Goal-setting Principles for Railway Health and Safety

Additional factors to be considered for unattended passenger train operation (GOA4)

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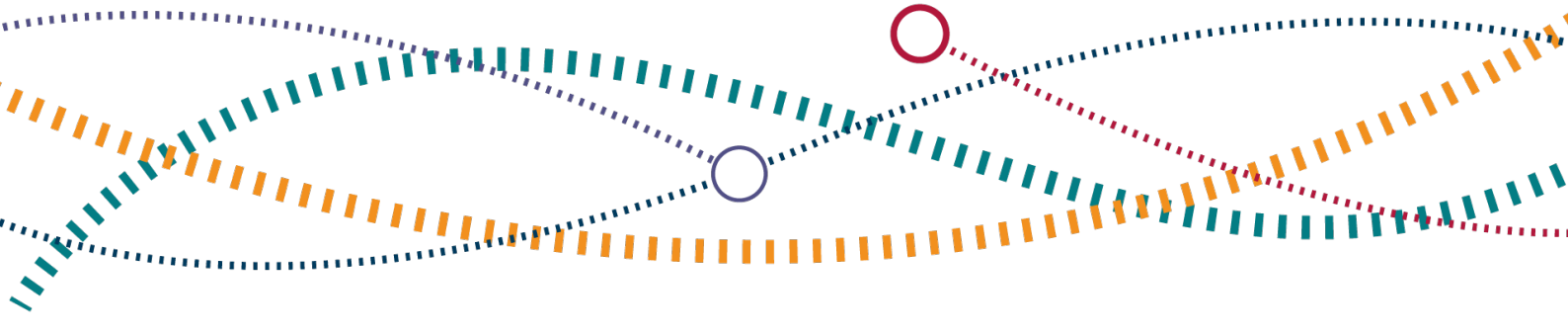

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Executive summary

The Goal-setting Principles for Railway Health and Safety (GPRHS) are fundamental to all railway systems. While they are primarily based around the concept of a human driver operating a train on a railway controlled by signallers or controllers they nonetheless remain applicable to the operation of passenger trains in Unattended Train Operation (UTO) configuration, Grade of Automation 4 (GOA4). Paragraphs 1.2 and Table 1.2 explain the various grades of automation.

Throughout this document the term 'driver' is used for all roles where a human being present on the train controls the movement of a train, regardless of the terminology that might be used by any particular railway (e.g. London Underground use the term 'operator') or the other roles undertaken by that person when not driving a train.

This document sets out the additional factors to be considered when applying the GPRHS in relation to a fully automatic railway system carrying passengers in UTO configuration. It also provides a reference point for the development of GOA2 and GOA3 systems. It should be read in conjunction with GPRHS.

A railway conceived, designed, built and operated in, or converted to GOA4 UTO, comprises a digital system of interacting hardware and software systems which undertakes functions historically provided by a human driver and automates a number of those traditionally carried out by a signaller or controller. In terms of safe operation for both passengers and staff this digital system as a whole must achieve an outcome at least as good as that achieved by a system with human drivers and signaller/controllers.

When implementing a system of GOA4 UTO, consideration should also be given to how other matters that are indirectly addressed by the presence of a driver, might be fulfilled by alternative means, perhaps by on-train detection systems or alternative system-based checking mechanisms including CCTV to monitor locations judged critical to safe operation of the system. As above, these alternative means must achieve an outcome at least as good as that achieved by the presence of a driver and signaller/controllers.

Such matters may include -

- noting track defects, infrastructure failures or severe weather conditions
- responding to the behaviour of people in the absence of a member of the railway organisation's staff on duty on the train.

1. Determining the most appropriate Grade of Automation

1.1 There are four recognised Grades of Automation associated with train operation as set out in **International Standard IEC 62267- Railway applications – Automated urban guided transport (AUGT) – Safety requirements.**
This is replicated in BS EN 62267:2009 and used as the primary reference throughout this document .

1.2 Reliance on operations staff reduces as the GOA level increases and the system assumes responsibility for more functions.

Table 1.1 Grades of Automation Summary

	On-sight train operation	Non-automated train operation	Semi-automated train operation	Driverless train operation	Unattended train operation
Abbreviation	TOS	NTO	STO	DTO	UTO
Grade of Automation	GOA0	GOA1	GOA2	GOA3	GOA4

1.3 Britain has a small number of metro railways - London Underground, Docklands Light Railway, Tyne and Wear Metro and Strathclyde Partnership for Transport (SPT) Glasgow Subway. Of these, London Underground and SPT Glasgow Subway were both initially developed in the second half of the 19th century as wholly human operated (manual) systems - what would now be classed as GOA1. In the 1980s the Tyne and Wear metro was developed (as a manual system), and Docklands Light Railway (DLR) was introduced as a driverless system. DLR was expressly designed for driverless operation and to have a capability for unattended operation i.e. although developed before BS EN 62267:2009 and GOA classifications, it nominally aligns with GOA3 but could in terms of technical capability (and if required), operate in GOA4 configuration.

1.4 More recently (second decade of the 2000's), Glasgow Subway, operated by SPT, has undertaken extensive work to upgrade the underground system. Features include a new automated signalling system, a new operational control centre, new trains and upgraded stations including platform edge barriers. The upgrade programme aims to provide UTO capability amongst a range of developments. The

features of the Glasgow Subway illustrate the development in thinking and risk control arrangements since the introduction of the original DLR system in 1987.

1.5 As part of planning for a GOA2 or higher grade of automation a comprehensive risk assessment must be undertaken as required under the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) regulation 19 and under the Management of Health and Safety at Work Regulations 1999 (MHSW) regulation 3, including considering the Principles of Prevention set out in Schedule 1 of MHSW.

1.6 This risk assessment should consider how and to what extent the 'Basic Functions of Train Operation' as detailed in Table 1.2 below (extract from BS EN 62267:2009) are fulfilled by a train driver, a train attendant, or the system alone without reliance on people to ensure safe operation of the train. It should also consider the use of technical and operational controls to ensure safety in accordance with the Principles of Prevention in MHSW. Key standards applicable for conducting mandatory and comprehensive risk analysis of a GOA4 UTO system are:

- BS EN 50126-1:2017 Railway Applications. The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS). Generic RAMS Process
- BS EN 50126-2 Railway Applications. The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS). Systems Approach to Safety
- BS EN 50129:2018 Railway Applications. Communication, signalling and processing systems. Safety related electronic systems for signalling.

1.7 ORR expects that where functions currently undertaken by a human are replaced by technical systems, the level of safety performance should be at least as good as that achieved when functions are undertaken by humans. Where a system requires transition of a train from an area controlled and operated under GOA4 rules, to an area controlled and operated under a lower grade of automation (or vice versa), the transport system should use appropriate technical systems, operational rules and infrastructure provisions to manage this transition safely.

BS EN 62267:2009 (© BSI)

(i) Basic functions of train operation		On-sight train operation TOS GOA0	Non-automated train operation NTO GOA1	Semi-automated train operation STO GOA2	Driverless train operation DTO GOA3	Unattended train operation UTO GOA4
Ensure safe movement of trains	Ensure safe route	X (points command/ control in system)	S	S	S	S
	Ensure safe separation of trains	X	S	S	S	S
	Ensure safe speed	X	X (partly supervised by system)	S	S	S
Driving	Control acceleration and braking	X	X	X	S	S
Supervising guideway	Prevent collision with obstacles	X	X	X	S	S
	Prevent collision with persons	X	X	X	S	S
Supervising passenger transfer	Control passenger doors	X	X	X	X or S	S
	Prevent injuries to persons between cars or between platform and train	X	X	X	X or S	S
	Ensure safe starting conditions	X	X	X	X or S	S
Operation of the train	Put in or take out of service	X	X	X	X	S
	Supervise the status of the train	X	X	X	X	S
Ensuring detection and management of emergency situations	Perform train diagnostic, detect fire/smoke and detect derailment, handle emergency situations (call/ evacuation, supervision)	X	X	X	X	S and/or staff in Operational Control Centre

NOTE re the letters X and S in the table above

X = responsibility of operations staff (may be realised by technical systems).

S = realised by technical system.

2. Matters for consideration for full UTO operation of passenger carrying trains

2.1 The fundamental areas in which UTO operation provides for a digital system to replace the decision of a signaller/controller, or a driver are set out in Chapters 3 to 9 together with the primary GPRHS principles to which they relate.

- Chapter 3: UTO factors for starting and stopping trains (GPRHS Principles 3, 5 & 6)
- Chapter 4: UTO factors for operation of doors (GPRHS Principles 3 & 6)
- Chapter 5: UTO factors for management of on-train passenger safety (GPRHS Principles 1, 3, & 6)
- Chapter 6: UTO factors for handling of emergencies (GPRHS Principles 5 & 6)
- Chapter 7: UTO factors relating to operation of a train without any on-train staff (GPRHS Principle 6)
- Chapter 8: UTO factors relating to operation of GOA4 Trains in depots and sidings (GPRHS Principle 3)
- Chapter 9: UTO additional factors to be considered (GPRHS Principles 2, 3, 5 & 6)

3. UTO factors for starting and stopping trains (GPRHS Principles 3, 5 & 6)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 3.2, 5.1, 6.5 & 6.8

Starting – entry into service

3.1 A GOA4 train entering into service in normal UTO configuration that is given authority to move by the signalling system shall not be capable of such movement unless and until:

(a) a positive confirmation that it is safe to move is received by the operating system from the on-board train control system and;

(b) there are no outstanding emergency alarms on board the train or within the system and;

(c) all external doors are proven closed and locked;

(d) there are no outstanding maintenance, technical or other restrictions in place on that train.

Starting – train in service and at a platform

3.2 A GOA4 train in UTO configuration that is given authority to move away from a platform by the signalling system shall not be capable of such movement unless and until a positive signal of confirmation to move is received by the operating system that:

(a) there is no outstanding emergency alarm activation and;

(b) every train door and Platform Barrier Systems (PBS) point through which passengers have access & egress is proved closed, secured and clear of obstruction. and;

(c) no obstacle is detected either:

(i) along the entire length of the gap between train and platform and on the track ahead of the train

OR

(ii) if the platform is fitted with PBS, or an equivalent means of protecting the platform train interface (PTI) from obstacles, that at the PBS/train access - egress interface no obstacle is located:

- between the train and the PBS,
- on the track ahead of the train

3.3 Systems for detection of obstacles at the PTI shall operate while any part of the train is adjacent to the platform from which a train is departing.

3.4 Where a system for detection of obstacles at a platform from which a train is departing is activated, and any part of the train remains within a platform, then the train:

(a) shall automatically make an emergency brake application and an alarm shall activate in the control room; and,

(b) the system shall not permit a following train to enter that platform until:

(i) the reason(s) for the activation of the detection system has been identified and recorded by an authorised competent person and the system has been reset by a competent person designated and authorised under the system to carry out such an action; and,

(ii) the reasons for the reset are recorded and the reasons for the activation are resolved and a positive signal of confirmation that it is safe to move is received by the operating system from the on-board train control system.

Starting – a train stopped elsewhere than in a station

3.5 When stopped on the network at a position other than in a station platform, a GOA4 train in UTO configuration that is given authority to move by the signalling system shall not be capable of such movement from a stationary position unless and until a positive signal of confirmation that the train is in a safe condition to move is received by the operating system from the on-board train control system.

3.6 If no positive confirmation can be obtained from the train that it is safe to move within a timeframe specified within the system, the train shall be considered 'failed in service' and the established recovery process shall be implemented.

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 6.6

Stopping – train in service stopping in a station platform

3.7 Except in emergency circumstances; it shall not be possible to activate door opening on a GOA4 train in UTO configuration at a station platform until a train is correctly berthed in that platform, is stationary with the brakes applied and a positive confirmation that it is safe to open the train doors (and activate the opening of any associated PBS) is received by the operating system from the on-board train control system.

Stopping - derailment

3.8 A GOA4 train in UTO configuration shall at any time (including in depots) be capable of detecting any derailment of its running gear and shall automatically apply the brakes (under emergency condition if required) to bring the train to a stop.

3.9 Such detection of a derailment of its running gear and activation of the emergency brakes shall be indicated to the controller(s) overseeing the system such that emergency action to stop other trains approaching that location can be promptly taken either automatically or by controllers.

Stopping - obstacle detection

3.10 Where necessary for safety, and so far as is reasonably practicable, a GOA4 train in UTO configuration shall be capable of detecting obstacles fouling the swept envelope of the train in its forward direction of travel that may endanger the train; and have systems that will automatically apply the brakes (under emergency conditions if required) to bring the train to a stop upon detection of such an obstacle.

3.11 So far as is reasonably practicable to do so, the equipment for detection of trackside obstacles shall adjust its forward detection capability in relation to the speed and braking capability of the train such that braking can be initiated early enough to minimise risks to safety posed by such obstacles(i.e. the trackside obstacle

detection shall operate further in advance of the train as the train's speed increases).

3.12 A GOA4 train operating in UTO configuration, which is stopped by activation of obstacle detection equipment while line-running, when departing a platform or when leaving or re-entering a depot, should only be authorised to continue following reactivation by an appropriately authorised person competent to make such a determination.

3.13 Before authorising train movement, the person authorised to take such decisions shall record:

(a) the suspected cause of the obstacle detection brake activation that has been identified;

(b) that this cause has been resolved including the nature of the resolution; and,

(c) that it is safe to continue.

4. UTO factors for operation of doors (GPRHS Principles 3 & 6)

Opening doors

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 3.2, 6.3 & 6.9

4.1 The doors of a GOA4 train in UTO configuration designated for routine passenger access and egress onto a platform should only be enabled when;

(a) the train is stationary with the brakes applied, and;

(b) the train is correctly berthed in a station platform.

A GOA4 train in UTO configuration should be equipped with systems that confirm this state before passenger doors can be enabled for opening.

4.2 Doors specifically designated as emergency access / egress route doors (e.g leading car front facing and rear car rear facing doors) should have additional alternative controls to enable detection of unauthorised opening.

4.3 In emergency circumstances (e.g evacuation between stations) enabling doors for emergency access / egress shall normally be on the side of the train giving rise to least risk to passengers on board and only be used when the train is

(a) stationary, and;

(b) rendered incapable of further autonomous movement.

Closing doors

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 6.3 & 6.9

4.4 Where a platform is fitted with PBS, the PBS shall be synchronised to open and close with the train doors as soon as the on-train and wayside communication and safe connection has been proven.

4.5 If either PBS or the train doors of a GOA4 train in UTO configuration are obstructed, and not proven closed and locked, it shall not be possible for the train systems that enable movement to be activated or reset in a manner which permits the train to move either automatically or by human intervention. Movement should remain inhibited until the obstruction is no longer detected and train doors, and PBS (where fitted), are proven closed and locked.

4.6 If either PBS or the train doors are obstructed following activation of the door closing cycle, the system shall be configured to stop the door closing sequence and reset to a doors-open condition.

4.7 In order for a GOA4 train in UTO configuration to continue in passenger service after a pre-defined number of attempts at reset by the door close process, an alarm shall be raised with the system controller(s), and the PBS/doors shall remain open until reset by an authorised person competent to make such a reset determination. Before authorising train movement, the person authorised to take such decisions shall record:

(a) the suspected cause of the PBS/train door obstacle detection reset activation that has been identified;

(b) that this cause has been resolved including the nature of the resolution; and,

(c) that it is safe to continue.

4.8 The starting process of the train shall not be activated either automatically or by human intervention until the doors have been reset in accordance with the established reset procedure.

4.9 For an out-of-service train, only when a train has been thoroughly checked to ensure no passengers are on board may doors be reset and closed remotely.

5. UTO factors for management of on-train passenger safety (GPRHS Principles 1, 3, & 6)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 1.1, 3.2, 6.2 & 6.4

Ride quality

5.1 The determined acceleration and deceleration rates for a GOA4 train in UTO, and the rate of change between those rates, should not create risk to people, or the safe operation of the train, rail vehicles and their couplings. Braking rates should conform to those in BS EN 13452-1:2003 “Railway applications. Braking. Mass transit brake systems – Performance requirements”.

Passenger communications

5.2 For a GOA4 train in UTO configuration, in the event of an emergency on the train passengers should at all times be able to communicate directly via an on-train communications system, with the system controller(s) overseeing the system operation.

Provision of appropriate passenger information

5.3 Consideration should be given to the information required to be presented to passengers on a GOA4 train operating in UTO configuration. This consideration shall relate to the content and its optimum presentation, including consideration of the needs of passengers with auditory and visual impairment, and including the needs of passengers travelling in a designated wheelchair location (see also Para 5.5).

5.4 Passengers should be made aware of the procedures in place to manage their safety in the event of an emergency. This should also include arrangements for signallers/controllers to communicate directly with passengers in emergency and degraded operational circumstances.

Avoidance of carry-over of passenger into depots or sidings

5.5 A GOA4 train operating in UTO configuration at a terminating station shall be thoroughly checked to ensure no passengers remain on board before it is authorised to proceed into either a depot or a siding.

6. UTO factors for handling of emergencies (GPRHS Principles 5 & 6)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 5.2, 5.3, 6.2, 6.3, 6.4 & 6.5

6.1 Two means of activating the emergency systems shall be provided for:

(a) Train systems emergency activation (TSEA):

Where the systems of a train operating in UTO configuration identify a safety critical fault or failure this should be automatically reported to the control centre and drawn to the attention of the system controller(s). The railway operator should have in place rules, standards and procedures that enable authorised system controllers to make decisions on the appropriate actions to take. For example, these may include taking the train out of service at the next appropriate opportunity, or bringing the train to an immediate stand and arranging for passenger recovery.

(b) Passenger emergency activation (PEA) either on-train or on-platform – where the train is outside a station or stationary at a platform

(i) **On-platform Passenger emergency activation (PEA): no train in platform**
Where platform PEAs are fitted, if the PEA is operated when there is no train in the platform, the next train entering the platform shall do so at reduced speed to ensure that the obstacle detection system of the train has sufficient time to bring the train to a halt without colliding with any obstruction.

(ii) **On-platform (or on-train) Passenger emergency activation (PEA): the train is stationary in a platform**
Where the train is stationary in the platform, activation of a PEA shall cause the train to be held in the platform until overridden / reset by controllers in accordance with the rules, standards, and procedures of the relevant operator and / or infrastructure manager.

(iii) **On-platform (or on-train) Passenger emergency activation (PEA): Train leaving (but still in platform)**
If any part of the train is in the platform, activation of an on-platform or on-train PEA shall cause the train control system to stop the train (even if the train comes to rest outside the platform) until overridden / reset by controllers in accordance with the railway operators' rules, standards, and procedures.

(iv) **On-train Passenger emergency activation (PEA): the train is outside station limits**
Where a PEA is activated on-train outside of station limits it shall cause the train operating system to immediately alert controllers to the activation. In order for such PEA activation to be dealt with in accordance with the operators' rules, standards, and procedures, controllers shall then direct the train to stop at the next suitable point (or station) on the route to allow emergency and railway services to attend to the activated PEA and any associated incident.

In all cases under a) or b) above, emergency alarm activation should cause the on-train or on-platform CCTV relevant to the activated alarm, to immediately appear upon the controller's screen.

7. UTO factors relating to operation of a train without any on-train staff (GPRHS Principle 6)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Section 6.4

7.1 Where a UTO system operates in UTO configuration it shall be clear to any system controller that this configuration of operation is active.

7.2 A GOA4 train in UTO configuration (with no on-board member of staff from the operator on the train in an official capacity) shall, throughout its entire journey for passenger carrying purposes, be fitted with a clear and audible system which allows direct contact by voice from a system controller to all passenger carriages. Passengers including those with disabilities, should be able to initiate contact with a system controller directly from all passenger carriages. i.e. a 2 way communication system shall be installed. These communication systems should be provided in an accessible manner in any designated wheelchair location as well as other appropriate locations in the passenger carriages.

7.3 The train shall be equipped with equipment and systems that monitor this functionality and shall initiate a TSEA if the 2 way communication system is not functioning in any carriage.

8. UTO factors relating to operation of GOA4 Trains in depots and sidings (GPRHS Principle 3)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Section 3.7

Depots and sidings solely operating GOA4 trains

8.1 People shall be restricted from entering a depot or sidings area in which GOA4 trains can move in automatic UTO configuration. Only people with authorisation should be granted access to work in or in proximity to trains capable of operation in UTO configuration.

8.2 Where staff are required to attend a GOA4 train in a GOA4 depot or siding area where trains can move automatically in UTO configuration, this shall only be permitted :

(i) where controlled access is granted, and

(ii) via authorised walking routes.

When for purposes of access within a train:

(iii) that train shall be securely rendered incapable of movement on the track

(iv) any other train on that track is securely rendered incapable of movement

(v) the trains display visual indications that they have been securely rendered incapable of movement

When for purposes of access to the exterior of a train or to the track area:

(vi) that track is blocked to train movement

(vii) train movement is on tracks adjacent to where the staff will be working is blocked

(viii) trains present on blocked tracks display visual indications that they have been securely rendered incapable of movement

8.3 Designated safe walking routes should be clearly identified for staff who need to use them and appropriate site-specific training should be given, to provide safe controlled access to trains by staff.

Mixed depots and sidings

8.4 In depots and sidings where trains operate in attended and unattended configurations , GOA4 trains intended for operation in UTO configuration within a depot shall collectively be physically segregated from non-GOA4 trains.

8.5 The principles set out for “Depots and sidings solely operating GOA4 trains” shall apply in the physically segregated GOA4 part of a mixed depot or siding.

9. UTO additional factors to be considered (GPRHS Principles 2, 3, 5 & 6)

To be read in conjunction with Goal-setting Principles for Railway Health and Safety Sections 2.2, 3.3, 3.7, 5.1, 5.2, 6.1 & 6.3

Line availability validation

9.1 When GOA4 trains operate in UTO configuration, the train operator(s) in conjunction with the infrastructure manager shall at all times be satisfied that the lines over which such trains run are safe for the passage of trains carrying passengers. This shall include being satisfied with the operations described in 9.2 - 9.4 below.

9.2 **In respect of daily operations or service suspension for repair etc**
a) Where operation of trains in UTO configuration has ceased for a continuous period greater than 24-hours, a train (or series of trains along the line) other than a GOA4 train in UTO configuration carrying passengers, shall be operated throughout the entire length of the line for the purpose of determining that the entirety of the line (or part of a line not in UTO operation) is clear of obstacles and is fit for operational use by passenger carrying GOA4 trains in UTO configuration.

b) Where UTO operation ceases in order to allow repair, maintenance or upgrade of the line or infrastructure and part of the line is taken out of operational use, then on reinstatement a non-passenger-carrying train shall be operated through the section of line in which the service was suspended for the purpose of determining that the line is fit for operational use.

9.3 Where a GOA4 train (without passengers) is used in UTO configuration for these purposes it shall be operated at a speed which allows onboard obstacle detection to bring the train to a stand prior to collision with an obstacle; this will normally mean operation at speeds lower than operational in-service speeds.

9.4 **Service suspension due to incidents/accidents on the railway**
Where UTO operation has ceased on a section of line due to an accident/incident on the line or infrastructure, then providing;

(a) the incident is resolved,

(b) the line/infrastructure has not been compromised and

(c) the relevant section of line declared fit for use by trains by a person competent to make such a declaration;

the first GOA4 train to use that section of line may be operated through the section in a restricted UTO configuration which allows onboard obstacle detection to bring the train to a stand prior to collision with an obstacle (see para 9.3(b) above) for the purpose of determining that the line is fit for operational use in full UTO configuration.

Management of operations in conditions of low adhesion

9.5 A UTO system shall be designed to detect conditions of low adhesion and alert the system controller(s). Operators shall have in place systems, plans, procedures and arrangements (including passenger communication arrangements) for safely managing and operating GOA4 trains in UTO configuration in circumstances of low adhesion.

Incidents potentially requiring passenger evacuation

9.6 Where a UTO system is in operation there shall be an already prepared plan including timings and durations, capable of being implemented on any part of the system, for evacuation of train passengers to a place of safety (e.g. infrastructure, station or alternative train). Such a plan shall include passenger communication arrangements and should avoid passengers having to remain on a non-moving train for extended periods of time. It shall be at least as effective in retaining control and ensuring prompt evacuation as having staff on board the train.

Action in event of a GOA4 system failed train (e.g. stalled train / loss of traction supply / control system failure)

9.7 In the event of loss of traction supply, failure of the control system, or a stalled train; the predetermined plan agreed between the infrastructure manger(s) and train operator(s) shall be implemented allowing either:

(a) a 'limp home' configuration to be activated on a UTO train; or,

(b) for the stalled train and any part of the permanent way and system used to provide access to the stalled train, to be rendered safe for staff to approach and safely recover or evacuate the stalled train.

9.8 Communications between the control centre and all train carriages on the network shall remain functional in these circumstances to support passenger management. This facility shall remain for a minimum period consistent with the operators' forseeble worst-case incident management timings.

Self-evacuation by passengers from a GOA4 system failed train

9.9 Trains operating on a UTO system must be equipped with door sensors capable of alerting controllers to unauthorised door opening. Unauthorised door opening to an extent in excess of doors closed / locked limits specified in BS EN 14752 shall cause :

(i) the train to come to an emergency stop,

(ii) the system controller(s) to be alerted such that emergency action to stop other trains approaching that location can be promptly taken either automatically or by controllers. and,

(iii) the electrical supply to be discharged.

9.10 When the unauthorised door open alert is activated the train should not be restarted without authorisation from appropriately authorised person competent to make such a determination. ***Before*** authorising train movement, the person authorised to take such decisions shall record:

(i) the suspected cause of the activation of the door opening alert;

(ii) that this cause has been resolved including the nature of the resolution; and,

(iii) that it is safe to continue.

Train fires

9.11 Activation of an on-train fire alarm on a train operating in a UTO configuration shall cause an alarm to be raised for system controller(s) and the relevant on-train CCTV to immediately appear upon the controller's screen.

9.12 Plans for dealing with train fires should ensure the optimal means of prompt evacuation and most effective means of escape for passengers on a GOA4 train in UTO operation in the event of fire.

Infrastructure fires including station fires

9.13 A train operating in UTO configuration shall not be permitted to enter a part of the infrastructure (e.g. station, tunnel, cutting, embankment etc) where there is a known infrastructure fire unless authorised to do so by an authorised person competent to make such a decision. Before authorising train movement, the person authorised to take such decisions shall record:

(i) the suspected cause of the fire that has been identified;

(ii) that the fire is such as to not pose a risk to the GOA4 train and its passengers through its proximity; and,

(iii) that it is safe to continue past the fire / through the smoke.

Station emergency other than fire

9.14 In the event of a station emergency (other than fire) for a system operating in UTO configuration, the system controller(s) shall be able to initiate alternative operating plans, including stopping prior to a station or not stopping at a station (the skip-stop process), to avoid exposing passengers to potential harm.

Emergency recovery of a GOA4 train

9.15 Following evacuation of passengers (see paras 9.6, 9.9, 9.12) recovery of a failed train on a GOA4 system may be by:

(a) Driving by an authorised and competent on - train operator using an in - train accessible console that provides vision of the track ahead of the train and limited to a pre-determined maximum train operating speed.

(b) remote operation from a control room by an authorised, competent operator provided with a clear vision of the track ahead and limited to a pre-determined maximum train operating speed.

(c) assistance provided by a recovery train; the driver of which is provided with clear information about the path ahead, e.g by CCTV from the train being recovered or by an assistant at the front of the failed train in direct communication with the driver of the recovery train.

The presence of railway workers where trains are operating in UTO configuration

9.16 Where trains are operating in UTO configuration, workers shall not routinely be permitted to work in proximity to them.

9.17 Where the safety of the railway demands workers be in the proximity of trains routinely operating in UTO configuration

(a) the movement of such trains in GOA4 configuration shall normally cease.

(b) where such trains are required to be operable (e.g. for testing the functionality of a safety system) such trains may only be operated in the presence of such workers in a restricted configuration designed to minimise the risks to the workers necessarily present in proximity to the train. Any workers required to work in the proximity of trains operating in UTO configuration shall be provided with appropriate information , instruction and training before being permitted to be in proximity to such a train.

9.18 A train operating in UTO configuration shall not be permitted to continue operating in this configuration in the known presence of person on the track (e.g. when a trespasser is known to be present or there are good reasons to suspect a person may be present).

Security of GOA4 systems and prevention of unauthorised access

Infrastructure and trains

9.19 To the extent necessary for safety, unauthorised access to the infrastructure and trains shall be prevented where GOA4 trains operate in UTO configuration. The formal authorised access routes onto the infrastructure shall be so equipped that the controller(s) in the systems control centre are alerted when such routes are accessed, and a record is made of the timings of such access

Control centres and control rooms

9.20 Where necessary for safety, only authorised persons shall be permitted access to system control centres and system control rooms.

Digital control systems

9.21 A digital operating system intended for operation in UTO configuration shall be designed to be as cyber-secure from external interference as practicable. Such cyber-security shall be maintained.

9.22 Where necessary for safety, at both the signalling/control centres and on trains, only authorised persons shall be permitted access to the hardware and software underpinning the UTO operating system, and this shall include access by remote means.

9.23 Where a UTO operating system is in place and operational, robust systems and processes capable of identifying attempted unauthorised access shall be in operation. Such systems and processes, shall be monitored and routinely tested for integrity and effectiveness. The organisation using a UTO operating system shall have in place pre-planned response strategies to prove the system safe and to be implemented where attempted unauthorised access is identified.

Annex A: Glossary

Term	Meaning
BS	British Standard
DLR	Docklands Light Railway
CCTV	Closed Circuit Television
GOA	Grade of Automation – see Table 1.1 for levels
GPRHS	Goal-setting Principles for Railway Health and Safety
IEC	International Electrotechnical Commission
MHSW	Management of Health and Safety at Work Regulations 1999
ORR	Office of Rail and Road
PBS	Platform Barrier Systems A Platform Barrier System means the entire structure provided for platform edge protection along the platform edge including opening doors and fixed sections
PEA	Passenger Emergency Activation
PTI	Platform Train Interface
ROGS	Railways and Other Guided Transport Systems (Safety) Regulations 2006
SIL	Safety Integrity Level
SPT	Strathclyde Partnership for Transport
TSEA	Train Systems Emergency Activation
UTO	Unattended Train Operation

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