Oliver Stewart
RAIB Recommendation Handling Manager

3 August 2023

Mr Andy Lewis
Deputy Chief Inspector of Rail Accidents

Dear Andy,

RAIB Report: Train travelling with doors open on the Jubilee line on 1 September 2018

I write to provide an update[1] on the action taken in respect of recommendations 1, 2 & 4 addressed to ORR in the above report, published on 10 July 2019.

The annex to this letter provides details of actions taken in response to the recommendations and the status decided by ORR. The status of recommendations 1, 2 & 4 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 4 August 2023.

Yours sincerely,

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

Recommendation 1

The intent of this recommendation is to mitigate the risk of train operators driving a train out of a platform with one or more doors open. It is anticipated that consideration will be given to additional safeguards when the train door interlock cut-out switch is operated.

London Underground should review the safety systems associated with control of passenger door opening and closing, including train door interlock cut-out switch operation, on its 1995 and 1996 stock trains. Where such features are inconsistent with current good practice, appropriate remedial action should be undertaken. The review should include gaining a sufficient understanding of train control systems so that potential impacts on door safety can be established.

ORR decision

1. As previously reported, LUL reviewed the safety systems associated with control of passenger door opening and closing on 1995 and 1996 stock trains. The review demonstrated a good understanding of the system and more robust tags were fitted to the cut-off switch as an interim measure, while continuing to consider longer-term solutions.

2. LUL is exploring the possibility of a software modification, but this may be costly and not have a significant impact on improving safety, as it would provide a warning, but no extra layer of engineering protection.

3. ORR consider the recommendation closed, as LUL has reviewed the safety systems associated with control of passenger door opening and closing, has a measure in place and continuing to consider how risk controls can be strengthened. We will continue to monitor LUL progress with technical modifications.

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

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

Status: Closed.

Previously reported to RAIB

5. On 10 June 2020 ORR reported the following:

LUL have carried out a review of the safety systems associated with control of passenger door opening and closing. LUL have made the seal on the interlock more robust and improved warning signs, but we have challenged them to find a more

effective risk control. As a result, LUL will undertake a quantified risk assessment and cost benefit analysis with a view to identify an appropriate technical solution.

We have asked LUL to keep us informed with progress and to provide a time-bound plan when they have identified a technical solution.

Update

6. On 18 May 2022 LUL provided the following update:

In our last letter to you, we set out our plans for improving the warning label and seal robustness of the cut-out switch and our progress in considering a technical solution. I have set out progress on both aspects below.

We reviewed of how the risk of incorrect use of the Train Door Interlock Cut-Out switch (TDICOS) may be better mitigated. The review considered several options for clearer identification of the TDICO to avoid an operation in error (by the train operator). It concluded that the signage on the switch should be updated with large visible warning labels in addition to making the associated seal more robust.

I can confirm that we have completed a modification to the Train Door Interlock Cut Out Switch on the relevant fleets (Bakerloo, Piccadilly, Central, Jubilee, Northern). This has included the signage on the switch being updated with large more visible warning labels in addition to making the associated seal more robust.

As per Lilli Matson's letter of 10th June 2020, the quantified risk assessment I referred to has been finalised. This report concluded that waiting until the next stock modification package planned in 3 years before implementing a technical solution was (and remains) within the 'broadly acceptable' region of 1 in 1,000,000 defined by the ALARP triangle in TfL standards.

We are currently undertaking an internal exercise to determine the best technical solution to further mitigate against the risk of trains operating with doors open in error. A number of workshops have been carried out (the last one took place in April 2022) to identify and categorise the best options, including consideration of procedural and hardware changes. Once this exercise is completed, LU will follow internal governance processes to progress a solution that both compliant and cost effective. The chosen approach and its implementation will take into consideration many drivers including other interventions being undertaken on the relevant fleet to balance outcomes, delivery and efficiency. Our overall safety improvement programme will be developed in light of our funding arrangements.

7. On 30 June 2023 LUL provided the following update:

To put the information provided below in response to this recommendation into context the TfL Engineering Team have provided further explanation of the safety systems associated with the control of passenger door opening and closing on the Northern and Jubilee line rolling stock. On both of these the passenger door opening (or 'release') and closing is controlled by high integrity hard wired relay logic circuits. There is Correct Side Door Enable provided by the Thales Automatic Train Control (ATC) on-board Signalling with SIL 4 integrity. The trains were also provided with selectable Passenger Open / Operator Open. In Passenger Open the high integrity

circuits operate in conjunction with the Trains Management System (TMS) to 'release' the doors but they are then opened locally by passengers using buttons at the doorway. It was a software lock-up that prevented some door closing in the Finchley Road incident.

On both rolling stock the door actuating mechanism is a pneumatic operator incorporating an over centre lock in the linkage at the door closed position. Detection of 'closed' is by a reed switch actuated by a magnet on the door leaf. The interlock 'makes' when the door is very close to fully closed. Each door leaf has its own detection. Only when all doors are proved closed, a train length high integrity circuit energises a head end proving relay which causes the doors closed indicators to illuminate in the cab, complete a providing interlock to allow Automatic Train Operation (ATO) Start or manual driving start cannot be pre-selected before the doors are provided closed.

To address cases where a door interlock fails to prove or another failure in the proving or door closing fails, the Train Door Interlock Cut-Out Switch is provided, so that they train can be moved to a depot or siding for attention. Due to the frequent service on LUL lines and the risk of delay at each stop, it is better to detrain and move the train away empty than to attempt to operate with an individual doorway locked out of use and its interlock by-passed, so local door by-passes are not installed.

In the case of the incident at Finchley Road after a fault with the train doors was realised (not all doors had opened to allow customers off of the train and onto the platform), after attempting to open and close the doors a number of times which did not resolve the issue, the train operator operated the Train Door Interlock Cut-Out (TCID) in error. They should have operated the Emergency Saloon Door Control (ESDC). The train then departed the station with train doors open. These stock differ from others on the LUL network because there is no audible alert to the train operator when a train is motoring with doors open.

TfL's Engineering Team are happy to talk through this in further detail with Catherine Hui if this would be helpful.

<u>Train Door Interlock Switch Modification</u>

By Spring 2022 a modification to the Train Door Interlock cut-out (TDICO) switch had been implemented on the relevant fleets (Bakerloo, Central, Jubilee, Northern). This modification included the signage on the switch being updated with large, more visible warning labels in addition to making the seal more robust.

<u>Longer term software change</u>

We are still considering longer term technical solutions to address this issue. We have undertaken an internal exercise to determine the best technical solution to further mitigate against the risk of trains operating with doors open in error. A number of workshops were carried out to identify and categorise the best options, including procedural and hardware changes. As an output of this work 4 potential solutions, which are all an audible alarm which sounds to the train operator when a train is motoring with doors open, have been identified and Seed Funding has been

approved to further investigate these options and consider what is feasible. At this time there is not a timescale beyond the Seed Funding as this will depend on which of the options we can justify proceeding with.

For the Northern Line we have received a quotation for a package of software modifications from Alstom, which includes the audible warning. This is currently subject to our business processes to determine if the package of 3 changes can be implemented. The indicative cost for the full package of works is around £1.5M with a delivery timescale of around 30 months.

Both the 95TS and 96TS work packages will be monitored via our Guiding Mind group, the Asset Investment Plan, our Asset Condition Reporting process and our project management processes.

In your letter of the 13 February 2023, you asked whether the purpose of the workshops was to start again with reviewing new options or whether we were revisiting the original work. You also asked whether the options that have been chosen are still considered to be the most cost effective in terms of hierarchy of risk controls.

In response to this I can confirm that the work undertaken has been to identify all ways in which we could modify the Jubilee and Northern line rolling stock so that they comply with our Standards, specifically addressing the risk of a train operator operating the train with open doors. The exercise was looking at technically feasible and best value options that we may be able to deliver within the overall financial constraints that we face at TfL. Appendix 2 to this letter (VOR-1162-A Value Study Output Report) outlines the options assessed as part of this work.

Appendix 2
VOR-1162-A Value St

LU Standards require that an audible alarm is sounded if a train is motoring with doors open. The Jubilee and Northern line rolling stock does not currently have this function. The purpose of this alarm is to act as a reminder to train operators that they are operating in this condition and that it has not happened inadvertently. This can only happen when door interlock cut out has been operated (the 'sealed' switch which we have already altered the sealing arrangements for). Whilst it is recognised that alarms are lower in the hierarchy of controls, it is not possible to engineer this possible condition out of the design of our trains as this is required to support the recovery from fault/failure conditions.

<u>Monitoring of approach</u>

In your letter of 13 February 2023 you noted that the ORR accept that there are no further interim modifications being done in addition to the seal/label changes to the TDICO. However, you asked about any checks or monitoring being done on the effectiveness of this approach and if incidents (such as door faults) are being tracked.

Our Fleet Team have confirmed that they cannot determine the number of operations of the door cut out switch as there is no technical method available to

enable us to complete this without manually downloading all trains on a regular basis. This would be a significant undertaking for a very infrequent event so has not been considered further. To note, there are no similar events since this incident at Finchley Road and very few, if any, similar events in the 10 years prior

Recommendation 2

The intent of this recommendation is for London Underground to support train operator decision-making when they are dealing with unusual faults under stressful conditions. The review could form an extension of the work London Underground is undertaking in response to Notting Hill Gate recommendation 2 (paragraph 123) but should not delay that work.

London Underground should review and, where necessary, take action to equip its train operators with the skills, knowledge and information needed to identify and respond appropriately to faults affecting their trains. This should include consideration of the:

- use of train simulators to practise fault finding; and
- provision of documentation, such as quick reference guides, to help train operators transition effectively from a low workload scenario to an unexpected high workload scenario when there is an unusual occurrence during automatic train operation.

ORR decision

8. LUL has reviewed train operator decision making and implemented a number of measures including guidance, use of simulators and updated competence assessment.

9. ORR consider the action taken by LUL to be sufficient to close the recommendation, and continue to monitor progress by LUL with measures put in place to better equip train operators to respond to faults on trains through continued proactive liaison work. We will also encourage LUL to consider identify best practice in other train and metro operators.

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

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

Status: Closed.

Previously reported to RAIB

11. On 10 June 2020 ORR reported the following:

LUL are making changes to their Competence Management System (CMS) to identify ways to improve the ability of train controllers to respond to train faults. We have asked LUL to keep us informed with progress of the project and to provide a time-bound plan when they have finalised the changes to the CMS.

Update

12. On 18 May 2022 LUL provided the following update:

Our actions relating to this recommendation are addressed in our work to improve the LU Competence Management System and support to our train operators to help them maintain concentration while driving our trains. Details on both workstreams were covered in the plan which was provided to the ORR in June 2020. At this time the priority was maintaining basic competence and training of our existing and promotional training for new train operators during the COVID-19 pandemic. The pandemic delayed roll out of this plan. We have reviewed the timescales associated with this work and updated our implementation plan which is included with this letter.

13. On 30 June 2023 LUL provided the following update:

Recommendation 2 – Decision Making & Adverse Events

As per our previous responses to the ORR we to continue work and develop in this area using a variety of mechanisms to support train operator decision making. These mechanisms are outlined in full below.

Quick Reference Guides

As per our response to the ORR on the 1 September 2019, every train operator is provided with a personal copy of a 'defect guide' relevant to their stock. A copy is also kept in every train cab for use by train operators. The defect guide is designed to enable a fast access to key information to act as a prompt, especially if they are dealing with an unusual fault and / or feel under pressure. Use of these also continues to be covered and reinforced in train operator training (promotional for new train operators and existing train operators as part of their normal competence assessment). Examples of these have previously been provided to the ORR.

Simulators

Work in this area remains ongoing and we continue to use simulators where we can to create scenarios where train operators can react and respond to potential incidents on the railway in a safe environment. We specify the need for simulators when we procure new rolling stock, and they are available on more modern LU lines. We also continue to actively explore new technologies in this space.

We recognise that learning in a live environment is the best approach for training and we use blended learning, using all of the means we have available to support train operator learning.

Competence Assessment

We have developed a new 2-day competence assessment which was piloted on the Central line at the beginning of March 2023 and has been consulted on with our Trade Unions. A further pilot took place on 27 and 28 April 2023. This has incorporated learning from the first pilot. I can confirm that this and the work done on Competence Assessment has taken account of the work undertaken at the start of the process (as per your question of 13 February 2023). This included incorporating some elements of the Human Factors review that was undertaken which covered risks and potential solutions to operators losing attention/awareness including the RSSB project 'Evaluating prevention and mitigations to manage cognitive underload for train operators' and the output of the train operator workshops that were held. The output of this has led to the production of a cognitive underload video and handbook. Further details on these is included in the 'LU Plan for addressing RAIB Finchley Road Train Incident' which is included as Appendix 1.

Appendix 1 LU Plan
for addressing RAIB F

On completion of the pilot sessions, we updated our trade unions, who are supportive of the approach that we are taking at a meeting on 8 June 2023. Following this, we are in the process of completing the design work on the other lines and rollout to all lines by the end of 2023. This assessment is based on a risk-based training needs analysis (RBTNA) which focuses on low frequency, high consequence events including defect handling. In your letter of 13 February you requested a copy of the training material, our RBTNA is included as Appendix 3.

Appendix 3 Copy of
Train Operator RBTN

You also asked how implementation of the training is being monitored, for any data that we have on when and how the training has been used and any feedback from the training. As this is currently in the pilot stage there is limited data. Monitoring effectiveness following the implementation phases will be undertaken in line with our normal process for doing so. Our evaluation of the course is based on Kirkpatrick model of evaluation – the most recognised method of evaluating the effectiveness of training programmes.

We undertake Level 1 and 2 evaluation on the day of the course through trainer evaluation and an evaluation survey which includes a score for understanding of material and engagement with the topic. Six months after implementation we intend to undertake level 3 evaluation of the course to evaluate the extent to which delegates have applied their learning and skills into the workplace which will help us to determine the effectiveness of this.

We will keep the ORR updated as the rollout of Competence Assessment continues as per our plans.

<u>Cognitive underload</u>

A 'Staying Focussed' handbook and a cognitive underload video have been produced for train operators. These has been included in support for all new train operators in promotional training since 2021 and they are referenced in ongoing competence assessment for existing train operators. They are hosted on a new Sharepoint site which contains materials for train operator continuous development. Access has been provided to Catherine Hui to view this Sharepoint site. These materials have been based on the research undertaken at the beginning of the process (including the Human Factors review and review of the RSSB training video of cognitive underload).

A communications plan is in the process of being developed to ensure continued awareness of video and the 'Staying Focussed' handbook and we are tracking the number of users who have viewed the materials which will feed into future communications needed.

Cognitive underload and non-technical skills are built into the scenarios tested as part of ongoing Competence Assessment. This is the case with the existing and the new Competence Assessment.

Therefore, we continue to develop the mechanisms that we use to train and assess train operators on decision making, dealing with adverse events and cognitive underload which is a continuous process.

In response to your questions on how this element of training is being monitored, data that we have on when and how the training information is being used and any feedback on this. Whilst the handbook and video are included in train operator promotional training (for new train operators) and are published on the Sharepoint site for train operator continuous 6 development we continue to work to increase awareness of the tools available. Monitoring on use will also be undertaken, this will remain under review and further communications undertaken as necessary on an ongoing basis.

Recommendation 4

The intent of this recommendation is to improve train operators' knowledge about the effects insufficient amounts of sleep can have on performance.

London Underground should review and, where necessary, revise its competence and fatigue risk management systems for train operators in order to increase awareness of the adverse effects on human performance from insufficient sleep and inappropriate eating patterns.

ORR decision

14. TfL has launched a new fatigue management plan which covers LUL. We have asked LUL to consider how to handle assurance of the new plan, as by relying on local managers, it may be difficult to ensure consistency across local areas. LUL will undertake a review of current fatigue related interventions as part of the 2023/24 operational safety plan.

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

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

Status: Closed.

Previously reported to RAIB

16. On 10 June 2020 ORR reported the following:

LUL have taken a number of actions aimed at improving fatigue management of train controllers, including updated training material, encouraging self-reporting of fatigue and an app to self-assess sleep health. LUL were planning to relaunch the app in April 2020 and we have asked if this was successful and the extent of take up among operational teams.

Update

17. On 18 May 2022 LUL provided the following update:

The work that we are doing to address this recommendation is included in the plan which has been provided to the ORR in response to the RAIB recommendations relating to the Notting Hill Gate Person Dragged Under a Train incident of the 31st January 2018. A copy of this plan is provided with this letter.

In summary there is now an established, pan TfL Fatigue Management Steering Group (FMSG) with representatives from across TfL operational business, occupational health and wellbeing and wider areas affected by fatigue issues. The FMSG has an agreed a terms of reference, and exists both to develop and oversee the delivery of the Fatigue Management Programme, and to discuss, share and disseminate emerging issues, best practice and lessons learned. It is supported by a Safety Strategy Manager and an appointed senior management lead.

This group has in place an overarching fatigue management programme and we have a commitment to having a pan-TfL Fatigue Management plan in place in 2023/24. A detailed update on this plan was provided to the TfL Safety, Sustainability and Human Resources Panel in February 2022. Three workstreams will be delivered which are structured to provide TfL businesses with the tools needed to identify and manage the risk of fatigue among employees and continually improve.

(a) Workstream 1: Increasing understanding, awareness & effective management of fatigue risk, through sleep and health screening.

(b) Workstream 2: Developing and implementing effective, evidence- based tools and guidance to support risk management and plans.

(c) Workstream 3: Widening the adoption of good practice across the organisation.

18. On 30 June 2023 LUL provided the following update:

Since our previous update, we have launched our Pan-TfL Fatigue Management Plan (FMP) in November 2022 - a year earlier than planned. The FMP sets out 12 activity areas for managing fatigue risk, aligned with regulatory and industry best practice. Progressive requirements from minimum to best practice are set out for each activity.

All TfL business areas are required to meet the minimum 'must' requirements, ensuring compliance with standards, and are encouraged to work towards progressive 'should' good practice requirements, continually building maturity in fatigue risk management. This would include requirements for Operational Managers including Train Operations Managers. The Plan has been embedded within our refreshed SHE Management System, which is easier to access, understand and apply and we will now work to communicate and embed these requirements across all areas of TfL. The requirements of the pan-TfL FMP can be seen here.

We actively encourage leading indicator reporting, including incidents of fatigue so we can work to address them. Our new FMP and associated tools provide us with a wider set of indicators to understand fatigue risk and to focus further improvements. A range of leading indicators have been identified including completion of fatigue training appropriate to colleagues' roles, incident investigations where consideration of fatigue has been included and measures relating to overtime.

Further performance indicators and measures we can now use due to the launch of the FMP include data on access to the SHE Management System Fatigue pages, completion of our fatigue risk screening process (detailed below), delivery of improvement plans and fatigue self-reports. There are also plans to digitise all of our fatigue outputs, enabling greater transparency, visibility, and oversight of fatigue related information for performance reporting.

As per our previous updates to you we have also updated our training material to strengthen the information included on the potential consequences of insufficient sleep and inappropriate eating patterns and this remains in place. 7 As part of the wider TfL Fatigue Programme, we have also implemented the Fatigue Risk Screening Process, Sleep Health Assessment Tool and a Colleague Fatigue Reporting Process. These are outlined further below.

<u>Fatigue Risk Screening Process</u>

This is completed by managers for their areas and focusses on fatigue factors present in their business areas and the measures that they have in place to manage them. A report with recommendations is produced on completion of this with recommendations being taken forward by the manager with support from their SHE Business Partner. A copy of the TfL Fatigue Risk Screening Questionnaire is included as Appendix 4. An example copy of the results of a TfL Fatigue Risk Screening Questionnaire is also included as Appendix 5.

Appendix 4 TfL Fatigue Risk Screenin

Appendix 5 Example Fatique Risk Screenin

In your letter of 13 February 2023, you asked whether the fatigue risk screening process covers all safety critical tasks, such as train operation including ATO. As this

is completed by local managers, this would focus on the specific fatigue factors for their areas. For example, a Train Operations Manager (TOM) would consider all activities a train operator would undertake in their role, the questionnaire includes:

- *The specifics of the area that the business area undertakes (area of LU they work, overview of role(s), how many people in the roles etc.). A TOM would consider train operating duties*
- *Whether safety critical activities are undertaken*
- *Shift work, including shift work where there are regular early starts or nights, where staff swap shifts*
- *Overtime*
- *Alertness*
- *Sedentary work including where staff remain in a similar position for extended periods of time such as train operators*
- *Lack of exposure to natural daylight*

As part of the TfL Operations Safety Plan for 2023/24 we will also be undertaking an exercise to evaluate the effectiveness of the current fatigue related interventions for each Directors team to understand the fatigue risk for those teams better. The output of this will then be incorporated into risk based plans for reducing fatigue. London Underground Line Operations will be subject to a function based evaluation as part of this.

<u>Sleep Health Self-Assessment Tool</u>

This provides colleagues with an individual report providing tailored feedback on aspects of their life that negatively impact on their sleep and sleep hygiene. The tool is available for use by all colleagues across TfL (safety critical and non-safety critical) to support them in their health & wellbeing including train operators. We facilitate electronic copies in addition to distributing over 1,000 paper copies to those colleagues without regular access to internal IT (like train operators).

The sleep tool self-assessment enables colleagues to gain an insight into how to improve their sleep and also screens for three impairing sleep disorders (Insomnia, Obstructive Sleep Apnoea and Restless Leg Syndrome). Since 8 October 2021 (when the tool was re-launched and extended for use across all of TfL), a total of 523 people have completed the assessment (across all of TfL). Of these, 213 work in London Underground. Indicative data suggests that 40 train operators / Instructor Operators have completed the survey. We continue to encourage uptake of this important tool. A copy of the TfL Sleep Health Questionnaire is included as Appendix 6.

Appendix 6 Sleep Tool Self Assessment.

In your letter you asked whether the completion of this is mandatory. I can confirm that it is optional. However, sleep health is covered as part of our mandated periodic age medicals for all operational colleagues (including train operators).

<u>Colleague Fatigue Reporting</u>

The purpose of this has been to encourage colleagues, including train operators, to report to their manager/supervisor if they feel too fatigued to work safely, and consequently enable their managers to provide support to individuals and better

understand when, where and why fatigue is occurring. It also aims to promote a more transparent, supporting culture. The rollout of this across the network was delayed as a result of the pandemic however was relaunched using an electronic process for fatigue reporting in 2021 across TfL. This was developed and pioneered by LU and use of the process continues to be monitored.

The wider Fatigue Programme is underpinned by our commitment to create a just and fair culture where colleagues feel comfortable reporting fatigue. We continue to promote our digital fatigue reporting process, encouraging individuals to proactively report any fatigue concerns to their managers to prevent incidents. This is aligned with our HR positions to ensure the individual knows they will be supported in doing so. Anyone openly and honestly reporting fatigue in advance of an incident will be treated sensitively and without criticism. Implementation has been accompanied by a series of support workshops and drop-in sessions.

The online process was launched in September 2021 and was accompanied by a series of online workshops and drop-in sessions to support our front-line managers.

Since this relaunch we have had 35 proactive reports of fatigue from London Underground colleagues, 15 of which (42.86%) have been train operators. We continue to actively encourage our colleagues to tell us about incidents of fatigue so we can work to address them.

Train operator knowledge of fatigue

In your letter of 13 February 2023 you asked what measures we are taking to check train operators' knowledge of fatigue and the impact of insufficient amounts of sleep can have on performance. Train operator knowledge of fatigue is not assessed specifically. However as per my response to recommendation 2 above the scenarios tested as part of Competence Assessment do incorporate such issues and fatigue and wellbeing continue to be reinforced at promotional training and ongoing competence assessment.

Previously reported to RAIB

Recommendation 1

The intent of this recommendation is to mitigate the risk of train operators driving a train out of a platform with one or more doors open. It is anticipated that consideration will be given to additional safeguards when the train door interlock cut-out switch is operated.

London Underground should review the safety systems associated with control of passenger door opening and closing, including train door interlock cut-out switch operation, on its 1995 and 1996 stock trains. Where such features are inconsistent with current good practice, appropriate remedial action should be undertaken. The review should include gaining a sufficient understanding of train control systems so that potential impacts on door safety can be established.

ORR decision

1. LUL have carried out a review of the safety systems associated with control of passenger door opening and closing. LUL have made the seal on the interlock more robust and improved warning signs, but we have challenged them to find a more effective risk control. As a result, LUL will undertake a quantified risk assessment and cost benefit analysis with a view to identify an appropriate technical solution.

2. We have asked LUL to keep us informed with progress and to provide a time-bound plan when they have identified a technical solution.

3. 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
- is taking action to implement it, but ORR has yet to identify if there is an appropriate technical solution.

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

4. On 15 October 2019 London Underground Ltd provided the following initial response:

As a result of the incident, a technical assessment was undertaken during April 2019 by TfL's Engineering Department. The assessment involved a review of how safety standards can be improved into the use of the Train Door Interlock Cut-Out ("TDIC") switch. Several options for improvement were identified as a result of this study and consideration was given to each option.

When feasibility of the proposed work was taken into account, it was decided that large visible warning labels would be fitted to the TDIC switch. The full details of

this work are set out on page 6 of report "AOS-E-RS-Int-MU-TR_12-N0-843-A1". A copy of this report will be included with this letter.

The incorrect use of the TDIC switch by the train operator was a major factor in this incident and we feel that the introduction of this visible warning label will be effective in raising awareness about the use of this switch. Next steps on this modification will involve mapping out its introduction with our Head of Fleet.

5. On 13 March 2020 London Underground Ltd provided the following update:

As a result of this incident, a technical assessment was undertaken in April 2019 by TfL's Engineering Department. This involved a review of how the risk of incorrect use of the Train Door Interlock Cut -Out switch (TDICOS) may be better mitigated. The assessment also considered several options for clearer identification of the TDICO to avoid an operation in error. It concluded that the signage on the switch should be updated with large visible warning labels in addition to making the associated seal more robust.

The ORR highlighted that these solutions are the lowest of all the options on the hierarchy of controls and the other, more technical, options should be considered further.

As a result, we are now undertaking a quantified risk assessment and cost benefit analysis. This will allow us to determine what is appropriate in terms of implementing a technical solution. A draft of this has been completed and is with the relevant subject matter experts for review. We will update the ORR in the next month of the outcome of this.

In the short term we will improve the warning label and seal robustness. We have sourced a new indicator seal/tag for the cut-out switch and this has undergone initial testing. The tag is coloured bright red to highlight the significance of operating the cut-out switch and it fits with the current design of the latch/cover with no modification required. The force required to break this tag is approximately the same as the previous version. This will be complemented by a security label which highlights the significance of operating the cut-out switch. The wording of the message on this is still being determined as we are consulting with Trains Health & Safety Representatives on this.

A site visit with the Trade Union Health and Safety Representatives was undertaken. These Representatives were on LU's Formal Investigation Panel into this incident. This proposal is being presented to the Trains Health and Safety Council on the 17th March 2020

Once agreement has been reached with all stakeholders the assurance and maintenance documents for the new seals and labels will then be developed. The production and approval process for these will be 12 weeks for all LU fleets.

The additional change to comply with the updated Category 1 Standard (to disable automatic train operation once the TDICO has been operated) will be included within the next major modification on Northern and Jubilee Lines.

Recommendation 2

The intent of this recommendation is for London Underground to support train operator decision-making when they are dealing with unusual faults under stressful conditions. The review could form an extension of the work London Underground is undertaking in response to Notting Hill Gate recommendation 2 (paragraph 123) but should not delay that work.

London Underground should review and, where necessary, take action to equip its train operators with the skills, knowledge and information needed to identify and respond appropriately to faults affecting their trains. This should include consideration of the:

- use of train simulators to practise fault finding; and
- provision of documentation, such as quick reference guides, to help train operators transition effectively from a low workload scenario to an unexpected high workload scenario when there is an unusual occurrence during automatic train operation.

ORR decision

6. LUL are making changes to their Competence Management System (CMS) to identify ways to improve the ability of train controllers to respond to train faults. We have asked LUL to keep us informed with progress of the project and to provide a time-bound plan when they have finalised the changes to the CMS.

7. 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
- is taking action to implement it, but ORR has yet to be provided with a timebound 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

8. On 15 October 2019 London Underground Ltd provided the following initial response:

A. Train Simulators

We are actively reviewing all elements of our Competency Management System ("CMS") and the detail of this was discussed during a recent meeting with the ORR in July 2019 at Palestra House. This includes use of simulators to train staff in handling unusual faults and attempts to recreate 'stressful conditions'. However, we recognise this is not the same as working on the live railway, nor is a training environment likely to be experienced similarly to operating an automated train prior to a fault occurring.

A review of our fleet simulators indicates that they are not available on every line, some require updates and others need maintenance. However, we are exploring new technologies which represent industry best practice which offer a realistic simulated environment. TfL recognises the need to make further improvements in this area. We are currently in the process of developing a plan for this work and we will share this with the ORR once this is complete. Whilst this is underway, we would be happy to arrange a demonstration of these and how we can use in our context.

B. Quick Reference Material

It is well recognised that prompt rectification of faults improves the safety and reliability of our fleet. This is why the ability of our staff in this area is an ongoing priority for TfL. Personal issue defect cards are already given to every train operator and staff are being reminded about their use in their annual refresher training as well as a specific reminder that took place on Friday 13 September 2019.

Recent analysis of how our rules our communicated, including use of prompt cards, has triggered a recommendation that has been accepted by the LU Directors Review and Change Control Team ("DRACCT").

Work in this area will allow staff to have better access to a single point of information and will include notices, bulletins and prompt cards. This may require significant changes to our information portals which may include the LU Rule Book. We are still in the process of examining how this will be best done to ensure that it is most effective for all our staff. Work on this will commence in 2020 and will be completed by no later than 2021. This action will also be tracked by the TfL Formal Investigation Action Tracker so that progress on this project is closely monitored.

9. On 13 March 2020 London Underground Ltd provided the following update:

A. Competence Management System (CMS)

In July 2019 and February 2020, we explained our project to overhaul much of our Competence Management System (CMS) for train operators to the ORR. The scope of this work includes their initial and annual refresher training, on-going live assessments, the supporting documentation and information systems plus how we train and monitor our instructor operators.

The CMS addresses support for decision making when responding to unusual faults under all conditions at various stages in live, simulated and classroom environments.

We have followed a robust method to re-base what and how we train starting with a 'risk-based training needs analysis' of all rolling stock faults, conducted by subject matter experts, using historic data. We then evaluated the best blend of experiential and theoretic training for each fault.

The result will be a CMS which is driven by risk, more capable of being quickly updated and better aligned with what our train operators need to know and how we want them to respond to faults when under pressure.

We began consultation with our Trade Unions on this last Autumn. We've concluded discussions about the risk-based training needs analysis and approach to redesigning training content and are currently working through the detail. We aim to

implement changes, starting with pilot versions in late Spring this year. More detailed timescales will be developed as consultation progresses.

It is relevant to add that this project integrates 'Non-Technical Skills' (NTS) in the CMS where appropriate. This means, for example, that the NTS 'situational awareness' is incorporated in our training concerning responding to faults.

Whilst we conclude consultation on the new approach to CMS, current promotional and refresher training continue to cover responding to unusual train faults under pressure.

Jubilee line train operators have been briefed about the outcomes of the investigation.

B. Support to Maintain Concentration

As the RAIB report notes, work was already underway to explore how we can better support train operators to maintain concentration as a result of their investigation into a trap and drag incident in 2018. This has taken on board findings from this later incident.

In addition to the recommendations made by the RAIB we have engaged extensively with train operators and our Trades Unions to better understand the topic and taken a number of steps:

- *Explored how technology may be able to assist with this challenge and tied in with the RSSB's research on this topic following the ORR's call to better understand this opportunity.*
- *produced a London Underground version of the recent RSSB training video explaining the risk of 'Cognitive Underload' and how to mitigate this risk. This includes the risk arising when transitioning from low to high workload. This will be ready to include in training from June 2020.*
- *Canvassed for research partners to design and trial a range of tactical approaches such as adding visual features to our tunnels in order to provide stimulation in key locations. This has included a research and development funding bid to a DfT scheme and corresponding with the rail research unit at the University of Birmingham. We have not been successful progressing with these bodies to date but we have also briefed the TfL Innovation Team who are currently looking for further options for finding research partners and funding. This is ongoing and we will keep the ORR updated as there are any developments.*

C. Train Simulators

As mentioned above, train operators are schooled in dealing with faults through a variety of methods: in classrooms, on live trains and by use of cab simulators. The latter are, in general, used when trainees are not ready to operate trains and, on occasion, when rolling stock is not available.

Part of this RAIB recommendation was to consider use of simulators to practice fault finding which prompted a review of these assets. Since they are usually procured when new stock is commissioned, they are not available on every line. In several cases our review showed that modifications of cab and signalling equipment has not been fully replicated and reliability is also a significant challenge, especially on older machines.

The LU Line Operations and Skills Development teams are discussing options for a more effective suite of cab simulators with our Asset Strategy Sponsor. However, due to the core focus of this team being on LU's overarching fleet replacement strategy and 25-year investment plans work is unlikely to be progressed further on this for the next 6 months. LU believes that the other methods of training used for unusual train faults combined with improvements to CDP and quick reference guides is sufficient in the interim. The ORR will be kept informed of progress in this area.

D. Quick Reference Guides

As per our response to the ORR on 1 September 2019, every train operator is given a personal copy of what we term a 'defect guide' relevant to their stock. This is designed to enable fast access to key information to act as a prompt, especially if they are dealing with an unusual fault and/or feel under pressure. As a result of the RAIB recommendation, their use is being reinforced in annual refresher training and a reminder was sent to all train operators on 13 September 2019.

Since the previous response, we've begun a review of how we communicate procedures such as these to front line colleagues through printed materials like prompt cards and leaflets which can be carried and referred to when they are involved in incidents or failures. Our aim is to ensure these types of publication are effective for their users, always current and aligned with each other, with our training and Rule Book.

This is a large-scale exercise since we are including in its scope all the key operational procedures used by station, train, service control and incident response colleagues. Therefore, we consider that it will take us eighteen months to conclude this work (summer 2021). We will share progress with the ORR and, in due course, would be interested in gathering views on best practice.

Recommendation 4

The intent of this recommendation is to improve train operators' knowledge about the effects insufficient amounts of sleep can have on performance.

London Underground should review and, where necessary, revise its competence and fatigue risk management systems for train operators in order to increase awareness of the adverse effects on human performance from insufficient sleep and inappropriate eating patterns.

ORR decision

10. LUL have taken a number of actions aimed at improving fatigue management of train controllers, including updated training material, encouraging self-reporting of fatigue and an app to self-assess sleep health. LUL were planning to relaunch the app in April 2020 and we have asked if this was successful and the extent of take up among operational teams.

11. 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
- is taking action to implement it, but ORR has yet to be provided with a timebound 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

12. On 15 October 2019 London Underground Ltd provided the following initial response:

The TfL Fatigue Management System has been reviewed in relation to content on the effects that insufficient sleep can have on performance. Whilst there is material and content on this topic, we feel that this can be strengthened so that it is more explicit and fully explains the potential consequences of insufficient sleep and inappropriate eating patterns.

In the short term, promotional training will be reviewed so that it is clear on this. This will be completed by the 29 November 2019 and will include any necessary updates.

Longer term, this will be built into the TfL Fatigue Improvement Work Programme. The scope of this programme is currently being developed and timescales can be made available in due course when the extent of this work is fully mapped out.

13. On 13 March 2020 London Underground Ltd provided the following update:

In the short term, a number of actions have been undertaken including:

- *Updating training material to strengthen the information included on the potential consequences of insufficient sleep and inappropriate eating patterns*

- *Launching a web-based 'Sleep Health – Self Assessment Tool' in December 2019. This provides staff with individual reports providing tailored feedback on aspects of their life that negatively impact on sleep health. The take up of this was mostly from office-based staff so this will be re-launched in April 2020 to encourage better use of this by operational teams e.g. by providing hard-copy surveys. This has been discussed with our Trades Unions, who are supportive.*
- *Rolling out a process to encourage self-reporting incidences of fatigue. This will enable managers to provide support to individuals and better understand when and where fatigue is occurring. It will also promote a more transparent, supporting, culture. This will be in place across all LU Line Operations teams by the end of April 2020. To date, only a few reports have been made on the Lines where we have introduced this, so we are planning to run more high profile communications throughout Spring 2020 to highlight that being open about fatigue, seeking support and discussions solutions is encouraged.*

We are also producing a 'wellbeing' video which will cover how individuals can manage themselves to meet fitness for duty requirements.

Longer term, this work will be aligned with the wider TfL Fatigue Improvement Work Programme. We have recently recruited a Manager to lead and Project Manage this over a 6-month period. They will be in position from April and will be able to ensure that we integrate key requirements into our management system. We will ensure that the ORR are updated as this work progresses.

As always, we are happy to share further detail of any of these activities with the ORR. Emma Burton will continue to work with the ORR's TfL team to ensure that the ORR is kept up to date as our work progress.