommendation into consideration; and
 - has taken action to implement it

Status: Implemented.

Information in support of ORR decision

6. On 14 December 2018 London Underground Ltd provided the following initial response:

LU's standard for passenger rolling stock (S2180) already includes a requirement for future rolling stock to be designed to ensure detection of any dragging incident

and provide automatic intervention. This requirement is set out in section B3.11.4 Project Requirements. I attach a copy for your information (Appendix 1).

We are currently reviewing available technology (such as that used on the S Stock and '09 Stock and other railway operators across the world). We will complete this review in March 2019

Once we have completed this review, we will then consider whether any of the solutions are appropriate for use on our network. We will share the review and its outcome with you.

7. On 10 June 2019 London Underground Ltd provided the following update:

A review of the current LU standards in 2018 mandated that all future rolling stock will consider a means of trapped item detection to an ALARP level and the most recent stocks on LU 09TS on the Victoria Line and S stock on the District, Metropolitan, Circle and Hammersmith & City Lines have anti-drag capabilities in use with anti-drag detection of 100N force. I shared our standard for passenger rolling stock (S2180) with you in December 2018.

We have completed our review into available technologies to improve object detection. I attach a copy of this review.

The review considered the options for detecting thin objects that are smaller than the door closed proving system limits. The review included other railways around the world, we received responses for 11 other railway operators. None of these had means of detecting thin trapped objects or anti drag-nor do they have plans in place to develop such a system.

Our review of railway door suppliers only revealed one supplier IFE that offers a sensitive edge with anti-drag capabilities, however this has a detection of 150N force compared to the LU value of 100N. Other suppliers offered pressure edges which require a deformation by a trapped object or optical sensors, these did not detect thin objects or were too sensitive due to the passenger congestion at the doorways.

From our review, it is evident that the LU standard with the anti-drag system fitted to 09TS and S stock is the best available detection and most suitable for a high intensity railway

The study of available technology is complete and a report submitted to the ORR. An update to the Deep Tube Upgrade Programme has also been made and a contract change to supply sensitive edge is being costed.

Recommendation 2

The intent of this recommendation is to reduce the risk of train operators losing attention and awareness while operating ATO trains, by designing their task to be more compatible with human capabilities and limitations.

London Underground should support train operators of ATO trains in maintaining attention and awareness by considering and, as appropriate, implementing task-related strategies that are based on established human factors knowledge and a review of current good practice (with specific reference to RSSB's ongoing project

T113323). Such strategies may include (but not be limited to) interspersing more regular periods of manual driving where feasible, introducing additional task-focused vigilance activities, or providing alerts if ATO start is attempted before the system is ready (paragraphs 97c.i and 99c).

ORR decision

8. London Underground have carried out a human factors review into the factors effecting train drivers when operating a train running ATO and produced an internal report (which we have seen). This has led to further work including an evaluation of T113323 for use by London Underground and implementation of task related strategies around posture and exercises to maintain alertness.

9. In the longer term, London Underground has undertaken to continue developments in monitoring alertness through wearable technology.

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

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

Status: Implemented.

Information in support of ORR decision

11. On 14 December 2018 London Underground Ltd provided the following initial response:

LU understands the safety risks associated with train operators of ATO trains losing attention or awareness.

In September, we started a human factors review of relevant research on risks and potential solutions to operators losing attention / awareness whilst operating a train. This review (which is being led by two of our Human Factors Engineers) is considering the information being gathered by the RSSB's project "Evaluating prevention and mitigations to manage cognitive underload for train drivers" (T1133). This research is useful, but is very focused on awareness and education of train operators in techniques they can use to maintain concentration levels or actions they can take to manage potential risks associated with cognitive underload.

As a result, our review is considering a much wider range of factors which we consider may have potential in managing these risks, including

- *engineering controls, including alarms and alerts if the train operator starts before the system is ready, task-focused vigilance activities, alertness monitoring devices and other engineering controls where identified,*
- *train operator development, competence and deployment, including rostering, training and competence management,*

- *train operator activities, including use of task-focused vigilance activities, application of scanning techniques, regular periods of manual and use of 'pointing and calling',*
- *approaches taken by other metros around the world, and*
- *review of other safety critical industry approaches to maintaining concentration.*

We are undertaking a functional task analysis of manual and automatic train operation and will use that task analysis to drive an error assessment to understand the nature and potential severity of loss of attention / awareness on train operation tasks.

The output of this review and analysis is to identify potential solutions for helping train operators maintain attention and awareness while operating their train.

We are involving our train operators in this work and have run a number of workshops with them to get their views on some of the options we have identified.

We will complete the first stage of this review in December 2018 and finalise the report and will share recommendations with our Directors for decision on next steps in January 2019. I have attached our plan (Appendix 2).

I note that the HM Chief Inspector of Railways recently asked operators of mainline trains to consider using in-cab monitoring devices and we understand that the ORR is developing a set of principles on this issue. Given the project I have described above, we would be happy to share what we have learned in our research and to contribute to the development of these principles. Once they are produced, I would be grateful for sight of these principles when they are developed so that we can apply them, where appropriate, on London Underground.

12. On 10 June 2019 London Underground Ltd provided the following update:

As identified in the previous response, a human factors review or relevant research on risks and potential solutions to train operators losing attention / awareness whilst operating a train has been undertaken and a report drafted. The recommendations made in this report have also been discussed with Directors. As a result there are now a number of workstreams in progress, we have:

- *Validated RSSB's T1133 'Evaluating prevention and mitigations to manage cognitive underload for train drivers' for a London Underground context. This was done via our Skills Development team with inputs from Instructor Operators who pooled their own techniques. Based on this a training document has been produced and will be used as a source for future promotional and refresher training from quarter 3 2019/20. The final implementation plan will be defined as consultation with our Trades Unions progress.*
- *Researched the potential for 'applied biometrics' tools such as wearable technologies to monitor levels of attention and awareness. We have met with several of the organisations who are innovating in this field and invited the ORR and RSSB to briefings. We continue to consider the applicability and*

suitability for trials, potentially in TfL functions other than train operators in the second half of 2019/20.

- *Brought together RSSB's Human Factors team and TfL Trams Operations to evaluate the data being generated by the 'Guardian' product which has been in use to support tram drivers since late 2017. This will result in insights being shared across the rail industry, for example correlations between fatigue events and shifts. We are awaiting timescales for next steps from the RSSB.*
- *Joined with the research and development team of a major signal systems supplier and bid for innovation funding to develop and 'virtual assistant' device for train operators. We are currently awaiting the outcome of this and will seek alternative sources if this is unsuccessful.*
- *Produced guidance material on posture in driving cabs, including videos demonstrating seating, standing and exercise techniques to maintain alertness both during and between spells of driving. This was launched on the Jubilee line in 2018 and versions for other lines are now in production. A delivery schedule is being prepared.*

Recommendation 3

The intent of this recommendation is to optimise the views presented on in-cab CCTV monitors in order to minimise the possibility of a train operator being unaware of problems at the platform-train interface.

London Underground should supplement the work of its GAPS project with additional objectives to review the presentation of images on platform monitors. The review should include consideration of the number and configuration of images displayed to the train operator, taking into account current standards and good practice (paragraphs 97c.ii and 99c).

ORR decision

13. London Underground have supplemented the work in the GAPS project by carrying out a human factors study of One Person Operation (OPO) CCTV. A number of improvements have been identified and changes made, such as at Stratford and Green Park stations.

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

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

Status: Implemented.

Information in support of ORR decision

15. On 14 December 2018 London Underground Ltd provided the following initial response:

LU is currently conducting a review of the human factors elements in its OPO CCTV Standard 1-150. Any changes to the standard will not be retrospective, but will be incorporated into the design proposals for new train stock. The human factors changes to the standard will ensure that obscured views are removed from future designs and that the display of the camera images in the driver's cab are consistent with best practice human factors.

A review is also being undertaken to consider how the OPO camera images are currently being displayed to train operators across each of the lines and if the image display is presented in the ideal format for the line OPO system. The finding of this review will be completed in the summer of 2019.

The GAPS Project (as part of its ongoing work) considers alternative proposals to the way the images are displayed to train operators. Our contractors undertaking the design and build work are required to consider best practice human factors when designing new camera layouts for each platform. This includes the number of cameras to be deployed and how those camera images are displayed to train operators. Where possible, we try to maintain or reduce the number of images used. If this is not possible and the design results in an increase in cameras, our contractors provide suitable designs proposals for how the images could best be displayed from a human factors perspective. Examples of this are set out in Appendix 3.

16. On 10 June 2019 London Underground Ltd provided the following update:

LU has undertaken a review of the human factors elements in its OPO CCTV Standard 1-150 and the Deep Tube Upgrade Programme and a report drafted. This included investigation into the presentation of OPO images to train operators. The recommendations are outlined in this report (attached). A programme of changes that are required to Standard 1-150 has been drafted. The programme itself commenced in January 2019 and is due to be completed in February 2020.

With regard to the existing legacy OPO systems, several workshops have taken place on the Northern line to consider if the track to train OPO PTI images currently displayed to Northern line train operators in their in-cab monitor is presented in the best format. This has identified several options to improve the sequence of how the images could be displayed although there is not proposal to move away from the current quad image. Similar exercises will be undertaken in the Piccadilly and Bakerloo lines on the 19th and 21st June respectively with the remaining lines to follow over the coming months. The final report is due to be completed in early October. Proposals associated with these will be consulted on with our Trade Unions.

Work with our contactors who undertake design and build work to consider best practice human factors when designing new camera layouts for each platform continues via the GAPS Project. This includes the GAPs project designing new OPO systems that provide improved views of the critical area of the PTI. The project is delivering improvements within the constraints that exist, e.g. the number and size of the monitors in the cab, restrictions on platform based OPO equipment, etc. Where we have implemented new OPO cameras, including at Green park on the Piccadilly

line and Bank on the Central line, we have seen significant improvements to the images displayed to train operators.

Recommendation 4

The intent of this recommendation is to improve the capabilities of train operators in making despatch decisions.

London Underground should review its competence management programmes for all train operators in order to ensure consistency in training techniques for visual scanning of platform monitors, and awareness of the limitations of door interlock systems (paragraphs 97c.iii and 98a)

ORR decision

17. London Underground have carried out a review of their train operator Competence Management System and now have a plan to ensure that train operators are briefed on the appropriate techniques for visual scanning of platform or in cab train monitors. Through consultation with their human factors engineers, London Underground are considering if any further actions are necessary to improve the capabilities of train operators making despatch decision.

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

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

Status: Implemented.

Information in support of ORR decision

19. On 14 December 2018 London Underground Ltd provided the following initial response:

London Underground has reviewed the train operator Competence Management System (CMS) in relation to training techniques for visual scanning of platform monitors, and awareness of the limitations of door interlock systems.

Our review of training techniques for visual scanning of platform monitors has identified opportunities to improve how we train train operators to monitor in cab CCTV. We do not use a consistent, risk-assessed, methodology such that we can be assured trainers and instructors are aware of and teaching best practice, nor do we consistently confirm through the CMS that every train operator is doing this in the best way.

Our review sought input from the RSSB and other train operating companies, and with security industries, specifically security guards at a major airport. No evidence or information on training/competence management programmes relating to visual

scanning of platform monitors was identified from other organisations. The review is attached in Appendix 4.

We now have a plan to ensure that train operators are briefed on the appropriate techniques for visual scanning of platform or in cab train monitors. This will be carried out line by line, with input from our Skills Development team to ensure that there is consistency in training techniques. This plan (Appendix 5) will be delivered by March 2019.

Our review of our CMS in relation to the limitations of door interlock systems highlighted opportunities to improve communication about door interlock systems with our train operators. We have developed a presentation for our train operators. This is attached in Appendix 6.

We are currently finalising a review of all aspects of our train operator training and competence management system including a refreshed risk-based training needs analysis. All relevant elements of the investigation into the incident at Notting Hill Gate, and from other significant safety incidents on the Underground, have been considered as part of this review.

20. On 10 June 2019 London Underground Ltd provided the following update:

The line by line review of training techniques took longer than the original plan envisaged. This was mainly due to undertaking detailed local consultation on best practice which took longer than anticipated. However, this extended consultation had the benefit of raising awareness through our line level PTI groups.

The resulting training material has been reviewed by our Human Factors Engineer and is currently being prepared for a peer-review by our Directors Risk and Assurance Change Control Team in July, followed by consultation with the Trade Unions in August and integration into promotional and refresher training from quarter 3 2019/20. This will be accompanied by specific briefings for Instructor Operators at workshop events throughout the autumn. The scope covers visual scanning, the limitations of door interlock systems and cross references techniques to maintain concentration and awareness.

Our wider review of our competence management system has progressed and elements of this have begun consultation. For example, we have started work on an updated methodology to convert line route risk assessments into learning tools and minimum numbers of driving trips for trainees.

Recommendation 5

The intent of this recommendation is to mitigate the consequences of incidents at the platform-train interface by improving staff awareness of the available means to stop trains in an emergency.

London Underground should review the information provided to its staff about Platform Emergency Stop Plungers (PESPs) and implement measures to promote amongst staff the appropriate use of PESPs where they are available (paragraph 99a).

ORR decision

21. London Underground have reviewed the information provided to staff on lines where PESPs are provided (Central and Victoria) and concluded that existing arrangements are adequate.

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

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

Status: Implemented.

Information in support of ORR decision

23. On 14 December 2018 London Underground Ltd provided the following initial response:

London Underground reviewed the information provided to staff about our PESPs in June 2018. This was done in conversation and by email between the HSE team and the LU Communications team

The review noted that

- *Information is included in LU's Rule Book 8: Managing the Platform Train Interface (Rule Book 8 is attached – Appendix 7).*
- *Station staff on the Central and Victoria lines – the only two lines with PESPs – are briefed on the use of these plungers during their local induction.*

Following that discussion, a news article was published on the LU intranet on 13 July 2018 (Appendix 8). This information was also included on digital signage at our head offices during the same week.

We have also included information on the appropriate use of PESPs in our training for Licensed Travel Ambassadors.

24. On 10 June 2019 London Underground Ltd provided the following update:

We discussed this issue when we met and I believe that the information that we have provided to you has addressed this issue and that this recommendation is closed.