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Ms Carolyn Griffiths
Chief Inspector of Rail Accidents
Rail Accident Investigation Branch
Block A, 2nd Floor
Dukes Court
Dukes Street
Woking GU21 5BH

Dear Carolyn

Train departed with doors open, Warren Street, Victoria Line, London Underground, 11 July 2011

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 5 July 2012.

The annex to this letter provides details of the consideration given/action taken in respect of each recommendation where all the recommendations have been implemented².

We do not propose to take any further action unless we become aware that any of the information provided becomes inaccurate, in which case I will write to you again³.

We expect to publish this response on the ORR website on 19 June 2013.

Yours Sincerely

Chris O'Doherty

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

² In accordance with Regulation 12(2)(b)(i)

³ In accordance with Regulation 12(2)(c)



Initial Consideration by ORR

All 4 recommendations contained in the report were addressed to ORR when RAIB published its report on 5 July 2012.

After considering the report / recommendations, on 19 July 2012, ORR passed all 4 Recommendations to London Underground Ltd asking it to consider and where appropriate act upon them.

Details of consideration given and any action taken, in respect of these recommendations are provided below.

Recommendation 1

The intention of the recommendation is that train operators should be issued with clear instructions on the action that they should take in the event of an activation of the sensitive edge system and should be briefed on their content.

In the light of the Warren Street incident, LUL should review the current instructions on the action that train operators should take in the event of the sensitive edge system being activated. This should include, in particular:

- the options available to train operators for dealing with activations of the sensitive edge system and which option should be used first in specific circumstances;
- under what circumstances the sensitive edge override should be used; and
- the information provided by the TCMS [Train Control Management System] to see whether there is suitable and sufficient information to train operators about using the override.

Any necessary changes to the instructions should be implemented, and train operators briefed and/or trained, as appropriate, on the changes made.

Details of steps taken or being taken to implement the recommendation

1. LUL in its response on 31 August 2012 advised that:

A programme of retraining on the Sensitive Edge Door System for Train Operators will take place over the autumn. A revised set of instructions, taking account of the lessons learnt from this incident, are being prepared and will inform the content of the training material.

It is proposed that the re-training will be completed by 31 December 2012

2. ORR in reviewing LUL's response, of 31 August 2012, wrote to LUL, on 28 September 2012, requesting the outcomes of its reviews / actions.

3. LUL in its response on 30 April 2013 advised that:

1.1 In response to the recommendation LU has reviewed and revised the instructions for Train Operators when dealing with Sensitive Edge system activations. In addition to this change, LU has also made engineering changes to design out the likelihood of human error from the system. All Victoria Line Train Operators have received training in the revised instructions and engineering changes (Train Operators on long term sickness absence or secondment will be trained upon returning to duty).

1.2 Action a)

LUL provided ORR with a copy of:

- *'Asset replacement phase (3) refresher course book issue 3.1' and*
- *'Asset replacement phase (3) refresher'.*

1.3 The instructions for Train Operators were reviewed and updated by a group including: engineers, trainers, operators and the upgrade project team. The review considered all options available to Train Operators and these are included in the instructions.

The attendance of each Train Operator was recorded and where additional coaching was required this was also recorded.

The revised instructions are now included within the Competence Management System for Victoria line Train Operators and will be part of the on-going competence assessment cycle.

1.4 These documents were used to train the Train Operators in the revised instructions and were issued to attendees. The revised process is detailed on page 21 and reiterates that Train Operators should check for obstructions and cycle the doors before using the reset function.

Other scenarios are covered in the training where Sensitive Edge activation occurs as the train is leaving the station and once the train is outside of the station limits. Each of the scenarios is explored in terms of whether the progressive steps are successful or not.

The training course included the use of a cab simulator to recreate a Sensitive Edge activation to check the Train Operators' understanding. The document 'Phase 3 Refresher Script 4 Brixton' details the scenario and what is required of the delegate to correctly respond to sensitive edge activation.

LUL provided ORR with a copy of:

- *Trainer and Simulator Operator Script 4 / Brixton to Victoria Sensitive Edge / Mainline ATP shunt move*

1.5 Additional options are now available to Train Operators for dealing with Sensitive Edge activations; these are 'limited push back' and 'Sensitive Edge Selective Reopen':

- *Limited push back allows customers to push open closed doors to a maximum of 150mm to free trapped objects and remove the Sensitive Edge activation without intervention by LU staff (similar to other LU stocks).*
- *The 'Selective Reopen' function is available for fully berthed trains only. If the activation remains after PAs [Public Announcements] have been made, the Train Operator is able to open one door of the pair the doors from where the activation is registered to a maximum of 100mm, thereby enabling the obstruction to be released.*

1.6 Action b)

Page 35 of 'AR Phase 3 refresher course book issue 3.1' details the use of the Sensitive Edge override and when this should be used. The training reiterates that the steps referred to in a) should be used first.

1.7 Action c)

The TCMS messages have been reviewed by a working group consisting of Rolling Stock Engineers, Human Factors Specialists, Operators and TU [Trade Union]

Health and Safety Representatives. The Sensitive Edge activation message displayed on the TCMS [Train Control Management System] was concluded to be the appropriate message for Train Operators, using the communication protocols applied to this work and therefore remains unchanged. However, an additional message was provided to alert Train Operators when the Door Interlock Cut-out switch is operated. This has been rolled out across the fleet. This message has been given a priority alarm status so it will appear on the TCMS once the door interlock cut-out switch is activated. The message reads:

“Train door interlock cut-out. Reset switch to normal if appropriate. Train can move with doors open”

1.8 Other actions taken

Sensitive Edge Override Button Light configuration

It was noted during the investigation that the override button light previously extinguished when pushed, rather than when the action was complete. This had the potential to cause confusion amongst Train Operators regarding when to release the button. The light has been revised to ensure it only extinguishes when the override step is complete. The modification is being progressed through the design review cycle.

1.9 Door Relays

During the investigation it was identified that the door relays would reset in the event of the train being shut down with Sensitive Edge door activation present. This was an undesired sequence of events and required additional steps by the Train Operator to reset the door relays and the Sensitive Edge activation, with the potential for human error. A modification to the door relays has been developed to remove this issue and is being rolled out (15 trains complete, the fleet will be complete by 31 May 2013).

1.10 Application to S Stock Trains

The Sensitive Edge system for S Stock has been reviewed against the lessons learnt from this incident by Rolling Stock Engineers. It was concluded that the two systems are significantly different, including their development, introduction and modification and therefore there were no engineering lessons to be shared between the two stocks. The training provided for S Stock has been reviewed in light of this incident and the content regarding the Sensitive Edge system has been expanded upon, with a particular focus on the Train Operators options and actions.

ORR Decision

4. After reviewing information received from London Underground Ltd, 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.

ORR will write to RAIB again if it becomes aware that the information above is inaccurate.

Status: *Implemented*

Recommendation 2

The intention of the recommendation is to identify why LUL did not follow good practice for the introduction of the sensitive edge override modification and why this was not detected.

In relation to the sensitive edge override modification, LUL should review how its process for managing engineering change and the associated management controls was not followed, and why it did not adequately identify the risks associated with the design modification. The review should include:

- why good and established practice in engineering change management was not followed during the design and introduction of the sensitive edge override modification with particular reference to the specification of requirements and the risk assessment of the proposed changes; and
- why the management system and controls did not identify or correct the design deficiencies relating to the sensitive edge override modification.

LUL should implement any necessary changes to its process for managing engineering change and associated management controls.

Details of steps taken or being taken to implement the recommendation

5. LUL in its response on 31 August 2012 advised that:

A senior LU Engineer, independent of the project management and assurance process, shall conduct a review of the management processes used in relation to the sensitive edge override modification. The processes used shall be compared with LU Standards and recognised good practice and specifically address the following points:

- *Risk identification and assessment following design modification*
- *Why established practices were not followed during the design and introduction of the SE override modification*
- *Why the management system and controls did not identify or correct the design deficiencies relating to the sensitive edge override modification*

The review shall be completed by 30 January 2013 with findings and recommendations reported to the LU Directors' Risk, Assurance and Change Control Team for review.

6. ORR in reviewing LUL's response, of 31 August 2012, wrote to LUL, on 28 September 2012, requesting the outcomes of its reviews / actions.

7. LUL in its response on 30 April 2013 advised that:

Findings

2.11 *The review has identified the following (the numbered sections relate to the numbered questions above):*

a) LUL should review how its process for managing engineering change and the associated management controls was not followed

2.12 *The High Level Requirement was identified as the key requirement to mitigate the intolerable level of reliability. In terms of input to the assurance process, this was the only requirement.*

2.13 *All reviews and assurance – safety, human factors, Change Assurance etc. were assessed against the High Level Requirement.*

2.14 As identified in the RAIB report, the High Level Requirement was not flowed down into a “Specification of Requirements”. Had a specification been produced that defined the current system, what the changes were to be and therefore what was the end definition, the way the light operated might have been detected earlier.

Discussions suggest that the way the light operates might well have been tolerated but it would have led to improved staff briefing. See LU Recommendation 1

b) Why it did not adequately identify the risks associated with the design modification?

2.15 Linked to the specification issue is that of risk assessment at LU level. LU’s supplier did carry out a risk assessment, but it was not holistic. There is no evidence that any risk assessment was carried out that covered operating risks, although it is recognised that the Safety Justification, Human Factors Assessment and Change Assurance Plan [CAP] did consider a number of risks. It is a finding that a suitable risk assessment should have been carried out and it should have been performed against the actual detailed design and not just the High Level Requirement.

2.16 The safety implications of correct use of the over-ride button were considered in the safety justification. This document robustly argued that introducing this change would improve the overall safety of the system. However, that is not quite the same as a risk assessment where the hazards and risks arising from failure of things to happen correctly are evaluated and discussed. For example, the Safety Justification describes and justifies the correct operation of the modification – i.e. SE [Sensitive Edge] activates, train stops, train driver checks that there’s no one attached to the train, then operates the over-ride. However, it does not discuss the risk that a genuine actual or potential dragging is correctly flagged by the SE system but then incorrectly disregarded by the train driver. In LU’s judgement, this risk is much smaller than LU lives with on other lines, but this should have been discussed and documented. A risk assessment might also have involved Health and Safety Representatives in the process and hence helped avoid some of the objections that were recorded in the CAP.

2.17 A risk assessment would also have highlighted the risk impacts of the “do-nothing” option and documented that whilst the modification may not have been the perfect solution, it made a significant improvement to safety and reliability of the railway.

2.18 Unrelated to this incident, there have been a number of recent changes to the railway that have been – on their own – quite small from a technical point of view, but that had significant risk implications when the technical process and people dimensions are considered. Implementation of these jobs has been delayed due to the lack of timely risk assessment⁴

2.19 No specific ALARP [As Low as Reasonably Practicable] assessment was made as is good safety change practice. The comment was made during the review that “the existing dragging risk was already well into the ‘Broadly Acceptable’ region of the ALARP triangle (risk < 1 in 1,000,000 p.a.) where no significant effort should be spent to find further risk reduction measures and certainly no Quantitative Risk Assessment should be produced. Within this region there is no need to do an ALARP assessment. This point is accepted but was not recorded in the Safety Justification, or CAP. See LU Recommendation 2.

⁴

For example, the introduction of GSM-R radio on Chiltern Trains running over the Metropolitan line

c) Why good and established practice in engineering change management was not followed with particular reference to the specification of requirements and the risk assessment of the proposed changes?

2.20 LU's Safety Management System taken as a whole sets out a regime where requirements capture and risk assessment are required.

The general approach in carrying out modifications to trains is for:

- Small modifications are assessed using professional judgement
- Larger or project works are subject to Engineering Safety Case process

2.21 As a gross generalisation, modifications are intended to implement changes to deliver the originally intended functions or requirements of the trains, whereas project works generally deliver new or improved functionality. Certainly, the vast majority of the hundreds of modifications to the 2009 tube stock have been in the former category and have been implemented successfully. The only question that needs to be answered is "does the change deliver the originally intended function/requirement". This one, however, was a comparatively straightforward electrical modification but one that had an impact on those using the train. It is proposed therefore that an additional category is introduced:

- Small modifications that impact on people using the trains.

2.22 This type of modification needs to adopt, on a risk basis, some or all of the features of the Engineering Safety Assurance Case⁵ process. These might include requirements analysis, "bust it" testing i.e. deviating from test scripts to seek out unexpected behaviour, and risk assessment. For this particular modification, there was very extensive use of elements of the Engineering Safety Case process. Those processes were extensive and diligently followed, but did not sufficiently explore the risks arising from not using the button correctly.

d) Why the management system and controls did not identify or correct the design deficiencies relating to the sensitive edge override modification?

2.23 This review has identified that the sole deficiency in the design was the light extinguishing as soon as it was pressed and not illuminating again even if the button was not held down for the required time. As can be seen from the attached document list [Provided to ORR], there was a considerable review process, but this issue was missed in all the review and challenge functions. This review has identified no issues of not following process or lack of diligence of any individual or team. However, the changes proposed in the recommendations are intended to address this issue for the future.

LU Recommendations

Recommendation 1

When modifications are proposed, requirements should be captured and evaluated to ensure that the modification delivers the requirements and that any gaps are captured and mitigated. These requirements should focus both on the functions the system should provide and where possible undesirable properties.

Recommendation 2

5 A process used by LU using goal structured notation and argument to bring together asset, process and people risks to assure that risks are Broadly Tolerable and ALARP

Where modifications affect the safety of the system, especially if it impacts on how staff use a safety system, a suitable and sufficient, risk assessment shall be carried out and documented involving those affected by the change, and the findings appropriately implemented. This is to include consideration of the hazards and risks relating to people, process and equipment and how they interface with the change. Moreover, the risk assessment process should be properly facilitated competent risk facilitator to ensure appropriate challenge e.g. – consideration and identification of what the undesirable consequences of modifications may be, what could go wrong.

2.24 These recommendations should be implemented in the guidance that will be developed for the Engineering Management Framework. It is proposed that this guidance will build on the good practice employed by the LU Rolling Stock Engineering in Asset Performance. The people accepting modifications (Heads of Profession or delegates) must check that appropriate risk assessment has been carried out, where ‘appropriate’ refers to risks at the system level, including the modification itself, the process for using it and the people who will use it.

LUL also provided ORR with details of how its review was carried out.

ORR Decision

8. After reviewing information received from London Underground Ltd, 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.

ORR will write to RAIB again if it becomes aware that the information above is inaccurate.

Status: *Implemented*

Recommendation 3

The intention of the recommendation is that LUL’s competence management arrangements for train operators should:

- a) identify those who are unable to reliably and correctly respond to out-of-course events (including faults and failures); and*
- b) incorporate arrangements designed to eliminate or resolve the competence deficiencies identified.*

In the light of the findings of this investigation, LUL should review those elements of its competence management system that relate to the ability of train operators to respond to out-of-course events, faults and failures. This should take into account:

- how the evidence from train operators’ performance in practical training and instruction is captured and dealt with by the competence management system;
- how the evidence from train operators’ performance in incidents in service is captured and dealt with by the competence management system (paragraph 124); and
- how LUL acts on any deficiencies identified from the above, relating to a train operator’s ability to recognise and correctly respond to an out-of-course event, with the aim of eliminating any competence deficiencies identified, including how

corrective action plans are developed, implemented and monitored to successful conclusion.

LUL should implement any necessary changes to the competence management system.

Details of steps taken or being taken to implement the recommendation

9. LUL in its response on 31 August 2012 advised that:

LU will review the Competence Management System (CMS) against the points raised by the RAIB in the recommendation. The findings from this review will be included within and communicated via 'Standardisation Workshops' which ensure consistent implementation of the CMS. The review will be completed by 30 November 2012.

The ability to deal with out of course events will be included within the Continuous Development Programme annual cycle which will have completed a full cycle in December 2013.

10. ORR in reviewing LUL's response, of 31 August 2012, wrote to LUL, on 28 September 2012, requesting the outcomes of its reviews / actions.

11. LUL in its response on 7 May 2013 advised that:

The London Underground Competence Management System team have reviewed the aspects of the Train Operator Competence Management System (CMS) that require Train Operators to be able to respond to out-of-course events, faults and failures.

- *Any shortfall in Train Operator performance during training and assessment is acted upon during the training session and recorded on the CMS records for the individual. This CMS record provides a basis for further support and managing improvement beyond the training phase.*
- *Evidence from incident investigation reports that recognises an error on the part of the Train Operator or demonstrates a competence or performance issue is (after validation) treated as evidence of an assessment and the relevant competence is rated and recorded on the individual's CMS record. This has the same impact as the identification of performance issues during training and can provide the basis for further training and support.*
- *Train Operators are currently required to be able to recognise and correctly respond to an out-of-course event, this is currently assessed during the Continuous Development Programme against the requirements of the CMS.*

As of the beginning of the next Continuous Development Programme cycle, all Train Operators will be informed of their responsibility to attend work in possession of and to be familiar with all the requisite equipment and documentation. Such possession and familiarity will be universally assessed during the course of the Continuous Development Programme. This will confirm the responsibility to be in possession of the 'Defective in Service Instructions' and stock 'Defect Handling Guide'.

Any non-compliance will result in a re-grading of the relevant criteria in CMS and lead to a follow up by local management to address this shortfall (e.g. through a monitored corrective action plan). The CMS Verification process will be revised to ensure that such re-grading of criteria is addressed by local and line management.

ORR Decision

12. After reviewing information received from London Underground Ltd, 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.

ORR will write to RAIB again if it becomes aware that the information above is inaccurate.

Status: LUL is taking action to address the recommendation

Recommendation 4

The intention of the recommendation is that train operators should be aware that operational or technical advice is available when required and they should know how to obtain it so that they can effectively resolve faults and failures and avoid mistakes which could reduce safety.

LUL should review how and in what circumstances train operators should request assistance following defects in service and implement any changes found necessary. This should include the adequacy of the competence management system and competence assessment of train operators in requesting assistance when needed. In addition:

- train operators should be reminded of the availability of operational and technical advice when they are unable to resolve train defects and how they can obtain it; and
- service controllers should be reminded that they should challenge train operators if they believe them to be acting outside LUL's mandatory instructions.

Details of steps taken or being taken to implement the recommendation

13. LUL in its response on 31 August 2012 advised that:

LU will implement a multifaceted approach over a period of six months to ensure the message is communicated to Train Operators and Service Controllers from a variety of sources.

Actions will include Traffic Circular entries, changes to training material, specific messages from trainers during formal training and assessment, messages from Instructor Operators, requirements to use and demonstrate the use of documents such as Defect Handling Guides during training and assessment.

A plan will be produced by the 30 September 2012 of the things we will do, which will run to end of March 2013.

14. ORR in reviewing LUL's response, of 31 August 2012, wrote to LUL, on 28 September 2012, requesting the outcomes of its reviews / actions.

15. LUL in its response on 30 April 2013 advised that:

3.1 The London Underground Competence Management System (CMS) for Train Operators and Service Controllers both include a requirement to seek or provide assistance in the event of a train defect or failure. The Train Operator Competence Management System requires Train Operators to demonstrate they are able to 'Inform the controller of the failure situation and whether or not assistance will be required to move the train.'

3.2 The Service Controller Competence Management System requires Service Controllers to demonstrate they are able to: 'summon assistance appropriate to the incident in a timely manner' and to be able to explain 'the appropriate types of assistance 'and 'the possible resources and options to assist with the incident'.

3.3 Train Operators and Service Controllers are trained in the requirements of the Competence Management System and are assessed against the requirements during the two year CMS cycle. Any required corrective actions are recorded on the individual's competence file and bespoke training and coaching provided as appropriate. LU has reviewed the requirements on Service Controllers and Train Operators and compliance with these requirements, both during this incident and more generally. LU has concluded that no changes to the Competence Management Systems are required; however, a reminder has been included within the LU Traffic Circular. The reminder is scheduled to repeat in the Traffic Circular at set intervals and remind Train Operators of the availability of technical support and Service Control of the need to challenge Train Operators if required.

ORR Decision

16. After reviewing information received from London Underground Ltd, 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.

ORR will write to RAIB again if it becomes aware that the information above is inaccurate.

Status: *Implemented*