

Transport for New South Wales, Australia

Independent Review of the New Intercity Fleet (NIF) Operating Model

Final Report

Issue 1a: 9th December 2019

Metcalfe Rail Safety Ltd

Metcalfe Rail Safety

29 Lansdowne Crescent, Derry Hill, Calne, Wiltshire, SN11 9NT, UK
Tel/Fax: +44 (0)1249248935

Metcalfe Rail Safety has prepared this report in accordance with the instructions of their client, Transport for NSW, for their sole and specific use. Any other persons who use any information contained herein do so at their own risk.

© **Metcalfe Rail Safety 2019**

Transport for New South Wales, Australia

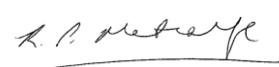
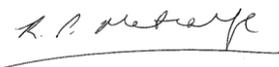
Independent Review of the New Intercity Fleet (NIF) Operating Model

Final Report

Issue 1a: 9th December 2019

Content Issue/Amendment

This report has been issued and amended as follows:

Issue	Rev	Description	Date	Signed
1	0	Final Report	20/09/2019	
1	a	Section 15. Recommendation 1.a. The text, 'then signal to the driver to stop the train movement.' changed to 'then signal to the driver to stop the train from departing.'	09/12/2019	

Contents

1	Executive Summary	1
2	Introduction	8
	2.1 <i>Background</i>	8
	2.2 <i>Remit and scope</i>	8
	2.3 <i>The consultant</i>	9
3	Methodology	11
	3.1 <i>Process</i>	11
	3.2 <i>Structure and content of the report</i>	12
4	Standards and project documents for passenger safety on stations and during the train dispatch process	13
	4.1 <i>Introduction</i>	13
	4.2 <i>Transport for NSW Asset Standards Authority</i>	14
	4.3 <i>Network Standards, Rules and Procedures</i>	16
	4.4 <i>Transport NSW Trains Safety Management System Documents</i>	17
	4.5 <i>NSW TrainLink train working procedures</i>	17
	4.6 <i>NIF project documents</i>	18
5	The current and proposed operating method for the safe working of trains at passenger stations	20
	5.1 <i>Introduction</i>	20
	5.2 <i>The current operating model</i>	20
	5.3 <i>Description of the new operating model</i>	22
6	Risk assessment of the proposed operating method	27
	6.1 <i>Introduction</i>	27
	6.2 <i>Risk assessment of the proposed change to the new operating model</i>	28
	6.3 <i>Train dispatch risk assessment</i>	29
7	Train design for station operations and train dispatch	30
	7.1 <i>Introduction</i>	30

7.2	<i>Cab Security</i>	30
7.3	<i>The crew cab/compartment</i>	30
7.4	<i>General description of the train doors</i>	31
7.5	<i>Safety measures at the door entrance</i>	31
7.6	<i>Safety measures for the arrival of a train at a station</i>	31
7.7	<i>Safety measures during door closure</i>	33
7.8	<i>Door obstruction protection</i>	33
7.9	<i>Safety measures and operation of the crew door</i>	34
7.10	<i>Indication of the status of the external doors</i>	34
7.11	<i>Safety systems and control measures for the train dispatch safety check</i>	34
7.12	<i>Managing Signal Passed at Danger (SPAD) risk at departure from a station</i>	37
7.13	<i>Testing and maintenance of the CCTV system</i>	38
7.14	<i>Incident Investigation</i>	38
7.15	<i>Degraded Operations</i>	38
8	Integration of human factors within the design of the NIF train	40
8.1	<i>Introduction</i>	40
8.2	<i>The NIF Rollingstock Human Factors Integration Plan</i>	41
9	Competence management of the train driver and customer service guard	45
9.1	<i>Introduction</i>	45
9.2	<i>Proposed changes for the operation of the NIF fleet at stations</i>	45
10	Interface management	47
10.1	<i>Introduction</i>	47
10.2	<i>NSW TrainLink Asset Management/Engineering Interface</i>	47
10.3	<i>Internal Stakeholder Identification, Assessment and Engagement</i>	48
11	Project safety assurance	49
11.1	<i>Introduction</i>	49
11.2	<i>Safe Train</i>	50
11.3	<i>Safe Operation</i>	52

11.4	<i>Safe Infrastructure</i>	54
11.5	<i>Signal sighting</i>	55
11.6	<i>Automatic train protection</i>	56
11.7	<i>Approval of Safety Assurance</i>	56
11.8	<i>Managing risk during the transition to the new operating model</i>	56
12	International practice on managing station operations and train dispatch risk	57
12.1	<i>Introduction</i>	57
12.2	<i>Railways that operate in DGO</i>	59
12.3	<i>Railways that operate in 'Driver Only Operation'</i>	62
12.4	<i>Driver Only Operation (DOO) in the UK</i>	64
12.5	<i>Driver Controlled Operation (DCO)</i>	65
12.6	<i>PTI and train dispatch risk in the UK</i>	65
13	Key findings	69
13.1	<i>Standards and project documents</i>	69
13.2	<i>Comparison of the current operating method with the new operating model – Revenue service dispatch</i>	69
13.3	<i>The new operating model – empty train dispatch and unscheduled stop dispatch</i>	77
13.4	<i>The risk assessments</i>	77
13.5	<i>The train design and human factors</i>	78
13.6	<i>Competence management of the train driver and customer service guard</i>	80
13.7	<i>Interface management</i>	81
13.8	<i>Project safety assurance</i>	81
13.9	<i>The use of on-train monitors during train departure</i>	81
14	Conclusion	83
15	Recommendations	86

Appendix 1	88
Requested meetings and list of subject areas identified by Metcalfe Rail Safety for review	
Appendix 2	91
Review Programme	
Appendix 3	95
List of documents used in the review	
Appendix 4	98
Questionnaire on train dispatch methods	

1 Executive Summary

Introduction

- 1.1.1 With the introduction of the New Intercity Fleet (NIF) train, NSW TrainLink propose to change the method by which these trains are operated when they arrive and depart from a train station. The proposed new method is called the 'New Intercity Fleet (NIF) Operating Model'.
- 1.1.2 In this model the train driver is responsible for operating the train doors on arrival and departure from the station and for carrying out the train dispatch safety check process. The role of the guard will change to one that is more customer focussed, managing passenger access and inquiries etc. The job title will be called 'Customer Service Guard' (CSG) and the role, in addition to providing customer service will be to support the driver during station operations and train departure.
- 1.1.3 Metcalfe Rail Safety have been commissioned by Transport for New South Wales (TfNSW) to carry out an independent review of the new operating model and answer three core questions:
1. Is the New Intercity Fleet (NIF) Operating Model safe?
 2. Is the new model as safe or safer than the current train fleet operating conditions for guards, when monitoring the platform train interface?
 3. How does the New Intercity Fleet (NIF) Operating Model compare with the methods used by the international train operating community?
- 1.1.4 The methodology for the review has included several meetings with relevant stakeholders and subject matter experts who are involved in the specification and approval of the NIF train design and the development of the proposed new operating model.
- 1.1.5 A desktop review has been carried out on a wide range of documents, including relevant standards, the design of the train and the procedures during station operation and train dispatch.
- 1.1.6 Practical experience and feedback from guards and drivers on the current method of train dispatch has been obtained by travelling with them over a significant section of each of the routes to be worked by the NIF.
- 1.1.7 The scope of the review has included several other important subject areas, which include:

- The standards that apply to manage the risk at the platform train interface (PTI) and train dispatch.
- Risk assessments.
- Design/functionality of the NIF driving cab and the train safety systems for managing PTI and train dispatch risk.
- How Human Factors have been integrated into the design of the train for the application of the proposed new operating model.
- Competence management of the traincrew operating the NIF.
- Interface management.
- Project safety assurance.

1.1.8 The key findings from the review, the conclusion reached, and the associated recommendations are summarised in the paragraphs below.

Standards for managing the platform train interface and train dispatch risk

1.1.9 The ASA standards provided for this review do not describe, in enough detail, the control measures required for the safe operation and the dispatch of trains from a station. There are many references in the project documents reviewed relating to rail industry standards and guidance produced by the UK Rail Safety Standards Board (RSSB) on managing platform train interface and train dispatch risk.

1.1.10 Consideration should be given by the NSW Asset Standards Authority to producing a standard which describes the required control measures, drawing on the documents produced by RSSB as necessary.

The current and proposed new operating model

1.1.11 The most significant safety risks to passengers during station operations and when a train departs a station that the current and proposed new operating method are designed to control are:

1. If an external door opens on the train when it is not alongside a station platform and a passenger(s) then falls from the train.
2. When a passenger falls down the gap between the train and the platform and this is not observed.
3. When a passenger is trapped in an external door as the train departs from the station.

1.1.12 All the above incidents can result in very serious injury or death.

1.1.13 The following are key concerns that have been identified by the review with the current operating model:

1. The guard can be subjected to verbal and physical attack and could fall from the open crew door when the train departs the station.
2. There is the potential for a lapse by the guard in controlling the train doors, which results in an external door being opened off the platform or on the side of the train that is not alongside a platform.
3. There are many stations where, due to platform curvature or congestion on the platform, the guard cannot observe the complete train when carrying out the safety check before dispatching the train.
4. The very long viewing distance for trains operating in multiple units, which is 192m for an 8 car V Set. This can mean that obstacles trapped in the doors that have not been detected by the door safety system are not visible to the guard. Note: The UK limit for 'line of sight' viewing for driver only operation is 160m.
5. The delay in stopping the train as it travels along the platform when there is an emergency, caused by the guard signalling to the driver to apply the emergency brake.

1.1.14

The review found that these risks are either eliminated or significantly reduced by the design of the NIF train and the proposed new model by the safety systems on the NIF train and procedures required by the new model, as follows:

1. The control of door opening is managed by an automatic system, which prevents the opening of passenger doors that are not alongside the platform.
2. A person is less likely to become trapped in a passenger door due to the improved obstacle protection on the NIF train.
3. In the new model the driver is responsible for closing the external doors and then carrying out the safety check before starting the train. The CCTV images used to view the train will overcome the problem with curved platforms, platform congestion and viewing long distances, by providing a closer view of the PTI along the complete length of the train before the train starts.
4. The customer service guard has an external view of the complete train using CCTV images displayed on the monitor in the crew cab, which means there is no requirement to visually look down the train with the cab door open.

5. After the train has started and as it travels along the platform the customer service guard will monitor the complete length of the train using images on the CCTV monitor. This will provide a closer view of PTI and the view will not be affected by curvature of the platform or congestion on the platform.
6. If there is a need to stop the train the customer service guard can bring the train to a stop much quicker, using the emergency brake.

1.1.15

The review identified the following issues with the proposed new operating model:

1. In the draft instructions there is insufficient clarity on what the driver is required to check when carrying out the safety check. Revised wording has been provided.
2. As the driver does not leave the crew cab it is likely that this will result in the driver having a reduced level of situational awareness of events on the platform, because of a lack of audible cues to alert the driver. To address this the review has recommended the customer services guard, while on the station platform, looks out for passenger behaviour/events that should stop the train from departing and then signal to the driver to stop the train movement.
3. The risk of driver distraction when the train departs the station. The review has recommended:
 - a. The functionality of the Driver Reminder Appliance (DRA) is reviewed, with the objective of bringing this in line with the UK functionality of this important safety system.
 - b. The CCTV monitor in the driving cab is not switched on when the passenger intercom is operated. The customer services guard already has the responsibility to monitor the CCTV monitors when the train moves along the platform during the dispatch process and deciding if there is a need to stop the train, using the emergency brake. When the passenger intercom is operated during departure from a platform the CCTV monitor the customer service guard is viewing should show the external view of the car where the intercom is operated.
4. The risk of the customer service guard being distracted when the train departs the station. The review has recommended the CCTV images from the passenger areas should not be displayed on the other monitor

when the customer service guard is monitoring the platform side images.

Train design, human factors and safety assurance

1.1.16 Significant consideration has been given to human factors throughout the design development so these can be integrated into the design of the driving cab and the safety systems used during station operation and the train dispatch process.

1.1.17 The review found that the design of the cab is significantly better than comparative trains in the UK.

1.1.18 The safety assurance process applied to the train design is robust and thorough and is compliant with rail industry practice.

Competence management

1.1.19 NSW TrainLink currently apply a competence management system for train drivers and guards. Changes to this for the implementation of the NIF are currently being developed.

1.1.20 Good practice is being applied to develop the content of the training course for the NIF train. It is important that the competence management system has an appropriate assessment and monitoring regime which ensures the train driver and the customer services guard are not only competent to apply the new operating model but are also consistently applying it every time a train is dispatched from a station. The competence assessment of the driver and the customer services guard need to be reviewed and updated to reflect the changed roles.

Risk assessment

1.1.21 Every station platform has different characteristics and it is essential that a location specific risk assessment is produced for every station where the NIF train will stop.

1.1.22 There is a need to document how to carry out the planned train dispatch risk assessments and how the findings from these are used. Examples of UK practice on train dispatch risk assessments and the documentation these generate have been provided.

Comparison with international practice on station operations and train dispatch

1.1.23 The review provides information on how station operations and train dispatch is managed in train companies in Europe (UK, France, Belgium,

Germany, Italy), Asia (South Korea, Hong Kong) and the Middle East (Saudi Arabia, Dubai, Qatar). Most of the information on this was obtained from the responses to a questionnaire that was sent to experienced persons in these countries known to Metcalfe Rail Safety.

1.1.24 It provides information on the methods used to carry out important safety tasks during station operations and train dispatch when a train is operated with a driver and a guard (DGO) and when a train is operated only with a train driver (DOO).

1.1.25 How DOO has developed since the 1980's, when it began to be introduced across Europe is also described, together with the more recent move towards driver controlled operation (DCO) in the UK, where the train driver is responsible for door operation and determining that it is safe to start the train with other crew members providing customer service, but have no safety role.

1.1.26 This section also describes some of the research that has been carried out by the UK Rail Safety Standards Board (RSSB) into Platform Train Interface (PTI) and train dispatch risk.

1.1.27 To put the UK PTI risk in context, the 'Annual Safety Performances Report 2014/15 - Key facts and figures', produced by RSSB on key statistics on fatalities and major injuries to passengers at the platform train interface over the previous 5 years reported that these incidents resulted in an average of 3 fatalities/year and 50.8 major injuries/year. This is for passenger journeys in Great Britain that average 58.59 billion passenger kms / year or 1.512 billion passenger journeys per year. There were three passenger fatalities in 2014/15. This equates to a rate of around one fatality per 550 million passenger journeys. The fatalities all occurred in separate accidents in stations, two of which were at the platform-train interface. Intoxication was recorded as a potential contributory factor in all the incidents.

Conclusion

1.1.28 The review has concluded that:

1. The New Intercity Fleet (NIF) Operating Model is safe.
2. The new model is safer than the current train fleet operating conditions for guards, when they are monitoring the platform train interface.
3. The NIF Operating Model is safer than the methods used by the international train operating community.

- 1.1.29 The above statements are dependent on an acceptable image quality being displayed on the CCTV monitors for the train driver and customer service guard, the CCTV system and door safety systems function as specified and the recommendations (or acceptable alternatives) are implemented.
- 1.1.30 The report provides details of how these decisions have been reached and recommendations to support the conclusion are provided on the following subject areas:
1. Improvement to the draft new operating model.
 2. Changes to the functionality of the CCTV monitors.
 3. The train dispatch risk assessment.
 4. The Competence Management System.
 5. A single standard that describes all mandatory requirements on managing risk at the 'Platform Train Interface (PTI).

2 Introduction

2.1 Background

2.1.1 The New Intercity Fleet (NIF) Project is being delivered by Transport for New South Wales (TfNSW) to provide a fleet of new intercity trains for operation by NSW TrainLink on the New South Wales (NSW) electrified rail network.

2.1.2 The high-capacity, double deck walk-through trains will be configured as four and six car units that each can operate independently. These will also form trains consisting of ten cars (coupling together a 4 + 6 car unit). They will operate on the Newcastle, Blue Mountains and South Coast lines.

2.1.3 The train has been designed so that it can be operated only by a train driver in 'Driver Only Operation' (DOO), or by a train driver and a train guard (DGO). The intention is to operate the train with a driver and customer service guard. The primary role of the customer service guard is customer service.

2.1.4 With the introduction of the new train it is proposed to change the method by which trains are operated when they arrive and depart from a train station. The proposed new method is called the 'New Intercity Fleet (NIF) Operating Model'. In this model the train driver is responsible for operating the train doors on arrival and departure from the station and for carrying out the train dispatch safety check process. The customer service guard will manage passenger access and inquiries and also support the driver during train departure.

2.1.5 To support the introduction of the NIF, an Operational Readiness Project team has been set-up within NSW TrainLink to work in partnership with TfNSW to manage the delivery of the NIF Program Management Plan and support the safe introduction of the NIF trains into service.

2.2 Remit and scope

2.2.1 Ray Metcalfe, of Metcalfe Rail Safety has been commissioned to carry out an independent review of the 'New Intercity Fleet Operating Model', produce a report on his findings and conclusions and present this to the Acting Deputy Secretary, Regional and Outer Metropolitan Division, Transport for NSW.

2.2.2 The scope of the review is the proposed method by which the train driver and the customer service guard will operate the NIF when the train arrives at a station, when it is stopped at a station and the dispatch process as the train departs from station.

2.2.3 The review and the associated report are required to answer three core questions:

1. Is the New Intercity Fleet (NIF) Operating Model safe?
2. Is the new model as safe or safer than the current train fleet operating conditions for guards, when monitoring the platform train interface?
3. How does the NIF Operating Model compare with the methods used by the international train operating community?

2.2.4 As the proposed new operating model depends on equipment fitted to the NIF train the review needs to consider the design of the train and the associated safety assurance processes. It also needs to consider the training that will be provided to safely operate the train to the new operating model. The following areas also fall within the scope of the review:

- The standards that apply to manage the risk at the platform train interface (PTI).
- Risk assessment of the proposed operating model.
- Design/functionality of the NIF driving cab and train safety systems that are used during the arrival and departure of the train at railway stations.
- How Human Factors have been integrated into the design of the train for the application of the proposed new operating model.
- Competence management of the traincrew operating the NIF.
- How the interface with the other train companies that use the same station platforms is being managed.
- Project safety assurance.

2.3 The consultant

2.3.1 The consultant carrying out all aspects of this assignment was Ray Metcalfe.

2.3.2 Ray Metcalfe is a Fellow of the Institution of Railway Operators and a Director of Metcalfe Rail Safety. He has extensive experience in rail operational safety management and has provided consultancy services to most UK train companies, Network Rail and internationally in the European Union (Transport Research Programme), Germany (Siemens and National Express), Sweden (MTRC/TBT Stockholm Metro), Hong Kong (MTRC), South Korea (KORAIL), Australia (QR, RailCorp, Perth PTA, Australian

Railtrack Corporation), New Zealand (Transdev, Auckland), Argentina (Buenos Aires Suburban Rail Network).

- 2.3.3 He has significant experience in managing risk associated with train operations, specialising in train dispatch and SPAD risk. Also in the development, production and application of national industry safety standards, codes of practice for railway operations and safety, with proven expertise in the creation and management of safety systems - specialising in competence management systems and safety systems for train operations including, train driving, shunting, driving cabs, train control systems.
- 2.3.4 Prior to establishing Metcalfe Rail Safety he was a consultant for Halcrow Group Ltd, where he was involved with numerous clients providing operational safety and risk management advice. These included the Channel Tunnel Rail Link, Railtrack Safety & Standards (now RSSB), the majority of the UK Train Companies and internationally in Australia, Europe, Dubai, Singapore and Hong Kong.
- 2.3.5 Whilst employed by Halcrow he was nominated by the UK Railway Industry Association to be their representative on the Human Factors Working Group, managed by the UK Office of Rail Regulation. In December 2006 he presented a paper to that group on a research project in which he was involved for the Rail Safety Standards Board (RSSB) on managing risk at the platform train interface.
- 2.3.6 He was the Traction and Traincrew Manager in the British Rail Director of Operations organisation, Traincrew and Train Systems Manager in the BR Group Standards organisation and the Head of Safety in the British Rail Safety Directorate.
- 2.3.7 He was also a chartered electrical engineer with experience of fleet engineering. He also has experience in the validation of change in the subject areas of organisational change and those relating to train operations on the UK railways and in international applications.

3 Methodology

3.1 Process

- 3.1.1 A list of proposed meetings and subject areas to discuss during the review process was sent to Transport for New South Wales (TfNSW) to enable meetings to be set up with key stakeholders and Subject Matter Experts (SMEs). The document listing the subject areas is attached as Appendix 1.
- 3.1.2 The review was then carried out through several meetings with relevant stakeholders and SMEs who are involved in the specification and approval of the NIF train design and the development of the proposed new operating model. Some of the meetings were in a 'workshop' format and some on a 1:1 basis. Details of the review program which lists the meetings held are provided in Appendix 2A.
- 3.1.3 To gain practical experience of the current method of train dispatch the consultant accompanied train crew on several journeys over a significant section of each of the routes to be worked by the NIF.
- 3.1.4 Priority was given to accompanying train guards in order to assess their role, the stations where the NIF will operate, passenger loadings and behaviours on station platforms. Travelling with the train crew gave the opportunity to discuss their role and their opinions on the hazards/risks associated with the current and the proposed new operating model.
- 3.1.5 The journeys on the trains were carried out during the hours of daylight, darkness, quiet and 'peak' periods. The journeys enabled the assessment of hazards/risk and the impact from the design of the current trains, the curvature of the station platforms and the impact on sightlines to carry out safety checks, congestion on station platform and passenger behavioural risk.
- 3.1.6 Some of the viewing of the arrival and dispatch process was carried out unobtrusively whilst travelling on trains and from the station platform. This was to assess compliance with the required rules by the train guard and to assess passenger behaviours on the station.
- 3.1.7 The practical experience programme is included within Appendix 2B.

3.2 Structure and content of the report

- 3.2.1 The structure of the report has been designed to describe, in Sections 4 to 11, the current and proposed new operating model, the train design for station operations and the safety measures that have been incorporated into the design, standards for station operations, safety risk assessment and other important subject areas.
- 3.2.2 Section 12 provides a summary description on international practice on managing station operations and train dispatch risk.
- 3.2.3 Sections 13 – 15 provides key findings and comments on the current and proposed operating model, conclusion and recommendations for TfNSW and NSW TrainLink to consider.
- 3.2.4 Listed in the Appendix 3 are documents used within the review process.

4 Standards and project documents for passenger safety on stations and during the train dispatch process

4.1 Introduction

- 4.1.1 All rail operations in New South Wales (NSW) are governed by the Australian Rail Safety National Law (NSW) No 82a. This states that a duty of a rail transport operator is "... to ensure, so far as is reasonably practical, the safety of the operator's railway operations."
- 4.1.2 It requires train operating companies to have a safety management system and that risks from the safety of rail operations are managed to 'So Far as is Reasonably Practicable' (SFARIP).
- 4.1.3 The Asset Standards Authority in New South Wales produce and manage standards across the NSW rail network. These are mandatory standards.
- 4.1.4 The routes over which the New Intercity Fleet (NIF) will operate are managed by Sydney Trains, and they produce Network Standards and Rules and Procedures for safe working over the infrastructure they manage.
- 4.1.5 NSW TrainLink develop and manage operating procedures and instructions applicable to their operation. These include documents that describe:
- Operator specific procedures
 - Train working procedures
- 4.1.6 A requirement of the NSW TrainLink safety management system is that for a significant change, such as the introduction of the NIF, the new operating method must be risk assessed and appropriate controls applied so that there is a demonstration that the operation is managed to a level where the risks are managed to a level that is tolerable and reduced SFAIRP.
- 4.1.7 For the NIF a new set of documents are currently in development. These are designed to create a manual containing all the new instructions for the operation of the NIF.

4.1.8 The following standards that are relevant to the new NIF train and the proposed new operating model that were assessed within this review are described below.

4.2 Transport for NSW Asset Standards Authority

4.2.1 The Asset Standards Authority (ASA), an independent unit of Transport for NSW, is the authority on network design and standards for transport assets across NSW. It is responsible for developing engineering governance and frameworks to support industry delivery in assurance of design, safety, integrity, construction and commissioning of transport assets for the whole asset life cycle.

4.2.2 The ASA is also responsible for providing the standards that industry organisations can use to deliver projects and manage transport assets across NSW in an innovative, safe, and efficient manner.

4.2.3 The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. The Authorised Engineering Organisations (AEOs) are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

4.2.4 Key ASA standards relating the design of the NIF train for station operations are:

A. System Safety Standard for New or Altered Assets. T MU MD 20001 ST. Version 1. Issued date: 20 December 2016

4.2.5 The standard requires that whenever new assets are introduced, or existing assets are modified, upgraded or removed operational safety risks are identified, assessed and managed and that sufficient evidence is provided to demonstrate a safety argument that the new or altered system has reduced all foreseeable safety risks SFAIRP

B. Human Factors Integration – Rolling Stock. T HR HF 00001 ST. Version 2.0. Issued date: 25 June 2018

4.2.6 This standard provides details of the minimum requirements for demonstrating Human Factors Integration (HFI) in the procurement of new rolling stock or alterations made to existing rolling stock.

C. RSU Appendix D - Train (Driver) Safety Systems. T HR RS 00840 ST. Version 2.0. Issued date: 04 November 2016

4.2.7 This standard covers the requirements of safety related equipment fitted to all rail vehicles operating in the TfNSW metropolitan rail area. It covers safety systems that reduce the likelihood, or protect against the consequence, of a failure in the manual functions of train operation. Safety systems not related to manual functions of train operation are outside the scope of this standard.

4.2.8 With regards to station operations the standard sets out requirements for:

- Controlling the opening and closing of train doors at platforms.
- Ensuring passengers are not hit by or trapped in door during the door opening and closing sequence.
- Ensuring a safe starting condition.

4.2.9 The section on 'Passenger transfer supervision system', requires a combination of systems (traction interlocking, door obstruction detection, visual and audio door motion warnings and closed-circuit television (CCTV)) to be used in isolation or in combination under different configurations across different passenger fleets.

4.2.10 Specific requirements in this section are:

- Traction interlocking
- Door obstruction detection
- A door motion warning system
- Closed-circuit television – this may be used, in conjunction with traction interlocking, door obstruction detection and door motion warnings to assist with supervising passenger transfer at platforms.

D. Passenger Rolling Stock Access and Egress. T HR RS 04001 ST. Version 1.0. Issued date: 28 August 2017

4.2.11 This standard sets the minimum requirements for the design of safety systems and access to and egress from rolling stock during normal operation and emergencies.

E. Train Safety Systems. T HR RS 13001 ST. Version 2.0. Issued date: 04 December 2017

4.2.12 This standard describes requirements for rolling stock onboard safety systems relating to the functions carried out by the driver. It also covers onboard safety systems that protect the platform train interface.

- 4.2.13 It requires the selection of risk controls and a preliminary hazard analysis. Documented in the list of safety risks to be assessed is the failure to supervise passenger transfer due to the following:
- Failure to ensure passengers alight onto the platform (for example, at short platforms).
 - Failure to control passenger doors (between cars or between platform and train).
 - Failure to ensure passenger safety before departing platform (for example, train moving while passenger still alighting or boarding).

4.2.14 Prior to critical or final design review (ready for construction review) the AEO is required to complete a detailed hazard analysis on the final design using suitable tools, such as fault tree analysis, event tree analysis and failure modes, effects and criticality analysis.

4.3 Network Standards, Rules and Procedures

4.3.1 The requirements in the Network Standards apply to all organisations that operate passenger trains or manage stations or passenger platforms in the Sydney Trains Network.

Requirements for Passenger Train Dispatch. NS-0918. July 2018. V4.1

4.3.2 This standard describes the requirements for determining the dispatch method to be used for passenger trains departing from platforms.

4.3.3 It includes:

- The methods of passenger train dispatch that can be used on the Sydney Trains Network.
- A requirement for a risk assessment for each station or passenger platform. The risk assessment must determine the most appropriate passenger train dispatch methods. Factors for consideration are provided.
- The requirement for a review of the train dispatch method risk assessment when a significant change is proposed. This includes the introduction of new trains.
- The requirement that when there are new or alternate method of working that the transition to these methods is implemented in a controlled manner.

4.4 Transport NSW Trains Safety Management System Documents

4.4.1 The following documents from the Transport NSW Trains Safety Management System are relevant to the NIF train proposed new operating model at stations.

A. Safety and Environment Change Management. SMS-07-SP-5067. Version: 3. 21/12/2017

4.4.2 This procedure explains the safety and environment change management activities to manage and reduce risks so far as is reasonably practicable (SFAIRP) for changes initiated by NSW Trains or to which NSW Trains is exposed.

B. Risk Management, SMS-07-SP-5213. V2. 15/04/2019

4.4.3 This document explains the NSW Trains risk management process.

C. Risk Assessment Guide. SMS-070GD-5084. V2. 15/08/2016

4.4.4 This document provides the guidance to undertake effective risk assessment activities in line with the Safety Management System (SMS) requirement.

4.5 NSW TrainLink train working procedures

4.5.1 The following documents from the NSW TrainLink train working procedures are relevant to the NIF train proposed new operating model at stations.

A. Operating Doors. NTTWP 156. November 2017, V1.0.

4.5.2 This document describes the procedures the guard on Intercity trains, or the Passenger Service Supervisor (PSS) on Regional trains, must follow to ensure that the train has stopped at the platform before they open/release doors and that passenger doors are closed before the train moves at a station.

4.5.3 Details of the instructions are described in Section 5 of this report.

B. Right of way procedure for Guards and Passenger Service Supervisors. NTOSP 7. November 2017. V1.0

4.5.4 This document describes the rules/instructions that the guard and passenger service supervisors must apply for the safe dispatch of a train from a passenger station. Details of the instructions are described in Section 5 of this report.

**C. Right of way procedure for Station Staff and On-Train Repeaters.
OSP 6. September 2018. V6.1**

4.5.5 This document describes the rules/instructions that Sydney Trains station staff and passenger service supervisors must apply for the safe dispatch of a train from a Sydney Trains passenger station.

**D. Right of way procedure for Station Staff and On-Train Repeaters.
NTOSP 6. November 2017, V1.0.**

4.5.6 This document describes safety procedures that station staff and on-train Repeaters must follow when dispatching trains at nominated station platforms. Details of the instructions are described in Section 5 of this report.

4.6 NIF project documents

4.6.1 The following documents are relevant to the NIF train design and the proposed new operating model and are being produced by the NIF project team.

A. NSW TrainLink Safety Change and Human Factors Integration Plan. TRIM Reference: DNSW2017/32988. Issue 1.2. 30/7/2018

4.6.2 The purpose of this document is to:

- Outline the Human Factors Integration strategy.
- Describe the high-level safety argument indicating how the safety objectives for the NSW TrainLink Operational Readiness for NIF will be met.
- Identify organisational roles and responsibilities related to the safe introduction of the NIF.
- Describe the project safety related timescales and milestones.
- Describe the safety management activities that will be performed in order to provide evidence that the safety arguments have been met.

B. RailConnect, New Intercity Fleet System Safety Plan, TeamBinder Ref NIF-150010-RCN-RS-00001, Revision 5, 14/12/2018

4.6.3 The purpose of this document is to:

- Ensure that system safety is managed in accordance with relevant legislation, Rail Safety Law and appropriate standards.
- Ensure that the qualifications, experience and authorities for each of the system safety roles are adequately managed.
- Ensure that a Project Hazard Log is developed, maintained and delivered, compliant with the relevant requirements of the Rail Safety National Law (RSNL) and T MU MD 20001 ST.

- Ensure that there is adequate integration between the SSP and other project plans including the Systems Engineering Management Plan (SEMP), Reliability, Availability and Maintainability (RAM) Plan and Human Factors Integration (HFI) Plan.
- Detail the safety assurance activities and deliverables that will allow RailConnect NSW to engage with the operator and other NSW rail entities.

C. RailConnect, New Intercity Fleet Human Factors Integration Plan, TeamBinder Ref NIF-150010-RCN-EM-000071, Issue 5, 8/2/2019

4.6.4

The plan describes:

- HF Integration requirements pertinent to the NIF Train design.
- Relevant HF standards and their application for NIF.
- The identification of Users to be considered during train system design.
- The integration of HF principles during Train system design.
- The activities required to identify and manage HF issues.
- Tools, activities and evidence required for progressive assurance.
- Alignment with safety assurance requirements defined in the NIF System Safety Plan (SSP) [Ensure.

5 The current and proposed operating method for the safe working of trains at passenger stations

5.1 Introduction

5.1.1 NSW TrainLink operates intercity over the routes to Newcastle, Lithgow, Kiama and Port Kembla using primarily two different types of train. These trains will eventually be replaced by the 'New Intercity Fleet' (NIF), starting with the 'V Sets', with service introduction of the NIF planned for 2020.

5.1.2 A new operating model for NIF has been developed over 3 years and it is proposed that this will be implemented with the introduction of the NIF. The current operating model has evolved following consultation with key stakeholders.

5.1.3 In the new model the responsibility for the operation of the passenger doors on the train and the final safety check before the train starts away from the station is with the train driver. The customer service guard is required to monitor the platform train interface from the rear or intermediate cab as the train moves along the station platform on departure, using in-cab cctv monitors instead of standing at an open cab door

5.1.4 This section of the report describes the rules/instructions for the current and proposed model. These provide the procedural control measures for managing safety during station operations and train dispatch.

5.2 The current operating model

5.2.1 The current procedure for the operation of the train arriving at and standing at a passenger station is described in the NTTWP 156, Operating Doors, November 2017, V1.0.

5.2.2 This describes:

- Required announcements prior to the arrival of a train at a station.
- Where the train is required to be stopped – at 'car markers'.
- The operation of the crew cab door when arriving and departing from stations.
- Visual checks to make sure cars are correctly positioned beside the platform.

- The operation of the passenger doors, including selective door operation. Details of short platforms are provided.
- Operation of the 'Door warning device' (DWD).
- How to deal with failures of the door system(s).
- Closure of the passenger doors.
- Closure of the crew cab door – it must be closed 4 carriage lengths along the platform or when the workstation reaches the departure end of the platform – whichever occurs first.

5.2.3 The current procedures for starting a train from a passenger station are described in the Operator Specific Procedures, NTOSP 7, 'Right of way procedure for Guards and Passenger Service Supervisors', November 2017 V1.0 and OSP 6, 'Right of way procedure for Station Staff and On-Train Repeaters', November 2017, V1.0.

5.2.4 NTOSP 7 places the responsibility on the train guard to:

1. Operate from the designated workstation.
2. If available, check the platform information. If the information is incorrect:
 - Use the public address (PA) system to tell customers the correct information.
 - Tell Station Staff if present, the correct information.
3. If there is an On-Train Repeater or Station Staff provided for Right of way purposes, wait for them to show a RIGHT OF WAY handsignal.
4. Shortly before the departure time, give one long whistle blast, to warn customers on the platform that the train is about to leave.
5. If DVA is provided, operate the recorded door warning announcement by pressing the DOOR CLOSE button or Door Warning Device (DWD) button.
6. If there is no DVA, announce to customers "Doors Closing, Please Stand Clear".
7. Make sure that customers have left or boarded the train safely.
8. Close the doors.
9. Make sure that nothing is protruding outside the train and it is safe for the train to depart.
10. Check that the Door Open Indicator Light (DOIL) if fitted, is extinguished.

11. When it is safe to proceed, give the ALL RIGHT, 1 long bell signal.
12. Watch the train leaves the platform ensure the Guard's workstation door is closed once the train has travelled 4 cars or the Guard's workstation reaches the departure end of the platform, whichever occurs first. Be prepared to respond to:
 - an emergency situation, or
 - handsignals from Station Staff, or
 - two whistle blasts.
13. If there is an emergency:
 - send the Driver the STOP (2 bells) bell signal.
 - if necessary, operate the emergency brake tap.

5.3 Description of the new operating model

- 5.3.1 The new procedure for the operation of the train departing from a passenger station is described in the draft document OIM 3.7 'Train Dispatch'. This places the responsibility with the train driver for the final PTI safety check before the train starts to move along the station platform.
- 5.3.2 The dispatch procedures require the driver to view the PTI using images from train mounted cameras which display images on a crew workstation closed-circuit television (CCTV) screen. Two display screens are provided for this purpose, but only one screen will display images at any one time. The normal configuration for the train driver is the screen displaying the platform images is located on the same side of the driving desk as the platform.
- 5.3.3 When the driver takes power and the train speed reaches approximately 3 kph, the CCTV screen will switch off. This is to prevent driver distraction and glare from the monitors when the driving cab is dark. If a risk is identified a train driver may elect to keep the CCTV screen active during departure by selecting this on the CCTV screen.
- 5.3.4 When a passenger intercom (PI) call is received within 10 seconds of departure from a platform the CCTV display screen automatically switches on, and currently the operating model requires the train driver to apply the train emergency brake to stop the train and then investigate the cause.
- 5.3.5 Where station staff are provided on the station platform to perform 'right of way' duties the train driver must follow their directions. If a 'STOP' handsignal is received from station staff, or a train is stopped by a customer

service guard during departure, the train driver must not move the train until the employee who gave the 'STOP' signal tells them it is safe to proceed.

5.3.6 When it is time to depart and station staff are not in position the train driver does not have to wait until they have received for the 'RIGHT OF WAY' handsignal from station staff if they have assessed that the situation is safe.

5.3.7 Different procedures are used for:

- Revenue service dispatch
- Empty train dispatch, and
- Unscheduled stop dispatch.

Revenue service dispatch

5.3.8 The train driver is required:

1. Prior to departure, to use the CCTV images to monitor the platform, ensuring that customers have finished boarding or alighting, and all boarding assistance tasks have been completed.
2. If a station staff handsignaller is present, to check they are giving a RIGHT OF WAY handsignal.
3. When all customers are clear of the doors, to press the DOORS CLOSE pushbutton.
4. To listen for the audible tone indicating all doors have closed and check that the traction interlock (TI) light has extinguished.
5. Complete the PTI safety check, using the crew workstation CCTV display screen, and check that:
 - nothing is protruding from the train.
 - customers are standing behind the yellow line.
 - station staff, if present, are not giving a STOP handsignal.
 - When it is safe to do so, move the train.
6. Apply the emergency brake if:
 - the customer service guard gives the STOP IMMEDIATELY (2) bell signal.
 - Station Staff give a STOP handsignal.
 - a dangerous situation is observed at the PTI.
 - a passenger intercom (PI) call is received within 10 seconds of departure.

7. If concerned about the safety of customers on the platform when the train moves, the train driver is required to switch on the crew workstation CCTV display screen, by tapping it, to keep it active following departure.
8. If the train is stopped for any reason during dispatch the train driver is required to:
 - wait for an instruction from the employee who gave the STOP signal that it is safe to depart before starting the train.
 - repeat the PTI safety check before moving the train.

5.3.9

The customer service guard is required to:

1. If required, carry out boarding / customer service activities assistance while the train is stopped at the platform.
2. When platform tasks are complete, close the door of the active guard's cab and sit at the crew workstation.
3. Watch the PTI on the CCTV display screen as the train departs until the trailing car of the train has reached the departure end of the platform, being prepared to stop the train if:
 - station staff give a STOP handsignal, or
 - a dangerous situation is observed at the PTI.
4. If a moving train is stopped by the customer service guard at the PTI they must:
 - tell the train driver when it is safe to resume train dispatch.

Empty train dispatch

5.3.10

Customer service guards are not required to observe the PTI from the train during empty train dispatch. The customer service guard must advise the train driver that terminating checks have been completed before the train driver carries out empty train dispatch from the station.

5.3.11

The train driver is required to:

1. Wait for the customer service guard to advise that the terminating procedure is complete.
2. Check that all passenger doors are closed.
3. Complete a PTI safety check using the crew workstation CCTV display screen, and check that:
 - nothing is protruding from the train.
 - customers are standing behind the yellow line.

- station staff, if present, are not giving a STOP handsignal.
4. When it is safe to do so, move the train.
 5. If concerned about the safety of customers on the platform when the train moves, train driver may choose to:
 - make an external PA announcement warning passengers to stand behind the yellow line.
 - tap the crew workstation CCTV display screen to keep it active following departure.
 6. The train driver is required to apply the emergency brake if:
 - station staff give a STOP handsignal, or
 - a dangerous situation is observed at the PTI.
 7. If the train is stopped for any reason during dispatch the PTI safety check must be repeated before moving the train.

Unscheduled stop dispatch

5.3.12

If a passenger train makes an unscheduled stop at a platform and the doors are not opened, or the train is stopped in a position where it may be partially on the platform the train driver is required to:

1. Complete a PTI safety check using the crew workstation CCTV display screen, and check that:
 - nothing is protruding from the train.
 - customers are standing behind the yellow line.
 - station staff, if present, are not giving a STOP handsignal.
2. When it is safe to do so, move the train.
3. If concerned about the safety of customers on the platform when the train moves, train drivers may choose to:
 - make an external PA announcement warning passengers to stand behind the yellow line, or
 - tap the crew workstation CCTV display screen to keep it active following departure.
4. Apply the emergency brake if:
 - station staff give a STOP handsignal, or

- a dangerous situation is observed at the PTI, or
 - a passenger intercom (PI) call is received within 10 seconds of departure.
5. If the train is stopped for any reason during dispatch, repeat the PTI safety check before moving the train.

6 Risk assessment of the proposed operating method

6.1 Introduction

6.1.1 The change from the current to the new operating method has the potential to introduce a change to the risk profile of NSW TrainLink unless appropriate control measures are identified.

6.1.2 System Safety Standard for New or Altered Assets. T MU MD 20001 ST. Version 1. Issued date: 20 December 2016, requires that whenever new assets are introduced, or existing assets are modified, upgraded or removed TfNSW needs to ensure the following:

- Operational safety risks are identified, assessed and managed with new or altered system or assets, when operating as an integrated part of the Transport Network.
- Sufficient evidence is provided to demonstrate a safety argument that the new or altered system or asset has achieved the following:
 - a) Designed to best ensure safety SFAIRP during its operation.
 - b) Manufactured or constructed and transitioned into the Transport Network in a manner which best ensures safety SFAIRP.
- Reduced all foreseeable safety risks SFAIRP.

6.1.3 A safety impact assessment of the change and the risks identified within that assessment is required to drive the detail and volume of safety assurance activities throughout the engineering V-life cycle. The application of the standard includes consideration of the asset or system in its operating context and not just as a physical system.

6.1.4 The standard requires the systematic identification of all reasonably foreseeable hazards for the entire system under consideration, including all its functions and interfaces across its full intended life.

6.1.5 It requires a suitable and sufficient hazard management system that includes a hazard log with an assessment of the safety risk for each identified hazard against the appropriate risk criteria.

6.1.6 The safety management system of NSW TrainLink requires that a significant change to the operation, such as the introduction of the new train, is risk assessed and that appropriate control measures are implemented. Details

of the procedure for risk management are provided in the SMS document 'Risk Management', SMS-07-SP-5213. Version 2. 15/04/2019.

6.2 Risk assessment of the proposed change to the new operating model

6.2.1 In accordance with the ASA standards RailConnect, as the AEO, has undertaken systematic hazard identification and assessment to eliminate or reduce risks SFAIRP. This has included specific risk assessment on changes arising from the new operating model, in particular the driver managing the platform to train interface from the crew cab.

6.2.2 These risk assessment activities are discussed in section 11.2.

6.2.3 The NIF project team has produced a draft document, 'Scope of Work: Risk Assessment - Proposed Change to Network Standard to enable Train Dispatch using CCTV'. Draft V0.4, dated 9th September 2019.

6.2.4 This document describes the objectives of the platform based risk assessment, the scope of the risk assessment, the risk assessment processes and the stages that must be followed to reach the level of assurance that the new operating model is safe, so far as is reasonably practicable.

6.2.5 The risk assessment will include the following:

1. Desktop review:
 - a) Review of UK data on train dispatch methods and the risk levels achieved.
 - b) Goal Structured Notation (GSN).
 - c) Review of factors for consideration as listed in NS-0918 and RIS-3703-TOM, and incorporation into risk assessment pro-forma.
 - d) Confirm areas of focus for test and verification program.
 - e) Review of every station and every platform from which NIF operates to determine location-specific factors.
 - f) Identification of operational procedures and competence assurance document for review/amendment.
 - g) Development of requirements for operational testing to verify effectiveness of proposed controls.
2. A test & verification program which includes:
 - a) Witnessing of relevant tests conducted by RailConnect.
 - b) Review of test reports to confirm assumptions are achieved.

- c) Test and verify the performance of the train crew in implementing the proposed dispatch method to ensure safety and practicability.
 - d) Specific stations/platforms with potentially unique or unusual characteristics.
 - e) Confirmation that the proposed dispatch method is safe SFAIRP.
3. Post-implementation activities to confirm system as operated in service is safe SFAIRP.

6.2.6 The deliverables from the risk assessment will include:

1. Interim report on the 'Desk-Top' review and follow up reports summarising outcomes from RailConnect Stage 2 activities.
2. At the conclusion of the test and verification program production of an operational test report providing required evidence that the proposed dispatch method is safe to SFAIRP.
3. A post-implementation review report six months after the introduction of NIF into revenue service to confirm validity of the stage 2 report.

6.2.7 The risk assessment is planned to be carried out to the following timescales:

1. The desktop review in Q4 2019.
2. Test and verification programme during Q1 to Q3 2020.
3. Post implementation monitoring during Q4 2020 to Q1 2021.

6.3 Train dispatch risk assessment

6.3.1 Location specific risk assessments will be carried out for every platform over which the trains will operate.

6.3.2 The output from these risk assessments may result in changes to station design and train protection requirements.

6.3.3 The methodology for these risk assessments is currently being developed in conjunction with Sydney Trains and other stakeholders.

7 Train design for station operations and train dispatch

7.1 Introduction

7.1.1 The train baseline design has been developed primarily from the NIF Project Deed, Schedule G - Scope and Performance Requirements, Appendix 02 - Rolling Stock Specification. It has evolved throughout the design process following stakeholder review work and workshops with drivers, guards, maintenance staff, members of the public and other stakeholders both internally and externally.

7.1.2 The NIF train is developed for three modes of operation, Driver Only Operation (DOO), Driver and Guard Operation and Driver and Customer Service Attendant Operation.

7.1.3 To bring the NIF train design in line with a driver and customer service guard mode of operation, an update to the train design would be required.

7.1.4 The descriptions provided below describe the method of operation in accordance with the current baseline design for DOO.

7.2 Cab Security

7.2.1 Cab security is controlled by a Smart Card system with unique cards provided for every crew member. This system logs all access to the cabs and each card can be individually revoked via a 4G link to the train.

7.3 The crew cab/compartament

7.3.1 The design of the crew cab/compartament was based on the existing Outer Suburban Car (OsCar), with the development of a centralised workstation and the addition of several technology systems. An indicative image of the crew compartment is provided in Figure 1.



Figure 1: Indicative image of the crew compartment

7.4 General description of the train doors

- 7.4.1 The passenger bodyside doors on the NIF train are bi-parting plug type doors that are flush with the car body in the closed position and stand away from the car body when open.
- 7.4.2 The passenger doors provide a passageway at the fully open position of 1800mm.

7.5 Safety measures at the door entrance

- 7.5.1 The doors, when not closed, will switch on exit lights, located approximately 200mm above floor level on each side of the door to provide illumination of the platform train interface at the doorway.
- 7.5.2 The gap between the train and the station platform is reduced on the NIF compared to the V-sets as the NIF train has a wider profile, thereby reducing the stepping distances between the train and the station platforms.
- 7.5.3 The doorway is provided with internal handrails to assist passengers with boarding and alighting. A yellow treadplate is provided along the external edge of the floor.

7.6 Safety measures for the arrival of a train at a station

- 7.6.1 Upon arrival at a station platform, the train will pass over track mounted balises, programmed with platform information. This information includes the platform side, length and position of the train. This is used when the train comes to a stop to calculate which passenger bodyside doors are completely alongside a safe point of train egress/access for passengers.

- 7.6.2 The driver is required to stop at a 'Car Marker', marked on the platform edge or a post mounted at the end of the platform. This positioning allows the driver access to the platform for station duties, where required. This is a change from current operations where the train is longer than the platform, in which train case the train is stopped so that the guard is adjacent to the platform and the driver is forward of the platform.
- 7.6.3 The driver's workstation is provided with two CCTV screens, one located to the left and one to the right of the workstation. The CCTV screen on the platform side of the train, the side enabled by the Automatic Selective Door Operation (ASDO), will switch from a blank screen to active images showing the Platform Train Interface (PTI). This happens when the train is stationary and the ASDO enables the train doors. The other CCTV screen will remain blank unless interacted with by the driver. Controls are provided to adjust the brightness and contrast of the CCTV screens.
- 7.6.4 The doors which are alongside and off the platform edge will be indicated to the crew on the CCTV screen and the Train Management System (TMS) screen. The doors that are enabled and closed are displayed in green and doors that are inhibited are displayed in light blue.
- 7.6.5 The driver's workstation is provided with left-hand side and right-hand side door controls, which enable the driver to 'Open', 'Release' and 'Close' the associated passenger bodyside doors. The configuration of the door control pushbuttons and signal bell are derived through user feedback sessions.
- 7.6.6 If the driver selects 'Door Open', the enabled doors will open and the colour display of the icons will change from green to red.
- 7.6.7 If the driver selects 'Door Release', the enabled doors will change the display of the icons from green to grey and once a passenger activates the local door open button the adjacent door will open and the indication colour will change to red.
- 7.6.8 Upon opening of any bodyside door, including the crew bodyside doors, the door 'Traction Interlock' circuit will be broken. This is indicated to the driver by a white light located on the left-hand side of the driver's console.
- 7.6.9 The driver is provided throughout the dwell time at the station with the current time and departure time displayed on both the TMS and CCTV screens. In addition, the CCTV screens include a dwell timer that begins a count-up sequence upon opening of passenger bodyside doors, indicating the time the train has been stopped at the station.

7.7 Safety measures during door closure

7.7.1 When the driver operates the door close pushbutton a 3.5s delay timer is initiated and during this time a PA announcement of “Doors closing, please stand clear,” is made.

7.7.2 After the 3.5s delay, the door buzzer commences, and a light will flash for 2s after which the doors open will then start to close. The buzzer and lights continue until the door is fully closed.

7.7.3 The total time from pushbutton activation until doors closed is approximately 10 seconds.

7.8 Door obstruction protection

7.8.1 The safety system of each door monitors for obstructions using three protection systems:

1. Traction Interlock - prevents the driver from moving the train if an object of 10mm or greater is detected.
2. Sensitive Edge - One of the door leaves of each doorway is provided with a sensitive edge strip which, when compressed, will detect an obstruction and cause the door to re-open.
3. Overcurrent protection - The door motors detect overcurrent upon closing on an obstruction. This will cause the doors to re-open.

7.8.2 For items 2 and 3 above:

- On the 1st obstruction detection, the door will fully re-open, pause for 1 second then attempt to reclose.
- For the 2nd obstruction detection, the door will re-open 200mm, pause for 1 second and then attempt to reclose.
- For the 3rd obstruction detection, the door will re-open 200mm, pause for 1 second and then attempt to reclose.
- For the 4th obstruction detection, the door will fully re-open and remain in the open position until commanded to close.
- The edging of the door is designed to facilitate removal of an obstacle caught within the door.

7.8.3 In comparing the NIF with existing fleets operated by NSW TrainLink:

- All of the existing fleets have door traction interlock protection.
- The V-sets do not have sensitive edge protection.
- The OsCar trains have sensitive edge protection.
- The V-sets and OsCar trains, to varying levels of accuracy, have overcurrent obstacle protection.

7.9 Safety measures and operation of the crew door

7.9.1 From the 'Closed' and 'Open' position, the crew door can be opened or closed by either a pushbutton located:

- On the crew workstation.
- Alongside the doorway.

7.9.2 The crew doors cannot be remotely closed from another cab.

7.9.3 The cab doors begin to close immediately the close command is given and it takes approximately 5 seconds to fully close and lock. It is provided with obstruction detection and is included within the 'Traction Interlock' circuit.

7.9.4 The crew door is also fitted with an emergency close function so that the crew can close the door in the event that someone is attempting to gain unauthorised access through the open doorway – in this event there is no obstacle detection and the door control system will continue to power the door closed until the closed position is reached or the open pushbutton is pressed.

7.10 Indication of the status of the external doors

7.10.1 When all doors are closed, including the crew bodyside doors, an audible alert (3 short beeps) is sounded in the cab controlling the doors and the white 'Traction Interlock' indicator extinguishes.

7.10.2 The status is also indicated to the crew on the TMS and CCTV screens, depicting each door with a green tile for closed and locked.

7.11 Safety systems and control measures for the train dispatch safety check

7.11.1 In all modes of operation, to monitor the PTI the driver is provided with a view along the complete length of the train, using images displayed on a CCTV monitor at the driver workstation. These are obtained from CCTV cameras located on the bodyside of each vehicle.

7.11.2 During the design development process for the location of the external cameras, a detailed evaluation was carried out of the 'Waratah' train design to identify areas where it needed improvement.

7.11.3 The design development process identified the need to optimise image quality and the view from the camera by improving camera lens selection and camera placement.

- 7.11.4 This review also included an assessment of the environmental effects experienced by existing fleets. This resulted in improved design of the camera cover to resist the impacts of glare, weather and dust effects.
- 7.11.5 The design of the CCTV interface the crew use to carry out the safety check during train dispatch is compliant with requirements identified within the RSSB Rail Industry Standard, RIS-2703-RST, Issue 02, 2014.
- 7.11.6 The view along the train that is displayed to the driver mimics the view that the driver would have when looking from the cab down back along the length of the train. This view can be switched by the driver to show the reverse view if the image is poor due to sun, glare or other external impacts.
- 7.11.7 Each CCTV monitor displays a view along each car, for example, a 10-car train will provide 10 images. The CCTV is provided with full colour, high fidelity live images that incorporate a High Dynamic Range and which will adjust individual areas of the image brightness to account for bright and dark regions of station platforms.
- 7.11.8 The camera positions have been chosen to maximise how far out from the car body the camera can be positioned without infringing on the outline gauge. In addition, this position mimics the view of a person standing in the doorway of the crew cab.
- 7.11.9 An identified issue is a blind spot of 670mm at the far door, which limits the ability of the train driver to observe a person who is in this area before operating the door close control. Gauge limitations may not enable this issue to be resolved. If a person is in this area when the doors are closed a warning is sounded of door closure. The blind spot does not exist when the doors are closed and when the driver carries out the safety check before starting the train.
- 7.11.10 Each camera views overlap with the view from the following camera so there are no gaps and it provides a view out from the car side which is in excess of 1.5 metres along the length of the train.
- 7.11.11 While conducting the train dispatch safety check, the driver can touch any image being displayed and the size of the image will be enlarged to allow for a more detailed examination of the image.

Note:

The opportunity to enlarge an image also applies to the customer service guard, when monitoring the CCTV images when the train is stationary and when the train moves along the platform.

7.11.12 The CCTV display in the driving cab switches off automatically when the 'zero speed relay' is deactivated. This occurs at a train speed of approximately 3kph.

Note:

In operation with a customer service guard, both CCTV monitors are always active:

- Away from the stations, the CCTV monitors display passenger saloon images to allow the customer service guard to monitor behaviour within the cars of the train.
- As the train enters the station, when the train is stationary and as the train moves along the platform, the platform side monitor displays the external images of the length of the train and the off-side monitor will continue to display the internal saloon images.
- After the train has left the station platform, the monitor displaying the external images will revert to the internal saloon images.

7.11.13 It is recommended that the CCTV monitor displaying the internal saloon images for the customer services guard should switch off when the platform side images are being displayed as these could be a distraction and direct the attention of the customer services guard away from the Platform Train Interface. (See Section 15. Recommendation 2)

7.11.14 The external CCTV images displayed to the customer services guard differ to that displayed to the driver in that the images displayed to the guard are the view that the guard would see if the guard were looking from the rear of the train towards the front of the train.

7.11.15 **Systems to stop the train in an emergency during dispatch from a station**

7.11.16 In an emergency:

- The driver can stop the train using the emergency position of the power/brake controller.
- The customer service guard can stop the train using the:
 - emergency position of the power/brake controller.
 - signal bell located between the door control buttons to send a stop signal to the train driver.
 - the emergency brake cock handle on the rear wall of the crew compartment.

- 7.11.17 Two-way voice communication is available between the driver and the customer service guard using the cab to cab intercom handsets, located adjacent to each doorway.
- 7.11.18 During the first 10 seconds after the train has started to move away from a platform, if a passenger activated a 'Passenger Intercom', the driver will immediately hear a calling tone and spoken communication from the passenger over the cab loudspeaker. The CCTV monitor in the driving cab will also automatically activate, displaying the internal images from the passenger saloons, with an enlarged image of where the intercom was activated.
- 7.11.19 Metcalfe Rail Safety has concerns with switching the CCTV monitor ON in the driving cab after the train has started to move. Details of this concern are described in Section 13.2.42. *(See Section 15. Recommendation 1c. and 3)*
- 7.12 Managing Signal Passed at Danger (SPAD) risk at departure from a station**
- 7.12.1 The CCTV system display provides a Driver Reminder Appliance (DRA) button which may be activated by the driver when the train comes to a stand.
- 7.12.2 The button can only be activated at stop and when activated will change colour from grey to orange.
- 7.12.3 The status of the button cannot be revoked manually by the driver and will only disable after the train has left the station platform.
- 7.12.4 When the train starts moving and the CCTV screen switches off, the DRA icon remains visible, then fades at 10kph and at 20kph disappears.
- 7.12.5 The DRA, as currently specified, does not interface with any other train system. This is different to the functionality of the DRA in the UK, which, when it is operated, prevents the driver from taking power until the DRA has been reset to the normal position. This functionality has been very successful in reducing the number of SPAD incidents in the UK, as it aids memory retention and assists in controlling distraction risk.
- 7.12.6 With the new operating model the driver will need to be focussed on carrying out the safety checks, by viewing the CCTV monitors. In doing this, particularly if something happens on the station platform that distracts, this may cause the driver to forget to check the signal aspect before starting the train. For this reason, even though there may be an ATP system to stop the train, it is important that the functionality of the DRA is effective in reducing the likelihood of a 'Start Against Signal' (SAS) and a 'Start On Yellow' SPAD.

7.12.7 It is recommended that a review is carried out of the functionality of the DRA and if possible bring this in line with how this system functions in the UK, by requiring it to prevent the driver from moving the train until the DRA has been reset to the normal condition. How to use it when stopped at a station needs to be included in the new operating model and the use of the DRA, if fitted, should be made mandatory. (See Section 15. Recommendation 4)

7.13 Testing and maintenance of the CCTV system

7.13.1 The external cameras are to be routinely inspected for image clarity and alignment. The train preparation procedures include a 'Facilitated Serviceability Test', where the CCTV images are overlaid with a template to assess alignment to ensure that the cameras remain serviceable for view of the PTI when the train is in passenger service.

7.13.2 Prior to the trains being approved for passenger service, a rigorous testing program will be conducted to ensure that the CCTV cameras used for train dispatch operate in all conditions likely to be experienced by the train in service. As part of this process, target detection exercises have been carried out using test objects and mocked scenarios in line with RSSB guidance, including 40+ train crew as participants.

7.14 Incident Investigation

7.14.1 For incident investigation purposes, all images from all CCTV cameras on the train are stored in full for 31 days minimum.

7.15 Degraded Operations

A. ASDO Failure

7.15.1 If the ASDO, does not respond and activate the CCTV monitor due to a location specific or train failure the driver will be required to lift the protective cover over the ASDO Bypass switch and activate the override. Upon activation, both the CCTV monitors will switch on and provide a view down both sides of the train.

7.15.2 The driver must then interact with the CCTV to select platform aligned doors to be enabled for opening or releasing.

B. CCTV Failure

7.15.3 If one of the CCTV screens fails, the driver can switch to the other screen.

7.15.4 If one CCTV camera fails, this is indicated to the driver by a blank image and the driver can then switch to view cameras looking in the opposite direction down the train.

C. Door Failure

7.15.5

In the event of a door failure, this is indicated through the TMS.

7.15.6

Individual external doors can be isolated and locked out of use by a key operated device local to the door.

8 Integration of human factors within the design of the NIF train

8.1 Introduction

8.1.1 The Asset Standards Authority standard, 'Human Factors Integration – Rolling Stock', T HR HF 00001 ST, Version 2.0. details the minimum requirements for demonstrating Human Factors Integration (HFI) in the procurement of new rolling stock or alterations made to existing rolling stock.

8.1.2 It requires:

- The organisation undertaking work for TfNSW to provide a human factors integration plan (HFIP) covering driving and crew cabs in accordance with AS/RISSB 7533:2013 Railway Rolling Stock - Driving Cabs.
- The identification and consideration of end users and human interactions, including different interfaces and human-system interactions, and creating a human factors integration plan (HFIP).

8.1.3 It provides examples of specific areas for consultation and review. One of these examples is the use of closed-circuit television (CCTV) systems for monitoring the interface between the platform and the train.

8.1.4 It requires organisations undertaking work for TfNSW to incorporate reviews into the design and engineering process by a range of end users including drivers, crew, and other operational and maintenance personnel and organisational stakeholder representatives.

8.1.5 Section 6.3 of the standard describes requirements for Driver Only Operation. This requires the driver to have ease of visibility of the platform train interface to ensure safety of passengers boarding and alighting the train, and to be able to safely operate the relevant doors from all driving positions.

8.1.6 It requires the use of technology to assist the driver in completing a thorough safety check of the door status and platform train interface area to confirm the area is free of any potential hazards. The technology should consider the appropriate coverage area and at a minimum provide the driver with visibility of the full length of the body side doors.

8.2 The NIF Rollingstock Human Factors Integration Plan

- 8.2.1 The NIF Rollingstock Human Factors Integration Plan (HFIP) (DAR NO: HRC-VEH-PL-0001-5, Doc NO. REDC204653) describes the Human Factors Integration (HFI) strategy for the design and build of the train.
- 8.2.2 For this review the NIF project provided the Hyundai Rotem 'Human Factors Assurance Report – DDR Unit Level', Document Number REDU21802, dated 06/09/2019, Rev.01 was reviewed.
- 8.2.3 The purpose of this document is to provide a summary of Human Factors Integration (HFI) for the NIF rollingstock asset, and to demonstrate human factors integration and assurance for the NIF train at the detailed design stage.
- 8.2.4 The overall aim of this report is to demonstrate that the unit level human factors integration meets the needs of the intended users and is consequently as safe and effective as reasonably practicable.
- 8.2.5 RailConnect has undertaken a user centred design approach in line with ISO 9241-210:2010, to ensure usability across the vehicle for key stakeholders as identified in the HFIP, including train crew, passengers, and maintenance staff. An iterative and detailed process has been conducted for the rollingstock design over 3 design phases:
1. Plan the design process.
 2. Understand context of use.
 3. Specify user requirement.
- 8.2.6 NIF vehicle mock-ups have been produced and workshops held involving stakeholder and end-user consultations. The mock-up review included demonstrations, scenario-based user interaction with the mock-up, usability testing, and semi-structured and structured questionnaires and interviews. They allowed end users to test the NIF design in the context of use, to help ensure the design is functional and fit for purpose.
- 8.2.7 Human Factors issues raised are captured in the NIF HF Issues Register (HFIR) throughout the project lifecycle and those that pose a risk to safety have been transferred to the NIF train Hazard Log.
- 8.2.8 Human Factors experts have been embedded in the design team to support human factors integration into the design of the train. There is ongoing human factors analysis and input to the train design as it progresses to ensure the crew cab and crew interfaces are designed to minimise the

opportunity and/or consequence of human error. Examples of these applicable to the proposed new operating model and station safety are:

1. The design and placement of controls to be used by the train driver and the customer service guard in the crew compartment.
2. The operation of the ASDO system for controlling the risk of door opening at stations with short platforms.
3. The optimisation of the door controls.
4. The functionality and design of the CCTV system used to carry out safety checks of the PTI interface.
5. Optimising the passenger information systems to support the train crew models and provide safety announcements to passengers.

8.2.9 It is a requirement that the design does not introduce workload and distraction that impairs the primary safety task and that workload is appropriately considered to ensure that a user can safely operate the design.

8.2.10 The NIF workload assessment strategy aims to provide progressive assurance that the NIF train design is suitable for task performance, and that the systems and interfaces on the NIF train provide a design appropriate to the skills and abilities of the train driver and the customer service guard.

8.2.11 The workload strategy assessment has been developed against a literature review of industry best practice, including the application of guiding principle ISO 10075:3, and the UK Rail Safety Standards Board (RSSB) Mental Workload Assessment.

8.2.12 A series of static evaluations of the NIF external CCTV cameras have been conducted within the progressive assurance argument for the NIF CCTV system. These have been used to support design decisions regarding the CCTV camera location, assessment of image quality and selection of camera hardware.

8.2.13 The CCTV display size was selected considering target legibility requirements and information needs. Design review, consultation and simulation processes were undertaken to assess and improve the cab design to optimise visibility of the CCTV images from the train crew workstation.

8.2.14 The external sightlines from the driving position have been optimised considering other constraints for the cab design. The detailed design has been demonstrated through CAD modelling and SME reviews to be a

significant improvement relative to the existing OsCar fleets. The final verification of external sightlines will be done at vehicle level type testing.

8.2.15 Scenario based evaluation workshops have been held with end users to contribute to the design and assurance of the crew compartment, focussing on the crew console, layout and usability of equipment and systems, reach and internal sightlines.

8.2.16 Feedback from users relating to the systems required for station operations and train dispatch include:

1. Reach to all equipment, including the CCTV screens, ASDO override, door controls and master controller was acceptable.
2. Internal sightlines to monitor the CCTV and TMS systems was appropriate.
3. Concerns with the two CCTV monitors - interrupting external sightlines and creating a perception of blinkers.
4. Concerns with screen brightness and glare at night or driving in tunnels
5. Audible alerts were appropriate.

8.2.17 A workshop was held on 18th October 2018 to review the potential for glare and reflection which could affect the ability of traincrew to conduct primary tasks. This review did not identify any obvious sources of glare or reflections that may impair the ability of the traincrew to conduct their primary tasks. Glare and reflection of the CCTV screens will be tested and verified within the CCTV On-Train Type Test.

8.2.18 Guard and driver SME's have raised concerns that the CCTV view is restricted to the passenger body side doors and this may cause them to miss events outside of the camera sightlines, such as passengers running for the door. There is also a concern about the loss of the audible cues of an incident.

8.2.19 Driver SMEs are concerned that their focus will be on external sightlines during the departure from a station and the driver will miss an event at the platform train interface, such as a catch and drag incident.

8.2.20 The design of crew training is an important element of the overall systems integration from a HF perspective. Initial task analyses and risk-based training needs analysis have been used to set learning objectives and course outlines.

- 8.2.21 The detailed content of the training packages has been designed using an evidence-based 'Instructional Systems Design' process. Throughout the process iterative reviews were conducted with SMEs from representative user groups, as well as inputs from several training focussed workshops.
- 8.2.22 Driver course outlines and training packs have been issued for review by the training working group including a detailed sample Driver course module.

9 Competence management of the train driver and customer service guard

9.1 Introduction

9.1.1 The introduction of the NIF train will impact on several roles within NSW TrainLink and Sydney Trains. This change has been identified using a Change Impact Assessment.

9.1.2 The roles impacted by the change to the new operating method are the train driver, the train guard/customer service guard and station staff who are involved in the dispatch of trains from railway stations. The task of dispatching a train from a railway station is 'safety critical' and this requires their competence to be managed through the application of a competence management system.

9.1.3 These roles currently have a Risk Based Training Needs Analysis (RBTNA) which identifies the tasks and training priority for that task.

9.2 Proposed changes for the operation of the NIF fleet at stations

9.2.1 The NIF project is in the process of undertaking a change driven update to the affected RBTNA documents to facilitate the required training for each role.

9.2.2 In addition, the project has mapped the applicable national training units for a driver, guard and station staff. This has been combined with technical and operational procedures to inform the learning outcomes for the identified roles. These are contained in and tracked using a 'training validation control map' which is being developed through the life span of the project.

9.2.3 Training modules are currently being created by the train designer, in alignment with a Risk Based Training Needs Analysis (RBTNA). These modules will feed into the material used to achieve the learning outcomes for the conversion training.

9.2.4 Training will be carried out using a variety of methods and will be delivered regionally in the relevant depots. The use of facilitator lead, computer based and simulated sessions will equip the learner with the skills and knowledge to achieve competence in NIF train operations.

9.2.5 Crew assessment will take place on computers, training simulators and on operational trains. The content of the assessments will be derived from the

learning outcomes and will be modular. Participants will need to be competent in the class and in simulator-based assessments before progressing to the on-train component.

- 9.2.6 Trainers and assessors will hold qualifications on the train, the new training modules as well as a formal adult training and assessment qualification (TAE40116). This will ensure compliance with regulatory requirements of the Australian Skills Quality Authority (ASQA).
- 9.2.7 Once qualified to undertake practical training the learner will be accompanied by a qualified 'coach' from NSW TrainLink who will ensure that the required behaviour change is embedded in the performance of the staff. This process is currently referred to as 'Hypercare'. This support model is currently under development but will link to the learning outcomes of the conversion training. This approach is intended to give the NIF traincrew an opportunity to engage with SMEs and any identified issues to be coached on the spot. Coaches will have completed training against the unit of competency TAEDEL404 – Mentor in the workplace.
- 9.2.8 NSW TrainLink currently uses a competence assurance program which utilises assessors to assess traincrew on an annual basis. The NIF project will review the documents used for these assessments to ensure they align with the learning outcomes of NIF. Further work is underway to migrate key aspects of these assessments to the simulated environment in order to allow the assessor to focus on behaviour and knowledge beyond what can be observed in an on-train assessment. The simulators provide an excellent opportunity to improve the quality and effectiveness of the ongoing competence assurance of drivers and guards.

10 Interface management

10.1 Introduction

10.1.1 It is essential, for a project involving the development and introduction into service of a new train, such as the NIF, that internal and external interfaces are identified and managed.

10.1.2 The project has produced documents that require this and describe how it is to be carried out:

1. 'NIF internal change communications & engagement plan – preparation phase'. Dated 25 May 2018.
2. 'NIF internal change communications & engagement plan – transition phase'. Dated 12 September 2019.
3. NIF Sydney Trains Change Impact Engagement Plan (Draft). Dated August 2019.

10.1.3 The following summarises how the project is carrying out this important task.

10.2 NSW TrainLink Asset Management/Engineering Interface

10.2.1 NSW TrainLink have had a technical lead from the Engineering/Asset Management team allocated for each of the technical packages of the project, which includes all train systems, the simulators and the maintenance facility. The aim of this was to keep continuity of technical knowledge for the systems and a detailed understanding of the history of design development.

10.2.2 This lead has a list of NSW TrainLink internal stakeholders to involve for any engagement activities, as well as to distribute any information or formal technical submissions to those that may be impacted. Using this approach has ensured that any information that has come into NSW TrainLink has been properly disseminated through the rest of the project and wider business if required.

10.2.3 Interfaces, working groups and relevant stakeholders across TfNSW, TrainLink and RCN have been defined and documented.

10.3 Internal Stakeholder Identification, Assessment and Engagement

10.3.1 The NIF change management team have conducted a stakeholder identification and analysis process across internal stakeholders to inform the development of relevant communication and stakeholder engagement plans and activities.

10.3.2 Key stakeholder groups have been identified, assessed and factored into the development of communication and stakeholder engagement activities across a range of business as usual and project specific channels.

11 Project safety assurance

11.1 Introduction

- 11.1.1 To meet the Australian Rail Safety National Law the NSW Trains Safety Management System (SMS) describes how changes that may affect the safety of railway operations are identified and managed, so far as is reasonably practicable.
- 11.1.2 NSW TrainLink will rely on the asset assurance processes of TfNSW for the assurance of the safety of the new trains as well as implementing their own management processes to assure the safety of its operations.
- 11.1.3 For the safety of the new trains, TfNSW Standards and NSW TrainLink SMS are required to be implemented to demonstrate and communicate the management of safety risks SFAIRP for the NIF. The method applied uses an 'Asset Life Cycle' approach.
- 11.1.4 The TfNSW Standards and the NSW TrainLink SMS requires the assessment of safety for all new or altered assets. These assessments have been based on the current risk experienced by NSW TrainLink as well as undertaking safety risk assessments to further develop the understanding of the safety risk for the proposed operation.
- 11.1.5 Safety assurance for the assets is provided to TfNSW by the respective Authorised Engineering Organisation (AEO) to demonstrate management of safety risks SFAIRP. This assurance of the management of safety is reported through Safety Assurance Reports (SARs) at designated 'Gates', where the status of the assurance is evaluated, and the project is only allowed to proceed if this is deemed acceptable.
- 11.1.6 TfNSW has appointed an Independent Safety Advisor (ISA) to provide the NIF project with independent assurance that the overall safety argument provided for the trains in support of the introduction of the NIF into operation is sufficiently robust. In doing this, the ISA provides an independent view on whether the project has adequately demonstrated that risks have been managed SFAIRP.
- 11.1.7 At each 'Gate', the assurance that is prepared for the trains, including that provided by the ISA, is subject to an approval process following the TfNSW Configuration Management Plan requirements, where a panel of subject matter experts assess the adequacy of the safety assurance provided and

determine if the project has progressed satisfactorily and in accordance with TfNSW requirements.

11.1.8 NSW TrainLink has also appointed an Independent Safety Advisor to undertake high level reviews at key stages in the project to formally report back to the Chief Executive with assurance or otherwise, that safety issues are being identified, assessed and treated such that NSW TrainLink can have confidence that it can meet its obligations to ensure the safety of its future services when the NIF trains are commissioned into service, so far as is reasonably practicable.

11.1.9 The Rail Safety Regulator has been consulted on the project and safety assurance process, including sharing with them the Safety Assurance Reports as part of the progressive assurance process.

11.2 Safe Train

11.2.1 The delivery of the NIF is in accordance with the TfNSW Standards (published by the ASA). These standards describe the physical and functional requirements for the trains in engineering standards, as well as the engineering and assurance processes that must be followed when delivering the trains as TfNSW Assets.

11.2.2 With regard to safety requirements associated with station operations and the dispatch of the train from the station, the engineering standards describe the configuration of the trains including train structure, door operations including warnings and obstacle detection and other safety systems required during the dispatch process that must be delivered by the trains. The engineering designs developed by the train supplier, Hyundai Rotem Corporation (HRC), have been reviewed by the technical team and the review has confirmed that the design is compliant to the applicable engineering standards.

11.2.3 The assurance standards, including systems engineering, human factors, and safety assurance, describe the processes that the technical team is required to follow to ensure that the trains are safe and fit for purpose.

11.2.4 At an early stage in the development of the train design, in order to meet these standards, the technical team carried out several safety assessments to develop an understanding of the risk for train operations and from this assessment mitigations were included in the train specification. Examples of these include:

1. Maximising the body width of the train to reduce stepping distances at the doors.

2. Automatic Selective Door Operation (ASDO).
3. Improvements to the door safety systems.
4. Train mounted CCTV cameras and in-cab monitors.
5. Improved train management system displays on the status of train equipment.
6. Improved train announcements to raise passenger awareness of safety hazards on stations.

- 11.2.5 The development of the systems to mitigate risk at 'Platform to Train Interface' (PTI) has been informed by the UK Rail Industry Standard 'Driver Controlled Operation (DCO) On-Train Camera/Monitors (OTCM)', RIS-2703-RST, which was used to develop the Human Factors input into the CCTV design.
- 11.2.6 A series of target detection studies have been carried out to optimise the design of the CCTV to be used by the train driver when carrying out the train safety check after the train doors are closed and the monitoring of the platform train interface by the customer service guard when the train departs the station.
- 11.2.7 Following the engagement of RailConnect (the supplier) further risk assessments were carried out to understand the safety and human factors risk issues and these were logged and mitigations developed to either eliminate or reduce the risk SFAIRP.
- 11.2.8 Mitigations included engineering controls where it was practicable for these to eliminate or reduce risk. Examples include the provision of dual obstacle detection of an obstruction to the train doors - current detection and sensitive edge detection in addition to the standard door interlock protection.
- 11.2.9 Hazard and Operability studies, have been carried out, including operational and safety hazard assessments and quantitative and qualitative risk assessments. These include input from NSW TrainLink and Sydney Trains personnel and the results from these are shared and agreed as part of the safety assurance process.
- 11.2.10 The human factors processes include the development of a task analysis for the crew, the use of both low fidelity and high fidelity mock ups to design the cab layout and workshops with crew representatives to develop cab layouts and controls.
- 11.2.11 The designs were then established or updated to address the safety and human factors issues that were identified through these workshops and

assurance activities, with the results included in Safety Assurance Reports to show that safety has been managed suitably and sufficiently.

11.2.12 When the operating model is finalised the technical team will review the train design to check it is compatible with the model and make appropriate changes to the design and ensure that safety is still managed SFAIRP.

11.3 Safe Operation

11.3.1 To comply with the NSW TrainLink SMS requirements the NSW TrainLink project team has developed a detailed safety argument based on the Goal Structured Notation (GSN) framework. This analysis is documented within a safety assurance report, a draft version (V6), being provided for review. This document covers all aspects of the operation of the NIF.

11.3.2 Within the document there is a section on safety risk management for normal operations, degraded situations and emergencies.

11.3.3 It includes a detailed analysis of risks arising from station operations and train dispatch and the required competence for the staff involved.

11.3.4 A wide range of reviews have been undertaken to inform the development of the train design and new method of dispatch. This includes:

1. PTI incident data (NSW TrainLink and Sydney Trains).
2. CCTV footage from 'Waratah' trains to analyse incidents and accidents that have occurred, the effect of curved platforms, passenger behaviours, environmental conditions etc.
3. Research and guidance by the Rail Safety Standards Board (RSSB) on train dispatch and PTI risk.
4. UK Rail Industry Standards for on-train camera/monitoring systems.
5. Railway Safety Principles on 'Driver Controlled Operation' produced by the UK safety regulator, 'The Office of Rail and Road' (ORR).
6. Lessons learnt from investigations into PTI incidents involving trains that are operated in 'Driver Only/Controlled Operation' by the UK Rail Accident Investigation Branch (RAIB).

11.3.5 Using the findings from the above work the operational requirements to manage risk at the platform train interface have been fed into the train design process with the objective of providing a robust safety specification for the NIF train.

- 11.3.6 A desk top comparison of the UK RSSB risk model and the NSW TrainLink risk model has been carried out by the NIF project team. This was to determine whether there is any evidence of a material difference in the risk profile of the UK and Australian rail industry in relation to PTI and Train Dispatch risk as a proportion of total safety risk. This study concluded there was little or no evidence of a material difference.
- 11.3.7 A study into incidents occurring at the platform train interface (PTI) has been carried out by the NIF Project Team to develop an understanding of the current risk at the PTI and potential impacts arising from the introduction of the NIF. The study used data extracted from the NSW TrainLink incident database and uses historical records dating from using PTI incident data (from NSW TrainLink and Sydney Trains incidents) for the period 2013 to July 2018. It focused on two specific incident types:
1. Doors closing while a customer was still in the doorway.
 2. Customers who experienced a loss of balance while alighting or boarding the train.
- 11.3.8 The study concluded that the occurrence of 'Slips, Trips and Falls' (STF) is strongly correlated to train set type. Whilst Oscar trains carry out twice the number of regular intercity services as V-Set trains on the Intercity network, STF at PTI incidents do not follow this trend. The study showed that 74% incidents were correlated with V-Set trains while 26% were correlated with OSCar trains. This disproportionate correlation shows the risk of STF at the PTI is higher on V-Set trains. The study also found elderly passengers made up a larger proportion of injured passengers.
- 11.3.9 The project analysed two specific types of PTI incidents of relevance to the proposed train dispatch operating model:
1. Where a passenger has fallen through the gap between the train and platform onto the track before the train has started to move.
 2. Incidents where the train has started to move.
- 11.3.10 Analysis of incident data has shown that both types of incidents are very rare and in most cases are not due to failures in the train dispatch process.
- 11.3.11 For item 1, all the incidents were detected and the person removed from the gap before train departure, typically by accompanying parents or other passengers.

11.3.12 For item 2, research has showed the incidents vary in severity. Station staff or the guard detected the incident and the train driver was alerted to stop the train in 14 of the 16 incidents.

11.3.13 Full details of the findings can be found in the report 'Study of Slips, Trips and Falls (STF) Incidents at the Platform Train Interface (PTI)', DNSW2017/32992, dated 25/10/17.

11.4 Safe Infrastructure

11.4.1 A key issue for platform operation is the stopping arrangements for trains at station platforms that are shorter than the train length. At these a train is currently required to stop with the rearmost cars on the platform. To manage the risk of a door opening that is not alongside the platform the following controls are currently applied:

1. Stopping constraints are provided in timetable information.
2. Announcements are made by station staff and the train guard prior to the train departure from a station and throughout the journey.
3. The OsCar fleet is fitted with a manual selective door opening system, where the guard selects the sets of doors to be opened. OsCar selective door opening is only available for 2 car, 4 car, 6 car or 8 car. (NIF can select individual doors of any cars)

Note: The V sets rely solely on the announcements made by the train guard, with all passengers doors being operable after the train guard has operated the passenger door release push button.

11.4.2 To support the NIF operations at stations, Automatic Selective Door Operations (ASDO) equipment is fitted to the NIF trains and on the infrastructure. This system, where balises are fitted and working, will prevent:

1. Doors on the non-platform side of the train from being opened.
2. Doors that are not safely alongside the station platform from being opened.

11.4.3 The system being deployed for ASDO is based on the currently deployed ETCS system and uses 'Eurobalise' equipment that is proven in use throughout Europe.

11.4.4 The development and implementation of the infrastructure changes include compliance with the infrastructure standards published by TfNSW for platforms and train equipment.

- 11.4.5 The assurance standards, including Safety Assurance, Human Factors, Systems Engineering, describe the processes that the technical team is required to follow to ensure that the infrastructure is safe and fit for purpose.
- 11.4.6 These assurance processes result in the provision of a Safety Assurance Report for each asset at specified project stages.
- 11.5 Signal sighting**
- 11.5.1 In accordance with established signal sighting standards signal sighting will be applied where there are changes to infrastructure that may impact current sightlines.
- 11.5.2 The NIF Project Deed requires the trains to comply with the signal sighting standard, T HR RS 00100 ST (v1.0), including TN 083: 2015 (sections 7.6 and 7.7) which deals with the visibility of signals from the driving position.
- 11.5.3 During design development, the supplier identified non-compliance with some of these requirements. Several cab design elements were modified to maximise compliance, including the desk, windscreen, black masking, and interior lining, but two non-compliances remained due to constraints presented by the combination of the detrainment door and crashworthy cab frame design.
- 11.5.4 The CCTV screens do not contribute to the non-compliances identified.
- 11.5.5 The supplier submitted a concession request, asking for an increased sighting distances for right-hand-side signals in tunnels and post mounted signals.
- 11.5.6 The concession was reviewed with stakeholders including Sydney Trains ESI Signalling, NSW TrainLink, and Sydney Trains Network Rules.
- 11.5.7 A sightlines demonstration was performed with NSW TrainLink drivers and subject matter experts on the NIF mock-up. This identified some design changes to improve visibility, and all feasible changes were implemented.
- 11.5.8 The signal visibility is shown to compare favourably to existing rolling stock operated by NSW TrainLink, including OSCar. A study of existing signals on the network was performed by TfNSW to determine the impact of allowing additional sighting distance for stopping at signals currently on the network affected by the concession. This identified no additional safety or operational risks. Subsequent to this, the concession was granted by the ASA.
- 11.5.9 Testing completed in early September has confirmed that the as-built NIF train meets the modified signal sighting requirements.

11.6 Automatic train protection

11.6.1 The NIF will be fitted with ETCS hardware. The current train protection system (mechanical train stops) will be upgraded to ETCS level 1 gradually, to a risk-based program of work.

11.7 Approval of Safety Assurance

11.7.1 The TfNSW Configuration Management Plan describes the asset life cycle stages and the Safety Assurance that must be carried out and reported at each project stage 'gate'.

11.7.2 The Safety Assurance Reports and other assurance documents are submitted to the Configuration Control Board (CCB), a panel of subject matter experts, to review the level of assurance that the project has carried out. CCB endorsement is required to progress to the next project stage.

11.7.3 The final CCB endorsement is for the delivery of the assets into operational service including that safety has been appropriately managed.

11.7.4 For the NIF projects, the train, the infrastructure and all other assets are required to adhere to these processes.

11.8 Managing risk during the transition to the new operating model

11.8.1 The project has identified that the transition from the current to the new operating model will create significant risk unless managed.

11.8.2 The following areas have been identified as requiring attention:

1. Human error by train drivers and customer service guards due to habituation e.g. a customer service guard becomes familiar with the operating model for the NIF and subsequently fails to carry out all mandatory tasks required for trains operating to the old model, for example fails to check the guard's indicator resulting in a SPAD.
2. Changes to customer awareness of different features on the NIF train.
3. Changes to locations where passengers will board and alight the train. Assistance will be provided for disabled passengers.

11.8.3 The project has systematically identified transitional risks and has a plan to address these through instructions, training, the competence management system of staff and passenger awareness initiatives.

12 International practice on managing station operations and train dispatch risk

12.1 Introduction

12.1.1 Metcalfe Rail Safety have been asked to compare the proposed new operating model with the international train operating community.

12.1.2 To make these comparisons a questionnaire was sent to UK and international contacts who Metcalfe Rail Safety knew had a detailed knowledge of the train dispatch process for Driver Guard Operation (DGO) and Driver Only Operation (DOO) operated trains.

12.1.3 For the purpose of this report, the term 'Guard', is a generic term used to describe the member of the crew, other than the train driver, with operational safety responsibilities, such as the safety checks during the dispatch of a train, managing train evacuation in an emergency, undertaking train protection duties when there is an emergency. In many train companies the 'Guard' also has customer services responsibilities, such as carrying out tickets checks, interfacing with passengers by providing information and selling tickets, etc.

12.1.4 The list of questions included in questionnaire that was sent out is included in Appendix 4.

12.1.5 Completed questionnaires were received from contacts who have a detailed knowledge of the companies listed below.

1. Railways comparable with the passenger services operated by NSW TrainLink

A. Driver Guard Operation:

UK - South Western Railway

UK - Great Western Railway

UK - London North Eastern Railway

UK - ScotRail

Ireland - Irish Rail

Northern Ireland - Translink Northern Ireland Railway

Belgium – SNCB

France – SNCF

South Korea – KORAIL

Hong Kong – International train to China

- B. Driver Only Operation:**
 UK – MTR Crossrail, ScotRail
 Irish Rail
 Germany – National Express
 Saudi Arabia – Supported by SERCO

2. High Speed Operators

- A. Driver Guard Operation:**
 France – TGV, SNCF
 Germany – ICE, DBAG
 South Korea – KORAIL

3. Mass Transit Operators

- A. Driver Only Operation**
 Hong Kong – Driver Only – MTR East Rail

- B. Fully Automatic - No Driver or Guard**

- 4. Dubai – Dubai Metro
- 5. Qatar – RKH Qitarat, on behalf of Qatar Rail Doha Metro

- 12.1.6 In addition to the UK train companies that responded to the questionnaire, Metcalfe Rail safety has knowledge of the method of train dispatch for the other train companies in the UK. Some of these use DOO and some use DGO.
- 12.1.7 In the UK, the operators using high speed train services between major cities and those operating regional services operate with DGO. Many of the train companies operating commuter services to London operate using DOO.
- 12.1.8 DOO is also operated by the RER operator in France and many other operators operating regional and ‘metro’ type services in Germany.
- 12.1.9 ‘Metro’ operators in the UK, such as London Underground and those serving European cities generally operate in DOO.
- 12.1.10 Information is provided in this section of the report on the feedback received on the questionnaires.

12.2 Railways that operate in DGO

A. Monitoring of the station platform as the train arrives

12.2.1 The responsibility for monitoring of the station platform and taking the required action as the train approaches the station is with the train driver.

12.2.2 Although not included on the questionnaire, to the best of my knowledge, none of the railways who responded require the train guard to view the station platform as the train approaches the station.

B. Opening the train doors

12.2.3 Responsibility for opening the train doors when a train stops at a station varies across countries. Mostly this responsibility is with the train guard, but recent trends have been for this task to be carried out by the train driver.

12.2.4 The opening of the train doors is carried out after the guard has checked that the train is correctly positioned alongside the platform. In the UK 'Selective Door Opening' is applied on routes that have short platforms. This requires the train guard to make the necessary announcements to warn passengers of this and apply the selective door opening door controls. Various other control measures have been applied.

C. Closing the train doors

12.2.5 Responsibility for closing the train doors is normally with the train guard.

12.2.6 The guard does a visual check, from a position on the station platform, before operating the door close controls.

12.2.7 In trains operating in the UK, the location where the train guard operates at can be:

1. A rear or intermediate cab vestibule (not accessible to passengers travelling on the train).
2. A door vestibule which is also used by passengers.

Note:

1. The design of some driving cabs enables the guard to drop a window within the driving cab and look out along the train through the open window.
2. If the door where the guard is operating is powered to the fully open position it is not permitted, for safety reasons, to have a window in the door that can be opened so the guard can look through it. This means

the field of view available to the guard as the train moves along the platform is very restricted.

3. This always applies when the guard is operating at a vestibule door that is shared with passengers and at some driving cabs/driving cab vestibules.

D. The safety checks before starting the train

- 12.2.8 Responsibility for carrying out the train safety checks before the train moves is with the train guard.
- 12.2.9 Where required, because of platform curvature, platform mounted CCTV monitors are provided to enable the guard or where appropriate, station staff, to carry out the safety checks during station operations and the final safety check before the guard gives the signal to the driver to start the train.
- 12.2.10 Where station staff are used in the dispatch process, because the guard is unable to view the complete length of the train or platform congestion reasons, the station staff signal to the guard that they have checked the section of the train they are observing and their safety check is complete.
- 12.2.11 Before giving the signal to start the train the guard is responsible for checking the applicable signal, or the signal repeater, is showing a proceed aspect and when all the passenger doors are closed for carrying out the final safety check.

E. Monitoring the train as it moves along the platform

- 12.2.12 The driver is responsible for observing and obeying the station starting signal ahead of the train and, where applicable, monitoring the station platform located ahead of train. There is no requirement for the train driver to monitor the platform train interface as the train moves along the station platform.
- 12.2.13 Responsibility for monitoring the movement of the train as it moves along the length of the platform is with the train guard. This can be carried out from a rear cab, an intermediate cab, or a doorway shared with passengers.
- 12.2.14 How the guard monitors the movement of the train is by looking through an open window in a driving cab and where this is not available, through a closed window in a train door. In some countries this is for a few seconds, in others (e.g. the UK), this is until the train has left the platform.

Note:

1. From all respondents the only train company that required the train guard to stand at an open door when the train departs a station is Belgium.
2. The Belgian respondents stated that guards are verbally and physically abused by passengers whilst doing this.
3. There was a very serious incident at Liege Station in Belgium in 2009, where a 70 years old passenger used a door that was open for the guard. Both the passenger and the guard ended up under the train and suffered life changing injuries – both legs were amputated. As a result of the incident the trade unions demanded that trains are only allowed to leave when all the doors are closed and greater supervision on platforms. It is understood that all new trains in Belgium no longer require the guard to stand at an open doorway as the train moves along the platform.

12.2.15 Where station staff are provided for train dispatch purposes, they also monitor the train as it moves along the station platform. Some railways monitor the train remotely from a control room.

12.2.16 Normally there are no CCTV cameras in the driving cab for the train driver or the train guard to use during the movement of the train along the station platform.

12.2.17 One exception to this is the new intercity trains operated by the Great Western Railway (GWR) in the UK, which have train mounted cameras and in-cab monitors on the desk of the driving cab.

12.2.18 GWR were unable to agree with their high-speed trade union representatives that train drivers would look at the screens when the trains are being dispatched. Agreement was reached for the train driver to take a cursory check of all desk controls and indications when starting the train to ensure it is safe to dispatch.

Note:

The CCTV monitors in the drivers' cab are viewed by the train driver when an empty coaching stock train is departing from a station in DOO.

12.2.19 The guards on these trains do not view the CCTV monitors as the train moves along the platform.

F. Stopping the train as it moves along the platform

- 12.2.20 In an emergency, in most railways the guard signals to the driver to stop the train using a signal bell code and then applies the emergency brake if the driver does not respond.
- 12.2.21 Where station staff are provided for train dispatch purposes, in an emergency they provide a hand signal to the guard and the guard then signals to the driver to stop the train.
- 12.2.22 In some railways a radio is used to verbally communicate the emergency from the guard/station staff/control room staff to the train driver.
- 12.2.23 The driver applies the emergency brake when observing an emergency ahead or on receiving the emergency stop bell code from the guard.

12.3 Railways that operate in 'Driver Only Operation'

A. Monitoring of the station platform as the train arrives

- 12.3.1 Responsibility for monitoring the station platform as the train approaches the station is with the train driver, looking through the cab windscreen.
- 12.3.2 On some 'metro' operations CCTV images are displayed to the driver as the train approaches the start of the station platform. This is to enable the driver to attempt to stop the train if someone is attempting suicide or has fallen from the platform. In these applications there is normally an automatic train protection/control system which will stop the train in the event of a signal being passed at danger/movement authority exceeded.

B. Opening the train doors

- 12.3.3 Responsibility for opening the train doors when a train stops at a station is with the train driver. On some metro type operations there is an automatic system to prevent the driver from opening the train doors on the wrong side of the train.

C. Closing the train doors

- 12.3.4 Responsibility for closing the train doors is with the train driver.

D. The safety checks before starting the train

- 12.3.5 Responsibility for carrying out the train safety check before the train moves is with the train driver.

- 12.3.6 There are several methods to provide the train safety check in the UK. These include:
1. A train dispatcher, located on the platform, who carries out the safety check after the train doors are closed. When it is safe this person signals to the driver to start the train.
 2. The train driver lowering the side window and looking back down the length of the train. On curved platforms CCTV monitors are provided on the platform covering the section of the train that the driver cannot visually see by line of sight.
 3. CCTV monitors or mirrors or combinations of these, located forward of the driving cab, which are viewed through the driving cab windscreen.
 4. CCTV monitors, located alongside the train, which the driver looks at through the side window.
 5. CCTV monitors, located inside the train driving cab, which the driver looks at from the driving position.
- 12.3.7 Some of these methods are also applied internationally – for example, Irish Rail (Ireland) and the RER network (Paris).
- 12.3.8 In Germany, the driver of a train- that is operated in DOO does not carry out a visual safety check after the passenger doors are closes, except at very busy stations where assistance is provided by station staff. Instead, in Germany, there is a reliance on the door safety systems to detect an obstacle that is trapped in the train doors.
- E. Monitoring the train as it moves along the platform**
- 12.3.9 The driver is responsible for observing and obeying the station starting signal ahead of the train and, where applicable, monitoring the station platform located ahead of train.
- 12.3.10 There is no requirement for the train driver to monitor the platform train interface after the train safety check has been carried out and the train driver has started the train by any of the methods listed above - looking back down the train through the driving cab window, looking at CCTV monitors provided internally or externally.
- 12.3.11 Where in-cab CCTV monitors are used to view the PTI there is no requirement, in most railways, for the train driver to observe the station platform using the CCTV monitors in the driving cab as the train moves along the station.

12.3.12 This is for very important safety reasons, because it is essential that the train driver is not distracted by the display of CCTV images and instead focuses on observing the lineside signal and the line ahead. For this reason, the in-cab CCTV monitors switch off when the driver applies power, or in most cases, at a very low speed, typically 5kph.

12.3.13 On some 'metro' operations CCTV images are displayed to the driver as the train travels along the station platform. In these applications the train is often entering a tunnel after leaving the platform and there is normally an automatic train protection/control system which will stop the train in the event of a signal being passed at danger/movement authority exceeded.

12.3.14 Where station staff are provided for train dispatch purposes, they also monitor the train as it moves along the station platform. However, their ability to stop the train after it has started moving is very limited.

12.3.15 Some railways monitor the train remotely from a control room.

F. Stopping the train as it moves along the platform

12.3.16 The driver applies the emergency brake when observing an emergency ahead.

12.3.17 Where station staff are provided for train dispatch purposes, in an emergency they provide a hand signal to the driver. However, in most cases this would have no effect as the driver is not able to see the hand signal as:

1. The station dispatcher is normally in rear of the cab where the driver is located.
2. Where in-cab CCTV monitors are used these are automatically switched off when a speed of 5kph is reached.
3. Where platform monitors or a mirror are used the driver will not be looking at these as the train starts away from the platform.

12.3.18 There is an emergency stop plunger on the station platform on some mass transit railways. The operation of this plunger reverts the station stop signal to a danger aspect or automatically stops the train, depending on the train control system in operation.

12.4 Driver Only Operation (DOO) in the UK

12.4.1 DOO for passenger trains is now a common arrangement in the UK with many commuter trains operating into London stations and 100% of the London Underground trains operating without a train guard. In Scotland it equates to approximately 60% of the ScotRail operations.

- 12.4.2 System design for DOO passenger trains was initially based on a cost-effective methodology, using the concept of drivers looking out of the driving cab window and back down the length of the train. In situations where the driver did not have a full uninterrupted view of the train down the dispatch corridor, due to the curvature of the platform and/or where a train was longer than 8 cars, CCTV monitors were additionally provided to cover the part of the train the driver could not observe using 'line of sight'.
- 12.4.3 Where the driving position is not alongside the side window the design of most driving cabs significantly restricts the ability of the train driver to move easily from the seat to the side window to look out and along the train to carry out the safety check. Where this applied the view down the train was provided by using mirrors or CCTV monitors located on the station platform which the driver could view from the driving position. In these applications the CCTV monitors displayed images from CCTV cameras mounted on the station platform.
- 12.4.4 With the introduction of improved technology newer trains are now fitted with CCTV monitors in the train driving cab which display images from train mounted CCTV cameras. This is a proven solution and is the same as the NIF solution.
- 12.4.5 DOO does not only apply to passenger trains. It is used by many train companies for train movements between railway stations and depots and stabling points. This is applied to passenger trains that normally operate with a guard as well as those which normally operate in DOO.

12.5 Driver Controlled Operation (DCO)

- 12.5.1 In recent years train companies in the UK want to change the crewing of their trains from 'Driver Guard Operation' (DGO) to a system of operation called 'Driver Controlled Operation' (DCO).
- 12.5.2 In DCO the train driver is responsible for door operation and determining that it is safe to start the train. Other crew members of staff are normally on the train, providing a customer service, but they do not have a safety role in dispatching the train from a station as this responsibility rests with the train driver.

12.6 PTI and train dispatch risk in the UK

- 12.6.1 In 2011 the Rail Safety Standards Board (RSSB) produced a report titled 'Passenger risk at the platform-train interface'. The report covers accidents occurring to passengers at the PTI which are categorised in two distinct ways:

- Accidents occurring while boarding or alighting trains (PTI).
- Accidents occurring at the platform edge not during boarding or alighting.

- 12.6.2 The usual measure for harm in the UK mainline rail industry is ‘fatality and weighted injury’ (FWI) which is a way of measuring the level of harm or risk in a consistent way, by combining the fatalities, major injuries and minor injuries in one unit of measurement. Each injury type is scored in a way that is ‘statistically equivalent’ to one fatality. The weightings can direct intervention towards those incidents and accidents that lead to the highest levels of risk without ignoring the types of incident that typically have less severe outcomes.
- 12.6.3 Data on incidents at the date of the 2011 report showed that slips, trips and falls in stations account for the largest proportion of passenger FWI risk, at 46%, with passenger accidents at the PTI accounting for the next largest proportion, at 20%. Of this, 12% of the accidents occur while passengers are getting on or off trains, and 8% occurs while not boarding or alighting.
- 12.6.4 Nearly one-third of the PTI risk to passengers resulted from injuries involving some part of the passenger falling between the train and the platform; 11% of the risk occurred when the passenger comes into contact with the external doors. Other injuries while alighting from the train account for more than double the risk than other injuries while boarding the train.
- 12.6.5 The 'Annual Safety Performances Report 2014/15 - Key facts and figures', produced by RSSB provides key statistics on fatalities and major injuries to passengers at the platform train interface over the previous 5 years. These incidents resulted in an average of 3 fatalities/year and 50.8 major injuries/year.
- 12.6.6 This is for passenger journeys that average 58.59 billion passenger kms / year or 1.512 billion passenger journeys per year.
- 12.6.7 There were three passenger fatalities in 2014/15. This equates to a rate of around one fatality per 550 million passenger journeys. The fatalities all occurred in separate accidents in stations, two of which were at the platform-train interface. Intoxication was recorded as a potential contributory factor in all the incidents.
- 12.6.8 To address the risk at the platform train interface the Rail Safety Standards Board developed a ‘Platform train interface strategy’, dated January 2015. This document put the risk at the platform train interface in context and set

out the rail industry's consolidated approach to identifying causal factors and mitigations that can be implemented.

12.6.9 In June 2018, RSSB produced a report titled 'Safety of Driver Controlled Operation' (DCO). The purpose of the report was to provide train companies with an informed understanding of both the size of the risk presented to them and to quantify the change in safety risk from moving from trains with DGO to services operated under DCO.

12.6.10 The study focusses on the guards (also called conductor in the UK) ability to mitigate risk in the following areas:

1. Dispatch risk, including SPADs that could be affected by the dispatch process.
2. On-board assaults.
3. Protecting the line in an emergency.
4. Dealing with or preventing uncontrolled evacuation.

12.6.11 At the date of the 2018 report:

- The risk to passengers and public at the PTI accounted for approximately 13 FWI /year.
- The risk associated with train dispatch was 1.8 FWI /year.

12.6.12 Dispatch risk covers all personal accidents to passengers and members of the public associated with train dispatch, including:

- Injuries while they are boarding or alighting a train.
- Coming into contact with a train while on the platform.
- Falling between the platform and a stationary or departing train.

12.6.13 It also includes the risk of collision following signals passed at danger (SPADs) when starting against signal (SAS) at platforms which can be related to train dispatch.

12.6.14 Data from the research for this report suggests that driver dispatch is a lower risk (0.87 FWI per billion passenger journeys) than guard dispatch risk (1.35 FWI per billion passenger journeys).

12.6.15 Some possible reasons for this include:

- Passengers on commuter routes may be more experienced and familiar with the way the trains are operated, and less likely to have an accident.
- Passengers on intercity routes may have more luggage and be more prone to having an accident at the platform-train interface (PTI).

- When there are large numbers of passengers, some elements of the risk at the PTI (e.g. being struck by the closing doors) may only affect the last few passengers to board through any given door. This may lead to the risk on very busy services to appear lower when normalised by passenger journeys.

12.6.16

The conclusion of study on dispatch risk is that DCO trains have lower overall dispatch related passenger safety risk than DGO operated trains.

13 Key findings

13.1 Standards and project documents

13.1.1 The standards provided for this review do not describe, in enough detail, the required control measures required for the safe operation and the dispatch of trains from a station.

13.1.2 Relevant UK standards and guidance are:

1. Rail Industry Standard RIS-3703-TOM. 'Passenger Train Dispatch and Platform Safety Measures'. Issue 3, September 2017.
2. Rail Industry Standard RIS-8060-CCS. 'Engineering Requirements for Dispatch of Trains from Platforms'. Issue 1, September 2017.
3. Rail Industry Standard RIS-2703-RST. 'Driver Controlled Operation (DCO) On-Train Camera/Monitors (OTCM)'. Issue 2, December 2018.

13.1.3 The project is however using relevant content from these documents.

13.1.4 It would assist the rail industry in NSW if a standard on this was produced, which takes account of each of the above UK documents, modified as necessary to make the content of the standard applicable to NSW railway operations. *(See Section 15. Recommendation 7)*

13.2 Comparison of the current operating method with the new operating model – Revenue service dispatch

13.2.1 Although not required by the Sydney Trains or NSW TrainLink procedures, it is the practice of most guards to open the cab door as the train enters the station platform.

13.2.2 After the signal to start is given the guard is required to stand at the open cab door until the train has travelled 4 cars or the workstation has reached the end of the platform, with the guard being prepared to respond to an emergency, using the signal bell to send a stop signal to the driver.

13.2.3 The door swings inwards and, to prevent movement of the door, it is fixed by a latch at floor level on the V sets.

13.2.4 Standing at the open doorway of a moving train puts the guard at risk of falling out if they were to trip/lose balance/lose contact with the handrails or struck by a door that was not properly latched open.

- 13.2.5 Observations of the train guard standing at the doorway as the train departs from a platform show they have a relaxed attitude to this, with a significant number hardly holding on to the handrails. A number of guards that were unobtrusively observed did not always look out along the train as the train moved along the platform, particularly those that stood in an intermediate cab, who tended to look only in the direction the train was moving and not in both directions. Guards often stay at the open door longer than required by the Sydney Trains or NSW TrainLink procedures, with many staying there until the train has left the station platform.
- 13.2.6 When questioned, guards did not show any major concern with their safety when standing in the open doorway, even though some said they had been struck on the back by a door that had not latched. Most guards had been verbally abused and spat at by passengers. The guards accepted these hazards were 'just part of the job'.
- 13.2.7 It is questionable if looking out of the door as the train moves along the station platform provides a safety benefit for the following reasons:
1. When the train arrives in a station the train driver, located at the front of the train is closer to and will have a clearer view of the PTI as the train approaches and moves along the platform, responding as necessary to a person at risk.
 2. When arriving and departing the guard may see the need to stop the train. However, in the time it takes for the guard to signal to the driver to stop plus the driver and the brake system response time, it is likely there would be insufficient time/distance to travel to prevent an incident/or accident from happening.
- 13.2.8 The NIF train design does not:
1. Allow the guard to open the cab door to look out when the train is in motion.
 2. Does not display to the train driver any images on the CCTV screen when the train is moving, so as not to distract the driver when the train is moving.
- 13.2.9 In my opinion the NIF train design, which prevents the guard standing in the open doorway, is better than the current method as it removes this existing occupational safety hazard.
- 13.2.10 The current model requires the train guard to operate the passenger door release/open controls. This is carried out whilst the guard is standing at the

crew door, after the guard has checked the train is correctly positioned on the platform.

13.2.11 In the proposed new operating model the driver has responsibility for operating the passenger release/open door control.

13.2.12 In my opinion it is better for the train driver to operate the door release/open control as:

1. The driver can observe on which side of the train the platform is located as the train stops in the station.
2. The driver knows if the train has stopped at the correct location – stop markers are provided at the station for this purpose.

13.2.13 Additionally, the positioning of the door release/open controls on the NIF train are ergonomically positioned with the objective of mitigating the risk of human error when selecting which control to operate.

13.2.14 The NSW TrainLink routes have a high number of platforms that are shorter than the train. This presents a significant risk if the passenger doors are opened on vehicles that are not positioned alongside the station platform, resulting in the risk of a passenger opening a door and falling to track level.

13.2.15 All trains currently using these routes rely on the train guard making a PA announcement when the train is to stop at a platform shorter than the train, along with manual selective door opening on OSCar services.

13.2.16 On the 'OSCar' trains there is a selective door opening control, which is operated manually by the train guard. This prevents doors being opened on the vehicles that are not positioned alongside the platform.

13.2.17 The application of the system has the following potential human error failures:

- The guard forgets to make the PA announcement.
- The guard forgets to operate the selective door control.
- The guard makes the wrong selection of the selective door control.
- The train driver stops the train in the wrong position followed by the guard not carrying out the required visual check of the stop position before operating the door open push button.

13.2.18 On the 'V Set' trains there is no selective door opening control so the potential for an incident is greater with those trains. The selective door opening relies of the train guard making a PA announcement and the passengers hearing and responding correctly to this.

- 13.2.19 In my opinion the risk associated with the opening of passenger doors that are not alongside the station platform is significantly less with the NIF trains due to the fitment, on the NIF train, of the 'Automatic Selective Door Operation' (ASDO) as it removes the risk of human error that currently applies to varying degrees with the current trains.
- 13.2.20 Before closing the passenger doors with the current model the guard carries out visual checks along the length of the train, observing passengers alighting and boarding the train and closing the passenger doors when it is time to depart. At some station platforms a signal repeater is provided for the guard to check the signal for the train has cleared to a proceed aspect.
- 13.2.21 When a train is standing in a station there is the potential for a person to fall down the gap between the train and the platform edge. If this happens, and other passengers are in the vicinity of where the person fell and they see the person fall they will probably assist the person/attempt take action to try to stop the train moving. The guard will then become aware of this and take appropriate action.
- 13.2.22 It is not always the case that a guard, member of platform staff or on-train repeater will see a person fall between the train and the platform. This is because:
1. When a person falls down the gap this happens very quickly, and they disappear out of view.
 2. The section of the train where the person fell may not be viewed at the time of the fall if the guard/member of platform staff/on-train repeater is looking in a different direction to that of the incident location.
 3. Congestion on the platform or a physical obstruction may block the view available to the guard/member of platform staff/on-train repeater.
 4. The guard/member of platform staff/on-train repeater may be distracted. This often happens with passengers making enquiries on trains/seeking their assistance, but it can also happen with other events on the station platform.
- 13.2.23 At curved platforms, platform staff or on-train repeaters are sometimes provided to view the section of the train that the guard is unable to view because of the curvature of the platform. At some station platforms CCTV monitors are provided to enable the guard to view the section of the train that cannot be seen by line of sight.

- 13.2.24 At some stations, platform staff are provided because congestion on the platform affects the ability of the guard to obtain a clear line of sight of the complete length of the train.
- 13.2.25 When platform staff or on-train repeaters are not provided on the station platform:
1. The guard is required to walk to a position on the platform to view the section of the train that cannot be viewed from the position adjacent to the crew cab doorway, where the guard would normally work.
 2. Walking to that position must be done twice:
 - Before closing the passenger doors, and
 - When moving to carry out the final safety check, after the passenger doors are closed.
- 13.2.26 At some stations this walk can be a significant distance, which means the guard will have their back to the train at some point whilst doing this.
- 13.2.27 This means, when platform staff or on-train repeaters are not provided on the station platform, the PTI along the section of the train that cannot be viewed from the area adjacent to the crew cab doorway:
1. is only viewed when the guard is at the required viewing position.
 2. would not be monitored as the train is moving along the platform, despite the guard standing in an open crew cab door.
- 13.2.28 After the signal to start is given the guard is required to stand at the open cab door. A benefit of this is that in the event of an incident the guard may be able to hear a shouted warning or observe an incident and then respond by stopping the train movement. This may not be the case if the platform is crowded.
- 13.2.29 In my opinion this is a real benefit only if this happens before the train has started to move or is moving very slowly. If a train is moving at any other speed, when the guard becomes aware of the incident and signals to the driver to stop it is unlikely that the driver will respond in sufficient time to stop the train in sufficient distance to prevent serious injury to a person who has fallen between the train and the platform.
- 13.2.30 It is possible that the extent of the injuries to a person who is trapped in a door would be less if a guard observed them and signalled to the driver to stop the train. If the safety check, after the doors had closed and before the signal to start was given, had been carried out sufficiently this type of incident

would not occur. The level of protection provided by the door safety system also has a significant influence on the frequency of these types of incident.

13.2.31 With the proposed new model, the train driver, using CCTV images in the driving cab, is responsible for monitoring the station platform, closing the train doors when it is time to leave the station and then carrying out the safety check of the PTI. After checking the signal is showing a proceed aspect the driver applies power and the CCTV monitors switch off at the very low speed of 3kph.

13.2.32 In the proposed new operating model, the customer service guard provides boarding and customer service activities (if required) while the train is stopped at the platform.

13.2.33 The customer service guard must then be in the crew cab and observe the PTI, using the CCTV images displayed on the cab monitor, as the train moves along the platform until the train has left the station, stopping the train if there is a stop signal from station staff or a dangerous situation is observed.

13.2.34 In comparing the two methods it is my opinion that the NIF train with the proposed new operating model provides the most safety benefit overall for the following reasons:

1. The obstacle protection systems to detect a person trapped in a passenger door are significantly better on the NIF train. Details of this are provided in Section 7.
2. The CCTV images, if functioning to specification and displaying images of an acceptable quality with an appropriate field of view, provides a view along the complete train length to the train driver whilst the train is standing at the platform regardless of the curvature of the platform. It also displays this, to the customer services guard, as the train moves along the platform. This is not always the case with the current method, for the reasons described above.
3. As there is a CCTV camera on every car, the CCTV images displayed will provide a close view of every car, compared to the very long viewing distances, towards the front of the train, if the line of sight method is used.

Note:

Previous UK Railway Group Standards for DOO set a maximum distance of 8 cars (with a nominal car length of 20m per car = 160m) for a driver to view a train length by the 'line of sight' method.

4. The driver is less likely to be distracted from the task of viewing the PTI.
5. The customer service guard can view the PTI when the train is departing, with a view along the complete train length, regardless of the curvature of the platform.
6. Removing the requirement for the guard to stand in the open doorway during the dispatch of the train will eliminate the occupational health and safety risk of the guard being attacked/falling from a moving train.

- 13.2.35 A disbenefit of the proposed new operating model is the driver is likely to have a reduced level of situation awareness of events when there is an emergency on a platform compared to that which is available to the guard in the current model. This is because the driver is in the crew cab and does not have the audible cues to draw attention to an incident.
- 13.2.36 This could be offset by requiring the customer services guard, while carrying out the customer service role on the station platform, to look out for any passenger behaviour/events that should stop the train from departing and then signal to the driver to stop the train movement. This is normally a general requirement for any member of staff who are involved in the direct operation of the railway. (See Section 15, Recommendation 1a.)
- 13.2.37 The proposed new model requires the customer service guard to view the CCTV images as the train departs the station and signal to the driver to stop the train in an emergency.
- 13.2.38 This is considered by Metcalfe Rail Safety to be a significant improvement over the existing methods used in the UK and internationally:
1. There is no monitoring of the PTI in DOO when a train movement from a platform has started.
 2. In DGO, although the guard is required to look out as the train moves along the platform the view of the platform is very restrictive for the guard in most trains due to the very limited view when looking through a closed window.
- 13.2.39 If platform staff are involved in the train dispatch there is some monitoring, but they have a very limited means to stop the train in an emergency.
- 13.2.40 Metcalfe Rail Safety considers the monitoring of the CCTV images on the NIF train as the train departs the station by the customer services guard is an improved method than either DOO or DGO.

13.2.41 In reviewing the draft instructions for the new operating model, Document 3.7, 'Train Dispatch' several possible amendments were identified by Metcalfe Rail Safety for consideration.

13.2.42 These are on the following subject areas:

1. What the driver checks when carrying out the train safety check. (See *Section 15, Recommendation 1b*)

It is impractical for the driver to check or apply two of the three subject areas listed within the PTI safety check after all the doors are closed (e.g. nothing is protruding from the train, customers are standing behind the yellow line). This list needs to be improved, with more detail included on the areas the driver should be looking for when making this important safety check.

For example, this could be changed to:

- Nobody is trapped in the doors
- Nobody is in contact with the train
- It is safe to start the train, taking account of the behaviour of persons shown on the CCTV images who may be at risk during the movement of the train.

2. The action the driver should take if there is a passenger intercom call as the train moves along the platform. (See *Section 15, Recommendation 1c*)

It is likely that this system will be operated by a passenger when there is no emergency.

Switching on the CCTV in the driving cab when the train is moving will distract the driver from the primary task of driving the train and in darkness may create unacceptable glare.

The customer services guard will be monitoring the CCTV in the rear or intermediate crew cab when the train is departing the station. It is recommended that the new operating model is amended so that the customer service guard has the responsibility, when the passenger intercom call is initiated, for deciding if there is a need to stop the train. The customer services guard should have their attention drawn to the operation of the passenger intercom and the outside view of the vehicle where the intercom is operated should be enlarged. (See *Section 15, Recommendation 3.*)

13.3 The new operating model – empty train dispatch and unscheduled stop dispatch

13.3.1 In reviewing the draft instructions for empty train dispatch and unscheduled stop dispatch the same comment and recommendation apply as described in paragraphs 13.2.42 regarding what the driver checks when carrying out the train safety check. *(See Section 15, Recommendation 1b)*

13.3.2 In these applications there is no requirement for a guard/customer service guard to be involved in the train safety checks before the train departs the station.

13.3.3 In the UK, DOO of an 'Empty Coaching Stock' train (e.g. when not conveying passengers for train movements between a station and a depot/stabling siding and relocation purposes) is safely applied by many train companies.

13.4 The risk assessments

13.4.1 The risk assessment process to meet the requirements of the standard appear to be robust. A detailed analysis of these is outside the scope of this review and in the time available this could not be carried out.

13.4.2 Within the scope of the review is to assess the adequacy of the process used to assess the risk of train dispatch at a station platform. It is a requirement to carry out these risk assessments but currently there is no procedure for these. The project intends to use the guidance in the RSSB Rail Industry Standard to produce the method to be used.

13.4.3 Every station platform has different characteristics and it is essential that a location specific risk assessment is produced for every station where the NIF train will stop. It is recommended the methodology for the train dispatch risk assessment is produced and this is applied to identify hazards/assess so these can be evaluated during the planned risk validation exercises of the NIF train. The risk assessment should identify where change is required to the station with residual hazards communicated to station and train crew involved in the dispatch of the NIF. *(See Section 15, Recommendation 5)*

13.4.4 Metcalfe Rail Safety has provided the operations project team with examples of UK practice on how to carry out a location specific train dispatch risk assessment, how this is documented and how it is used in the instructions provided to train crew and station staff.

13.5 The train design and human factors

13.5.1 The attention to detail and the identification, consideration and integration of human factors in the development of the train design and the safety systems is impressive.

13.5.2 The design of the cab is significantly better than comparative trains in the UK. The location of the controls and displays are very well positioned for ease of use, it has significantly better sightlines from the driving position through the cab windscreen. It is more spacious and allows ease of movement between the cab door and driving position, which is important to enable the customer services guard to easily move from the crew cab door to the cab seat to view the CCTV images, whilst the driver is carrying out the safety check immediately before starting the train.

13.5.3 A photograph of a comparative UK driving cabs is provided in Figure 2a to 2c. Figure 2a is of the Class 385 EMU, recently built by Hitachi for operation by ScotRail showing the very small windscreen of the driving cab and the passenger gangway. The controls used by the driver on this train are shown in Figure 2b.



Figure 2a: Windscreen and gangway of a Class 385 Driving Cab used for DOO



Figure 2b: Drivers desk of a Class 385 Driving Cab used for DOO



Figure 2c: CCTV Monitors for DOO - Class 379 Driving Cab for DOO

13.5.4 Included in the train design are systems that will improve the safety of station operations and train dispatch compared to the current fleets.

13.5.5 This includes:

1. Automatic Selective Door Operation (ASDO).
2. Reduced stepping distance between the train and the platform compared to the V-sets.
3. Ergonomically and functioning CCTV monitors and TMS display.

4. Automatic PA announcements for warning of the closure of the passenger doors.
5. Improved door obstruction protection.
6. CCTV for train dispatch with the recording of the CCTV images for incident investigation.
7. ETCS automatic train protection.

13.5.6 Throughout the design development significant consideration has been given to human factors so these can be integrated into the design of the driving cab and the safety systems used during station operation and the train dispatch process.

13.6 Competence management of the train driver and customer service guard

13.6.1 NSW TrainLink currently apply a competence management system for train drivers and guards.

13.6.2 A detailed review of the competence management system is outside the scope of this review but Metcalfe Rail Safety have been informed that the project is currently developing a training course for the train driver and customer service and are aware of the need to update the current competence management system to reflect the different competences and knowledge requirement for the changed roles.

13.6.3 It is important that the competence management system has an appropriate assessment and monitoring regime which ensures the train driver and the customer services guard are not only competent to apply the new operating model but are also consistently applying it every time a train is dispatched from a station. The competence assessment and monitoring regimes need to be reviewed and updated to reflect the changed roles.

13.6.4 It is also important that the competence assessors and line managers are also competent to perform their assessment and managerial roles. To assist the project, examples of good practice, which include the assessment of 'non-technical' skills and the assessment of managerial skills for the assessors and managers, have been provided by Metcalfe Rail Safety. It is recommended that NSW TrainLink review these documents, compare them to their existing competence management system documents and use the supplied documents, as appropriate, if changes are deemed necessary. *(See Section 15, Recommendation 6.)*

13.7 Interface management

13.7.1 Appropriate arrangements are in place and are being applied for the management of the safety interfaces.

13.8 Project safety assurance

13.8.1 The framework for safety assurance is robust and thorough and is compliant with rail industry good practice.

13.9 The use of on-train monitors during train departure

13.9.1 The UK Rail Safety Standards Board have carried out a risk analysis, published in August 2018, which evaluates the use of on-train monitors during station departure. This analysis was carried out to assess the impact on risk from on-train camera and CCTV monitor images to train drivers on departure from stations, where only the driver was involved in the dispatch procedure and no platform staff or on-board train crew were involved.

13.9.2 The risk analysis compared two operating states:

- The CCTV monitor is switched OFF when the driver takes power.
- The CCTV monitor is ON until the train has fully departed the platform.

13.9.3 This comparison was made by considering the risk from events that could take place at the PTI during dispatch and the risk, due to distraction, from passing a signal at danger or passing a signal returned to danger.

13.9.4 The conclusion is that there is no distinct difference in risk between the two methods, suggesting that leaving the monitors on does not impact on overall system risk when compared with the monitors being off.

13.9.5 The study found that if the CCTV monitors remain ON this provides additional benefits in managing risk at the PTI, by allowing the train driver to rectify errors made in the safety check prior to starting the train and identify an incident/late after the train has started the train movement.

13.9.6 The report points out that the requirement on the train driver to share attention between tasks needs to be considered, particularly at locations where the driver is required to focus their attention on the track ahead due to location or time specific hazards. It states that this can be managed through local instructions to the driver, driver competence and other measures, such as the standard UK train protection system, Train Protection Warning System (TPWS), to minimise the consequences of driver error.

13.9.7 The application, within the new operating model for the NIF, for the customer service guard to view the CCTV monitors during the departure of the train

eliminates the potential risk of driver distraction if the driver had to carry out this task.

13.9.8 Metcalfe Rail Safety agrees with the findings of the RSSB that monitoring the movement of the train until it has left the station platform provides limited safety benefit, but as there is planned to be a customer service guard on the NIF train, it makes sense to use this person to carry out this task.

13.9.9 When viewing the train side images it is important that the customer service guard is not distracted. There is the potential for this to happen if the other CCTV monitor is displaying images from inside the train. It is recommended that those images are not shown, by disabling their display during the movement of the train along the platform. (See *Section 15, Recommendation 2*)

Conclusion

The review has assessed a wide range of subject areas relating to the application of the proposed new operating model with the New InterCity Fleet. From this a decision has been able to be reached on the three core questions that are required to be addressed.

Subject to an acceptable image quality being displayed on the CCTV monitors for the train driver and customer service guard, the CCTV system and door safety systems function as specified and the recommendations (or acceptable alternatives) are implemented, it is the opinion of Metcalfe Rail Safety that:

1. The New Intercity Fleet (NIF) Operating Model is safe.
 - i. Appropriate safety checks, by the train driver, are included in the operating model for when the train is stopped in a station and before the train moves.
 - ii. The project has identified the need to ensure the competence of the train crew and station staff through appropriate training and the implementation of a revised competence assessment and monitoring regime.
 - iii. The procedures within the model, which require the driver to operate the door controls and carry out the safety checks have been applied internationally for many years with acceptable levels of safety.
 - iv. The design of the driving cab and the associated controls and displays that are used during station operations and during the dispatch of the train have been subjected to a rigorous process of human factors assessment and user input.
 - v. There is an assurance regime to ensure the NIF train complies with the applicable Australian and NSW standards.

2. The new model is safer than the current train fleet operating conditions for guards, when they are monitoring the platform train interface.
 - i. The occupational safety risk to the guard, when travelling at an open door, has been eliminated.

- ii. The risk of the passenger door not being opened alongside a station platform has been significantly reduced, if not eliminated, by the application of the automatic selective door operation system.
 - iii. The passenger doors are fitted with enhanced obstacle detection system.
 - iv. The CCTV system, if operating as specified, will provide the train driver with an improved view of the PTI for the complete train length, compared with the restricted view the guard has, under certain conditions, with the current system.
 - v. When carrying out the train safety check the train driver is less likely than the guard to be distracted by external factors, such as passenger enquiries.
 - vi. The customer service guard can view the PTI when the train is departing using the CCTV images, with a view along the complete train length, regardless of the curvature of the platform.
 - vii. In the new model, requiring the customer service guard to use the emergency brake instead of a bell code when there is an emergency as the train moves along the platform will stop the train quicker than the current method.
3. The NIF Operating Model is safer than the methods used by the international train operating community.
- i. The technical systems used by the NIF train are more advanced than many systems currently in use internationally, some of which date from the 1980's.
 - ii. A customer service guard is provided to support the train driver by monitoring:
 - a. the situation on the platform and intervening to stop the driver from starting the train if a risk to passenger safety is identified.
 - b. the station side of the train as the train departs, viewing the CCTV images of the side of the train alongside the station platform, stopping the train in an emergency.

Note:

Internationally, trains that operate in DOO (and DCO where there are traincrew with a customer service role) have no monitoring of the PTI as the train moves along the platform, other than where

platform staff are provided and their potential to stop a train in an emergency is limited.

Internationally, trains that operate in DGO require the guard to monitor the PTI as the train moves along the platform, but their field of view is very limited.

Recommendations

The following recommendations are provided for TfNSW to consider.

The new operating model

1. Modify the instructions on the application of the model:
 - a. To require the customer services guard, while carrying out the customer service role on the station platform, to look out for any passenger behaviour/events that should stop the train from departing and then signal to the driver to stop the train from departing. (*Reference: Section 13.2.36*)
 - b. Improve the subject areas the driver is required to check when carrying out the safety check. (*Reference: Section 13.2.42 – 1., 13.3*)
 - c. When the passenger intercom is operated the customer service guard has the responsibility for deciding if there is a need to stop the train and, in an emergency, apply the emergency brake. (*Reference: Sections 7.11.19, 13.2.42 – 2.*)

CCTV Monitors

2. During the dispatch from the station the images from the passenger areas should not be displayed on the other monitor when the customer service guard is monitoring the platform side images. (*Reference: Sections 7.11.13, 13.9.9*)
3. When the 'Passenger Intercom' is operated, the customer services guard should have their attention drawn to the operation of the 'Passenger Intercom' and the outside view of the vehicle where the intercom is operated should be enlarged on the CCTV monitor. (*Reference: Section 7.11.18 and 13.2.42 - 2*)

Driver Reminder Appliance (DRA)

4. Review the functionality of the Driver Reminder Appliance (DRA) and if fitted, using it should be made mandatory. How and when to use the DRA needs to be included in the new operating model. (*Reference: Section 7.12.7*)

Train dispatch risk assessment

5. Produce a document that describes the method for the train dispatch risk assessment and apply this to the stations where the NIF will operate. (*Reference: Section 13.4.3*)

Competence management

6. Review the NSW TrainLink competence management system to ensure it has an appropriate assessment and monitoring regime for the NIF train and the proposed new operating model. (*Reference: Section 13.6.4*)

NSW Asset Standards

7. Produce a single standard that describes all mandatory requirements on managing risk at the 'Platform Train Interface (PTI). (*Reference: Section 13.1.4*)

Appendix 1

Requested meetings and list of subject areas identified by Metcalfe Rail Safety for review

A. Stakeholder Meetings

1. With the project sponsor(s) to discuss the project, project management, assurance and accreditation, industrial relations, operational readiness.
2. With Health and Safety and Rail, Tram and Bus Union (RTBU) Trade Union representatives to hear their concerns and discuss the review process/subject areas.
3. With the Office of the National Rail Safety Regulator (ONRSR) - NSW Accreditation Division and the TfNSW Asset Standards Authority to discuss how they have been consulted/involved with the project and to hear any concerns they have.

B. Meetings with subject experts and project teams

1. To discuss safety performance data on incidents involving the dispatch of a comparable train service from stations in NSW/Australia and initiatives that have been implemented or planned to reduce these incidents.
2. Provide and discuss current mandatory Australian/State standards/rules/instructions relating to the dispatch of passenger trains from stations. Examples are:
 - a) Risk management
 - b) Requirement for and how to carry out train dispatch risk assessments
 - c) The design of passenger stations relevant to the safe dispatch of trains. E.g. platform lighting, warning signage, clearances between the train and the platform.
 - d) The design of train safety systems relevant to the safe dispatch of trains. E.g. Stepping distances between the train and the platform, door safety and control systems, stopping the train in an emergency including communication between traincrew.
 - e) Competence management of traincrew with responsibility for train dispatch.
 - f) Competence management of platform staff with responsibility for train dispatch.
 - g) The rules/instructions on the dispatch of a train from a passenger station
3. Discuss (and where appropriate provide relevant documents/information) the current company standards specific to the dispatch of passenger trains from stations and how these have been applied. Examples are:
 - a) The company standard which requires a 'safety validation' process to be applied when there is a significant change to the design of a train and how a train is operated.
 - b) Company instructions issued to staff on the dispatch of a train from a passenger station

- c) The generic and location specific train dispatch risk assessments at the stations where the current train operates
 - d) Specific risk control measures that are provided on the stations where the current trains operate. Examples are: Raising passenger awareness of the hazards/risk, platform staff at high risk locations/specific times of the timetable, PA announcements, warning signage etc
 - e) The train safety systems relevant to the safe dispatch of trains. E.g. Stepping distances between the train and the platform, door safety and control systems, stopping the train in an emergency including communication between traincrew.
 - f) Competence management of the driver and guard relating to managing the risk associated with train dispatch.
 - i. Competence standards
 - ii. Training and assessment
 - iii. Monitoring regime
 - g) Competence management of platform staff with responsibility for train dispatch.
 - i. Competence standards
 - ii. Training and assessment
 - iii. Monitoring regime
4. Discuss (and where appropriate provide relevant documents/information) on the current training of staff on the dispatch of passenger trains from stations.
5. Discuss (and where appropriate provide relevant documents/information) on the assessment and management of risk arising from the introduction of the new train. Examples are:
- a) A 'Safety Case' document, which describes the new train and the proposed method of operating it at stations and the identification and assessment of potential hazards/risk and how these will be managed. If human factors have been sufficiently considered within the risk assessment process
 - b) How the above document was reviewed and approved – i.e. the application of a 'safety validation process'.
 - c) Generic and the location specific train dispatch risk assessments for the stations where the new train will operate.
 - d) New / changes to the risk control measures provided on the stations where the new trains will operate. For example, an assessment of the platform lighting and the effect of this on the quality of the images displayed on the CCTV monitors
 - e) New / changes to the safety systems provided on the new trains. For example:
 - i. An assessment of the impact of the train design on the tasks required of the traincrew during the dispatch process
 - ii. An assessment of the interface between the traincrew and the equipment that needs to be operated/observed.
 - iii. If the CCTV cameras cover the entire length of the train and a 'corridor' alongside the train to an acceptable depth
 - iv. The ability of the train guard/driver to scan the images displayed on the CCTV monitors:
 - within the required station 'dwell time'
 - when the train departs the station
 - v. An assessment of the risk from displaying CCTV images as the train moves along the platform and that determines when the CCTV monitors are switched OFF

- f) Changes to the competence management of traincrew with responsibility for train dispatch.
 - g) Changes to the competence management of platform staff with responsibility for train dispatch.
6. Discuss (and where appropriate provide relevant documents/information) on the instructions issued to staff on the dispatch of the new trains and how these instructions were developed / trialled:
- a) Traincrew
 - b) Platform staff
7. Discuss (and where appropriate provide relevant documents/information) on the planned training provided to staff on the dispatch of the new trains:
- a) Traincrew
 - b) Platform staff
8. Discuss (and where appropriate provide relevant documents/information) on planned changes to the assessment and monitoring of staff involved in the dispatch of the new trains:
- a) Traincrew
 - b) Platform staff

Appendix 2

Review Programme

A. Meetings Agenda

1. 11/09/19

With the TfNSW NIF Engineering team - All day

Presentations and discussion on the train design and functionality of train safety systems for station and train dispatch.

2. 12/09/19

With health and safety representatives from the Rail, Tram and Bus Union (RTBU) Trade Union - 2 hours

Discussion with representatives from Mount Victoria (driver) and Wollongong (guard) depots on the review process, to hear concerns with the proposed method and their alternative arrangements.

3. 12/09/19

With Rail, Tram and Bus Union (RTBU) Trade Union representatives - 2 hours

Discussion on the review process, to hear concerns with the proposed method and their alternative arrangements.

4. 13/09/19

With Matthew Fuller, Acting Deputy Secretary, Regional NSW and Outer Metropolitan, Transport for NSW and Peter Allaway, A/CEO NSW TrainLink - 2 hours

Discussion on the project, project management, assurance and accreditation, industrial relations, operational readiness.

5. 13/09/19

With representatives from the Safety Regulator, ONRSR - 2 hours

Discussion on how the ONRSR have been involved in the consultation process during the development of the design of the train and the proposed operating model and their role in the approval process.

6. 13/09/19

With representatives from the Transport for New South Wales Asset Standards Authority - 2 hours

To discuss the mandatory standards that apply and the approval process.

7. 16/09/19

With the NIF Project Operational Readiness and Compliance Team – all day

Presentations and discussion on the new operating model, risk assessment, training and competence management of staff.

8. 17/09/19

1:1 meeting with a member of the NIF Project Operational Readiness and Compliance Team – all day

Detailed discussion on the instructions within the new model and the training, competence assessment and monitoring of staff.

9. 18/09/19

1:1 meeting with the NIF and NSW TrainLink Assurance Subject Experts - all day

Discussion on the assessment and management of risk arising from the introduction of the new train and the assurance processes.

10. 19/09/19

1:1 meeting with a engineer form the TfNSW NIF Engineering team - all day

Discussion on the train design and functionality of train safety systems for station and train dispatch.

B. Observation of the current method of train dispatch from stations and passenger behaviours

Carried out on trains during quiet and 'peak' periods in daylight and darkness over routes which the NIF will operate. During the journeys there was discussion with the guards/drivers to obtain their opinion on the benefits and risks with the current method of operation and to establish their knowledge and opinion on the proposed new method. A focus was placed on station platforms considered to have a high level of risk from:

1. Passenger congestion.
2. Platform curvature.
3. Behaviour risk. (e.g. passengers under the influence of alcohol, mobility impaired etc)

With a train guard

09/09/19

1. 10:18 hrs Central Station to Mt.Victoria, between Central Station and Katoomba
2. 13:47 hrs Mt.Victoria to Central, between Katoomba and Central Station
3. 08:23 hrs Central Station to Kiama, Between Central Station and Hurstville

10/09/19

4. 07:41 hrs Central Station to Bondi Junction, between Central Station and Bondi Junction
5. 07:59 hrs Bondi Junction to Kiama, between Bondi Junction and Wollongong
6. 09:51 hrs to Kiama to Central between Wollongong and Central Station
7. 12:45 hrs Central Station to Newcastle, between Central Station and Gosford
8. 1515 hrs Newcastle to Central Station, between Gosford and Central Station

12/09/19

9. 1515 hrs. Central Station to Newcastle. Between Central Station and Woy Woy
10. 1512 hrs. Newcastle to Central Station. Between Woy Woy and Central Station

13/09/19

11. 1918hrs. Central Station to Mt.Victoria. Between Central Station and Springwood
12. 2058 hrs. Mt.Victoria to Central Station. Between Springwood and Central Station

With a Train Driver

13/09/19

13. 19:18 hrs. Central Station to Mount Victoria. Between Central Station and Springwood.

23/09/19

14. 17:15 hrs. Central Station to Lithgow. Between Central Station and Blacktown.

15. 17:25 hrs. Springwood to Central Station. Between Blacktown and Central Station.

26/09/19

16. 10:23 hrs. Central Station to Kiama. Between Central Station and Kiama.

17. 12:55 hrs. Kiama to Central Station. Between Kiama and Central Station.

Unobtrusive Monitoring - Observation of trains arriving and departing

09/09/19

18. 07:00hrs to 08:00 hrs. At Central Station

10/09/19

19. 07:00 to 07:40 hrs. At Central Station

14/09/19

20. 14:45 – 15:22 At Leura Station

Appendix 3

List of documents used in the review

Current operating rules and procedures:

1. NTTWP 156, Operating Doors, November 2017, V1.0
2. NTOSP 7, 'Right of way procedure for Guards and Passenger Service Supervisors', NTOSP7. November 2017. V1.8
3. Right of way procedure for Station Staff and On-Train Repeaters. OSP 6. September 2018. V6.1
4. OSP 6, 'Right of way procedure for Station Staff and On-Train Repeaters', September 2018, V6.1
5. Right of way procedure for Station Staff and On-Train Repeaters. NTOSP 6. November 2017, V1.0.

Draft operating rules and procedures for the new model:

1. Operator Instruction Manual, Volume 3. Normal Operations – 3.7 Train dispatch

Transport Asset Standards Authority Standards:

1. Human Factors Integration – Rolling Stock. T HR HF 00001 ST. Version 2.0. Issued date: 25 June 2018
2. System Safety Standard for New or Altered Assets. T MU MD 20001 ST. Version 1. Issued date: 20 December 2016
3. RSU Appendix D - Train (Driver) Safety Systems. T HR RS 00840 ST. Version 2.0. Issued date: 04 November 2016
4. Train Safety Systems. T HR RS 13001 ST. Version 2.0. Issued date: 04 December 2017

Network Standard

1. Requirements for Passenger Train Dispatch. NS-0918. July 2018. V4.1

NSW Safety Management System Documents

1. Safety and Environment Change Management. Document number: SMS-07-SP-5067, Version: 3
2. Risk Management. Document number: SMS-07-SP-5213 Approver: Director, SEQR, Version: 2
3. Risk Assessment Guide. Doc No: SMS-07-GD-5084, Version: 2.0 Issue Date: 15/08/2016

Project Assurance Documents

1. NIF Driver and Guard Train Dispatch Communications Protocols – Human Error Analysis. Issue 01
2. Safety Validation Report – Detailed Design. June 2019
3. Overview of Safety Management activities: RTBU key safety concerns. TRIM Reference: DNSW2018/4296. Draft D
4. Risk Associated with PTI and Train Dispatch for NSW Trains. DNSW2019/2742
5. Study of Slips, Trips and Falls (STF) Incidents at the Platform Train Interface (PTI). DNSW2017/32992. Issue 1. 25/10/17
6. Safety Change and Human Factors Integration Plan. TRIM Reference: DNSW2017/32988. Issue 1.2. 30/7/2018
7. Risk Assessment - Proposed Change to Network Standard to enable Train Dispatch using CCTV. Draft, V0.4, 89/09/2019
8. RailConnect, New Intercity Fleet Human Factors Integration Plan, TeamBinder Ref NIF-150010-RCN-EM-000071, Issue 5, 8/2/2019
9. Human Factors Assurance Report – DDR Unit Level. REDU21802. Rev .01. 06/06/2019
10. Safety Assurance Report (Units). REDA201896. Rev 1. 25/06/2018
11. System Hazard & Risk Analysis (Units). REDA201874. 21/05/2019
12. RailConnect, New Intercity Fleet System Safety Plan, TeamBinder Ref NIF-150010-RCN-RS-00001, Revision 5, 14/12/2018
13. Safety Assurance Report (ACC – Access and Egress). REDA202019. 29/03/2019
14. Driver Reminder Appliance (DRA). NIF design options and considerations paper. DNSW2018/3500. V1.0. 09/07/18.

United Kingdom

UK Office of Rail and Road

1. Railway Safety Principles on Driver Controlled Operation. 5th April 2019

UK Rail Safety Standards Board

A. Reports

1. Passenger risk at the platform-train interface. Dated 2011
2. Annual Safety Performances Report 2014/15 - Key facts and figures.
3. Minimisation of accidents at the train/platform interface. T426. June 2006
4. Assessing the impact of increased numbers of CCTV images on driver only operation of trains. 2005
5. Guidance on the use of selective door operation in the GB rail industry. 2008
6. A review of passenger train dispatch from stations. 2008
7. Taking Safe Decisions -How Britain's railways take decisions that affect safety. 2014
8. Research brief: Evaluating technological solutions to support driver only operation train dispatch. T1035 - March 2015
9. Risk associated with train dispatch - Summary of risk analysis and consolidation of current knowledge. July 2017
10. Safety of Driver Controlled Operation (DCO). Dated June 2018
11. Driver Controlled Operation. 09/11/2018
12. Evaluating the use of on-train DCO(P) monitors during station departure: risk analysis. 2018

B. Standards

1. Rail Industry Standard, RIS-2703-RST, Issue 02, 2014
2. Rail Industry Standard: Passenger Train Dispatch and Platform Safety Measures, RIS-3703-TOM. Issue 3, September 2017.
3. Rail Industry Standard: Engineering Requirements for Dispatch of Trains from Platforms. RIS-8060-CCS. Issue 1, September 2017.
4. Rail Industry Standard: Driver Controlled Operation (DCO) On-Train Camera/Monitors (OTCM)RIS-2703-RST. Issue 2, December 2018.

Appendix 4

Questionnaire on train dispatch methods

1. Methodology

To determine current train dispatch practices questionnaire comprising 21 questions with multiple choice answers was distributed to international contacts with a detail knowledge of station operations and train dispatch.

The questions covered issues of responsibility, signalling, monitoring and emergency stop during dispatch.

Answers were received from the following respondents:

Driver and guard - InterCity Translink Northern Ireland (GBR), DMU Translink Northern Ireland (GBR), SWR (GBR), Scotrail (GBR), LNER (GBR), GWR (GBR), KORAIL (KOR), Mainland trains (HKG), ICE (DEU), TGV - SNCF (FRA), NMBS/SNCB (BEL), Trenitalia (ITA)

Driver-only - MTR Crossrail (GBR), Irish Rail, Class 22000 (IRL), National Express (DEU), Saudi Arabian Railways (SAU), East Rail MTR (HKG)

2. Questionnaire

Questions are listed numerically, with possible answers below in letters.

Note: For some of the questions multiple answers are possible

1 How are trains dispatched from a railway station?

- a. By a train driver and guard
- b. By a train driver and guard and where necessary (e.g. at curved platforms/platforms that are congested) platform staff
- c. By only the train driver

2 Who is responsible for controlling the opening of the passenger doors on the train when it comes to a stand in a station?

- a. The train guard
- b. The train driver
- c. Other staff

3 Who is responsible for carrying out the safety checks before the passenger doors are closed?

- a. Train guard
- b. Staff on the station platform
- c. Station control room staff
- d. Train driver
- e. Technical systems

4 Who is responsible for closing the passenger doors on the train?

- a. Train guard
- b. Train driver

5 Who is responsible for carrying out the safety checks after the passenger doors are closed and before the signal to start the train is given?

- a. Train guard
- b. Staff on the station platform
- c. Station control room staff
- d. Train driver

6 Where a train guard/platform staff/station control room staff are involved, who gives the final signal to the driver to start the train?

- a. Train guard
- b. Station platform staff
- c. Station control room staff

7 What method is used to signal to the driver to start the train?

- a. Signal buzzer/bell from the train guard
- b. Handsignal from the train guard
- c. Handsignal from platform staff
- d. Platform indicator/signal operated by the train guard
- e. Platform indicator/signal operated by the platform staff
- f. Platform indicator/signal operated by station control room staff
- g. Radio from the train guard
- h. Radio from the platform staff
- i. Radio from station control room staff
- j. Green indication light in cab

8 Who is responsible for monitoring the train as it moves along the station platform?

- a. No monitoring carried out
- b i. Train guard - looks out of an open window
- b ii. Train guard - looks out of a closed window

- b iii. Train guard - stands at an open door
- c. Staff on the station platform
- d i. Train driver - looks out of an open window in the driving cab
- d ii. Train driver - looks at CCTV monitors in the driving cab
- e. Station control staff observe images on CCTV monitors in a control room

9 What method is used to stop the train in an emergency?

- a. Guard sends message to the driver using a signal buzzer/bell - the driver applies the train brake
- b. Radio message from guard to the driver - the driver applies the train brake
- c. Guard applies the train brake and then signals to/communicates with the driver
- d. Signal from station staff to the guard
- e. Signal from station staff to the driver
- f. Radio message from station platform staff to the driver
- g. Radio message from station platform staff to the guard
- h. Radio message from station platform staff to the driver and guard
- i. Radio message from station control room staff to the driver
- j. Radio message from station control room staff to the guard
- k. Radio message from station control room staff to the driver and guard
- l. Station staff use equipment on the station platform to return the signal to danger and driver then applies the train brake
- m. Station staff use equipment on the station platform to automatically stop the train using the signalling/train protection system
- n. Emergency brakes operated by passenger

10 What station/platform equipment is used for the visual checks?

- a. No equipment
- b. CCTV monitors/mirrors located on the platform, viewed by the train guard
- c. CCTV monitors/mirrors located on the platform, viewed by the train driver
- d. CCTV monitors located on the platform, viewed by platform staff

11 Where CCTV monitors for train dispatch purposes are provided in a station control room, when are these viewed by control room staff?

- a. While passengers are boarding the train
- b. When the passenger doors are closed and before the signal to start is given
- c. As the train moves along the station platform

12 What train equipment, is used for the visual checks required during train dispatch?

- a. No equipment
- b. CCTV monitors, viewed by the train guard
- c. CCTV monitors, viewed by the train driver

13 Where CCTV monitors are provided on the train where are the monitors located?

- a. When used by the train guard
- b. When used by the train driver

14 How many images are displayed on the CCTV Monitors?

- a. How many images are displayed?
- b. How are these configured?

15 Where train CCTV monitors are provided are these required to be viewed as the train moves along the station platform?

- a. No
- b. By the train driver
- c. By the train guard
- d. By the train driver and the train guard

16 Where train CCTV monitors are provided when are the images displayed to the driver switched off?

- a. When the driver applies power

- b. When the train speed reaches a certain value – typically 5kph
- c. Automatically, when the train has left the station platform
- d. Left on permanently

17 Where train CCTV monitors are provided for the train guard to observe when are the images displayed to the guard switched off?

- a. When the driver applies power
- b. When the train speed reaches a certain value – typically 5kph
- c. Automatically, when the train has left the station platform
- d. Left on permanently

18 How many train CCTV cameras are there?

- a. One on every train vehicle
- b. Two on every train vehicle
- c. Other

19 Is an alarm sounded when the passenger doors close?

- a. Only before the doors start to close
- b. Before and during the closure of the passenger doors

20 What kind of protection is provided to detect an obstacle trapped in a door?

- a. Mechanical switches with electrical interlocks to prevent the train from moving if obstructed
- b. Beam detection system(s) with electrical interlocks to prevent the train from moving if the doors is obstructed
- c. Beam detection systems, closing force detection systems, door edge detection system, closing motor current monitoring, moving step monitoring

21 What level of safety checks are required before the train is allowed to start away from the station?

- a. The doors safety system is considered to be sufficient and no visual checks are required
- b. A visual check is always required as there remains a risk that an obstacle is trapped in the doors and has not been detected by the safety system
- c. Despite very good door safety system(s) the behaviour and location of passengers needs to be assessed

3. Summary of Results

C. Train operated by driver and guard

Question	Response
1 Who dispatches train?	Driver & Guard 90% Optional Station Staff or Train Crew 30%
2 Who opens doors on arrival?	Driver 70% Guard 25% Train Crew 8%
3 Who checks before closing doors?	Guard 80% Driver 15% Driver & Guard 5% Station Staff 40%
4 Who closes doors?	Guard 80% Driver 15% Driver & Guard 5%
5 Who checks after closing doors?	Guard 85% Station Staff 45%
6 Who signals driver to start?	Guard 80% Station Staff 45%
7 How is driver signalled to start?	Guard - bell or handsignal 85% Platform indicator 60%
8 Who monitors train moving along platform?	Guard - window 45% Guard - open door 15% Driver - window or CCTV 5% Station Staff 70%
9 What is the emergency stop signal?	Guard - bell/buzzer (55%) Guard - radio (25%) Guard - brakes (40%) Station Staff - signal (45%) Station Staff - radio (5%) Control Room - radio (15%) Station Staff - train protection system (15%)

Question	Response
12 What on-train equipment is used for visual checks during dispatch?	None 45% Driver - CCTV 15% Station Staff - visual 5%
13 Where are on-train CCTV monitors?	Drivers cab 30%
15 Who views on-train CCTV as train leaves?	Driver 5%
16 When is on-train driver CCTV switched off?	At set speed 30%
17 When is on-train guard CCTV switched off?	n/a
19 When is door closing alarm sounded?	Before & during closure 70% During closure 15% Before closure 5%
20 Type of door closing obstacle detection system?	Mechanical switch 85% Beam 15% None 15%
21 Type of safety check before train departs?	Visual 70% None 15% Driver & Guard; Station staff 5%

Train operated by driver only

In the tables below, percentages do not add up to 100% as they indicate the percentage of operators responding with an option. For example guard (80%) and station staff (30%) means that both guards and station staff perform the same action.

D. Train operated by driver only

Question	Response
1 Who dispatches train?	Driver 100%
2 Who opens doors on arrival?	Driver 100%
3 Who checks before closing doors?	Driver 50% Other 50%
4 Who closes doors?	Driver 100%
5 Who checks after closing doors?	Driver 50% Driver and optional Station Staff 50%
6 Who signals driver to start?	Station Staff 75%
7 How is driver signalled to start?	Station staff - platform indicator 50% Station Staff - handsignal 25%

Question	Response
	Auto Indicator 25%
8 Who monitors train moving along platform?	Driver - window or CCTV 75% Station Staff 50%
9 What is the emergency stop signal?	Station Staff - train protection system 25% Station Staff - contact signaller 25% Station Staff - signal driver 25% Station Staff - radio driver 25%
12 What on-train equipment is used for visual checks during dispatch?	Driver CCTV 25% Optional Driver CCTV 25%
13 Where are on-train CCTV monitors?	Drivers cab 50%
15 Who views on-train CCTV as train leaves?	Driver 50%
16 When is on-train driver CCTV switched off?	At set distance or speed 50%
17 When is on-train guard CCTV switched off?	n/a
19 When is door closing alarm sounded?	Before & during closure 100%
20 Type of door closing obstacle detection system?	Mechanical switch 50% Beam 25% Other 25%
21 Type of safety check before train departs?	Visual 75% None 25%

4. Detailed Results

Key:

Blank cell = no response.

* (asterisk) = optional party or action, e.g. "*Guard" means optionally the guard

; (semicolon) = additional party or action, e.g. "Guard; Station Staff" means both guard and Station Staff

- (dash) = action taken, e.g. "Guard - bell" means guard operates bell

Number & Short Question	MTR Crossrail (GBR)	Irish Rail, Class 22000 (IRL)	National Express (DEU)	Saudi Arabian Railways (SAU)	InterCity, Translink Northern Ireland (GBR)	DMU, Translink Northern Ireland (GBR)	SWR (GBR)
Operation Mode	Driver	Driver	Driver	Driver	Driver & Guard	Driver & Guard	Driver & Guard
1 Who dispatches train?	Driver	Driver	Driver	Driver	Driver & Guard	Driver & Guard; *Station Staff	Driver & Guard; *Station Staff
2 Who opens doors on arrival?	Driver	Driver	Driver	Driver	Driver	Driver	Guard
3 Who checks before closing doors?	Driver	Driver	Auto	Guard; *Station Staff	Station Staff	Guard; *Station Staff	Guard
4 Who closes doors?	Driver	Driver	Driver	Driver	Driver	Guard	Guard
5 Who checks after closing doors?	Driver; *Station staff	Driver; *Station Staff	Driver	Driver	Guard	Guard; *Station Staff	Guard
6 Who signals driver to start?	*Station staff	Station Staff		Station Staff	Station Staff	Guard	Guard; Station Staff
7 How is driver signalled to start?	*Station staff - platform indicator	Station Staff - handsignal	Auto Indicator	Station Staff - handsignal	Guard - bell	Guard - bell	Guard - bell; *Platform Indicator
8 Who monitors train moving along platform?	Driver CCTV; *Station staff	Driver - window; Driver - CCTV; Station Staff	Driver - window	Station Staff	Guard - window; Station Staff	Guard - window; Station Staff	Guard - window; Station Staff
9 What kind of emergency stop signal?	*Station Staff - train protection system; *Station Staff - contact signaller	Station Staff - signal driver		Station Staff - radio driver	Guard - bell; Station Staff - signal	Guard - bell; Station Staff - signal	Guard - bell; Guard - brakes
12 What on-train equipment is used for visual checks during dispatch?	Driver CCTV	*Driver CCTV		None	None	None	None

Number & Short Question	MTR Crossrail (GBR)	Irish Rail, Class 22000 (IRL)	National Express (DEU)	Saudi Arabian Railways (SAU)	InterCity, Translink Northern Ireland (GBR)	DMU, Translink Northern Ireland (GBR)	SWR (GBR)
13 Where are on-train CCTV monitors?	Drivers cab	Drivers cab					Drivers cab
15 Who views on-train CCTV as train leaves?	Driver	Driver					None
16 When is on-train driver CCTV switched off?	55m after depart	Speed >5km/h					Speed >6km/h
17 When is on-train guard CCTV switched off?							
19 When is door closing alarm sounded?	Before & During	Before & During	Before & During	Before & During	Before & During	Before & During	Before
20 Type of door closing obstacle detection system?	Other	Mechanical switch	Beam	Mechanical switch	Mechanical switch	Beam	Mechanical switch
21 Type of safety check before train departs?	Visual	Visual	None	Visual	Visual	Visual	Visual

Number & Short Question	Scotrail (GBR)	LNER (GBR)	GWR (GBR)	KORAIL (KOR)	Mainland trains (HKG)	East Rail MTR (HKG)
Operation Mode	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard
1 Who dispatches train?	Driver & Guard; *Station Staff	Train Manager; *Train Crew; *Station Staff	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard
2 Who opens doors on arrival?	Guard	Driver	Driver	Guard	Train crew	Driver
3 Who checks before closing doors?	Guard	Guard; *Station Staff	Guard	Guard	Train crew	Driver; Station Staff
4 Who closes doors?	Guard	Guard	Guard	Guard	Train crew	Driver
5 Who checks after closing doors?	Guard	Guard; Station Staff	Guard	Guard; Station Staff; Control Staff	Station Staff	Station Staff
6 Who signals driver to start?	Guard; *Station Staff	Guard	Guard	Control Staff	Guard	Station Staff
7 How is driver signalled to start?	Guard - bell; *Platform Indicator	Guard - bell	Guard - bell	Guard - handsignal; Guard - radio; Guard - bell; Platform Indicator	Guard - handsignal; Platform Indicators	Station Staff - Platform Indicator
8 Who monitors train moving along platform?	Guard - window; Station Staff	Train Manager - window	Driver - window; Driver - CCTV; Station Staff	Guard - window; Station Staff	Guard - open door; Station Staff	Station staff - CCTV
9 What kind of emergency stop signal?	Guard - bell; Guard - brakes	Guard - bell	Guard - bell; Station staff - signal	Guard - radio; Station Staff - radio; Control Room - radio	Guard - brake; Driver - brake	Station Staff - signal; Station Staff - train protection system
12 What on-train equipment is used for visual checks during dispatch?	Driver - CCTV	None	Driver - CCTV	None	Station Staff - visual	

Number & Short Question	Scotrail (GBR)	LNER (GBR)	GWR (GBR)	KORAIL (KOR)	Mainland trains (HKG)	East Rail MTR (HKG)
13 Where are on-train CCTV monitors?	Drivers cab	Drivers cab	Driver views CCTV	None		Drivers cab
15 Who views on-train CCTV as train leaves?	None		Yes by driver			
16 When is on-train driver CCTV switched off?	Speed >5km/h	Speed >5km/h	Speed >5km/h			
17 When is on-train guard CCTV switched off?						
19 When is door closing alarm sounded?	Before & During	Before & During	Before & During	Before & During		Before & During
20 Type of door closing obstacle detection system?	Mechanical switch	Mechanical switch	Mechanical switch	Mechanical switch	None	Mechanical switch
21 Type of safety check before train departs?	Visual	Visual	Visual	Visual	None	Visual

Number & Short Question	ICE (DEU)	TGV - SNCF (FRA)	NMBS/SNCB (BEL)	Trenitalia (ITA)
Operation Mode	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard
1 Who dispatches train?	Driver & Guard	Driver & Guard	Driver & Guard	Driver & Guard
2 Who opens doors on arrival?	Driver	Driver	Driver; *Guard	Driver
3 Who checks before closing doors?	Guard	Driver & Guard; Station staff	Guard	Guard
4 Who closes doors?	Guard	Driver & Guard	Guard	Guard
5 Who checks after closing doors?	Guard	*Driver & Guard; *Station staff	Guard	Guard

Number & Short Question	ICE (DEU)	TGV - SNCF (FRA)	NMBS/SNCB (BEL)	Trenitalia (ITA)
6 Who signals driver to start?	Guard	*Guard; *Station staff	Guard	Guard
7 How is driver signalled to start?	*Guard - Platform Indicator; *Station Staff - Platform Indicator	Guard - handsignal; Guard - bell; Station Staff - Platform Indicator	Guard - handsignal; Guard - bell; *Guard - Platform Indicator; *Station Staff - Platform Indicator	Indicator
8 Who monitors train moving along platform?	None	Station Staff	Guard - open door	None
9 What kind of emergency stop signal?	Guard - radio; Guard - brakes; Station Staff - signal	Guard - bell	Everything possible	Guard - radio; Guard - brakes; Station Staff - signal; Control Room - radio; Station Staff - train protection system
12 What on-train equipment is used for visual checks during dispatch?				None
13 Where are on-train CCTV monitors?				
15 Who views on-train CCTV as train leaves?				
16 When is on-train driver CCTV switched off?				
17 When is on-train guard CCTV switched off?				
19 When is door closing alarm sounded?	Before & During	Before & During	During	Before
20 Type of door closing obstacle detection system?	Mechanical switch	Mechanical switch	None	Mechanical switch; *Beam
21 Type of safety check before train departs?	None; *Visual	Driver & Guard; Station staff	Visual; *None	Visual; *None