Railway Accident Investigation Unit Ireland

INVESTIGATION REPORT

Trend Investigation:

Road Rail Vehicle occurrences on Iarnród Éireann Network from 2015 to 2018

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Reader guide

All dimensions and speeds in this report are given using the International System of Units (SI Units). Where the normal railway practice, in some railway organisations, is to use imperial dimensions; imperial dimensions are used, and the SI Unit is also given.

All abbreviations and technical terms (which appear in italics the first time they appear in the report) are explained in the glossary.

Descriptions and figures may be simplified in order to illustrate concepts to non-technical readers.

Report preface

The RAIU is an independent investigation unit within the Department of Transport, Tourism and Sport (DTTAS) which conducts investigations into accidents and incidents on the national railway network, the Dublin Area Rapid Transit (DART) network, the LUAS, heritage and industrial railways in Ireland. Investigations are carried out in accordance with the Railway Safety Directive 2004/49/EC enshrined in the European Union (Railway Safety) (Reporting and Investigation of Serious Accidents, Accidents and Incidents) Regulations 2014.

The RAIU investigate all serious accidents. A serious accident means any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety. During an investigation, if the RAIU make some early findings on safety issues that require immediate action, the RAIU will issue an Urgent Safety Advice Notice outlining the associated safety recommendation(s).

When the RAIU consider a full investigation is not warranted the RAIU may issue a Safety Brief to reinforce the correct adherence to existing guidelines or standards that resulted in an accident or incident.

The RAIU may investigate and report on accidents and incidents which under slightly different conditions might have led to a serious accident.

The RAIU may also carry out trend investigations where the occurrence is part of a group of related occurrences that may or may not have warranted an investigation as individual occurrences, but the apparent trend warrants investigation.

The purpose of RAIU investigations is to make safety recommendations, based on the findings of investigations, in order to prevent accidents and incidents in the future and improve railway safety. It is not the purpose of an RAIU investigation to attribute blame or liability.

REPORT SUMMARY

General description

In March, April and June 2018 the RAIU received reports, from Iarnród Éireann-Infrastructure Manager (IÉ-IM), of three collisions between two *Road Rail Vehicles* (RRVs) operation in convoy; prior to 2018, the RAIU had never received a notification of an RRV incident or accident. After a preliminary examination of the three accidents, the RAIU made the decision to review all reported RRV incidents/ accidents from 2015 to 2018 to establish if there was an apparent trend in the causation of these incidents /accidents. In total sixteen occurrences involving RRVs were included in the trend investigation. The occurrences were divided into three main categories:

- Loss of control of RRV – resulting in RRVs collisions with other RRVs;
- Collisions – RRV collisions with infrastructure, *on-track machinery* (OTM) and rolling stock;
- Points run-through by RRV – resulting to damage to points (and in one case derailment).

Immediate causes, contributory factors, underlying causes and root causes

RAIU identified a number of causes and factors associated with the occurrences, the main causes and factors are outlined below.

The main immediate causes to these occurrences was as a result of the RRV Operators (RRVOs) losing control over the operation of the RRVs or losing situation awareness of their surroundings (e.g. due to focusing on other work tasks); or, RRVOs and RRV Controllers (RRVCs) not checking the positioning of the points before travelling over them.

The main contributory factors to these occurrences were:

- RRVOs not allowing adequate time (e.g. speeding) or maintaining sufficient distances between RRVs when operating in convoy;
- RRVOs not controlling the movements of their RRVs in such a way to manage external conditions, such as weather, rail contamination, track gradients; or, not being able to manage RRVs in an emergency situation;
- RRVOs not requesting, following or waiting for instructions from the RRVC; or the RRVC was not effective in providing instructions for the control of movements for the RRVs;
- RRVOs not maintaining situational awareness in terms of the positioning and movements of the other RRVs; or, the presence of other assets (overhead line equipment (OHLE) or rail vehicles);
- RRVOs do not have a clear understanding on the railway infrastructure i.e. they could not differentiate the position of the points when either in normal or reverse positions;
- Lack of supervision from IÉ-IM (through RRVCs) in that there were no RRVCs present during RRV movements or there were not enough RRVCs on site where there are multiple RRVs operating in convoy;
- RRVCs have not requested the correct positioning of points, from the signalman, before requesting the RRVO to travel over the points;

- There is some doubt as to the suitably of the RRVs in their current state, in particular, in terms of braking performance;
- Signalmen did not set the points for the route requested in some instances.

Underlying causes are identified as:

- Inadequate training requirements of RRVOs/RRVCs, as set out in IÉ-IM CCE Plant and Machinery Standard (I-PLM-5001), in the operation of the RRVs;
- Inadequate training of RRVOs in relation to infrastructure on the railway network (e.g. OHLE) and in relation to the operation of RRVs on the railway network (e.g. confined spaces);
- There is some doubt as to the requirements, inspection and maintenance of RRV plant, as set out in I-PLM-5001; in particular, the braking performance in an emergency situation.

Root cause are identified as:

- Section Q of the IÉ-IM Rule Book is not robust in terms of the operation of RRVs in convoy, in particular in terms of the presence and allocation of RRVCs;
- I-PLM-5001 is not effective in terms of the requirement criteria for:
    - Inspection, maintenance and management of plant on site;
    - Training of RRVOs/RRVCs;
    - RRVs operating in confined/ restricted spaces (e.g. height limiters on RRVs).

Other important findings by the RAIU

The RAIU made a number of significant findings in relation to:

- The classification of RRVs and the consequences of the classification;
- The fact that IÉ-IM were not using current European Standards in relation to the design requirements for RRVs.

Safety recommendations

As a result of the RAIU investigation, the RAIU made twenty new safety recommendations:

- Recommendation 2019004-01 – The DTTAS should review the Railway Safety Act 2005 and current amendments to make clear the classification of RRVs; consultation should be sought with the Commission for Railway Regulation (CRR); and, relevant stakeholders where appropriate;
- Recommendation 2019004-02 – The CRR & IÉ-IM should review the requirements prescribed in the Railway Safety Act (and current amendments) to ensure they are satisfied that all the requirements of the Railway Safety Act (and current amendments) are met in terms of RRVs being classified as rolling stock;

- Recommendation 2019004-03 – IÉ-IM should review and improve its current Chief Civil Engineer (CCE) Plant and Machinery Standards; attention should be given to best international practice in RRVs; and, as a minimum, the following should be considered for inclusion:
    - Applying the requirements set out in the EN 15746/ I.S. EN 15746 standards such as controls & indicators, visibility from the cab, warning systems & communications between work positions, etc. Where, due to a technical impossibility, the design specifications of EN 15746 cannot be met in full, control measures to address these deficiencies should be clearly identified, risks assessed, and suitable controls implemented;
    - The installing of an appropriate emergency warning system, which, when activated in emergency, can produce a suitably loud audible alarm and/or visual alarm. In cases, where this is not possible, as a result of a technical impossibility, control measures to address this deficiency should be clearly identified, risk assessed, and suitable controls implemented;
    - Installing *Wheel Slip Prevention* and/or sanders on RRVs;
    - Installing of Anti-Collision Devices (ACDs) on RRVs for the prevention of collisions with other RRVs, rolling stock, infrastructure and staff (through the provision of portable ACDs fitted to staff) on the IÉ network. In cases, where this is not possible, as a result of a technical impossibility, control measures to address this deficiency should be clearly identified, risk assessed, and suitable controls implemented;
    - Introducing an appropriate means of communication between work positions, whereby the RRVOs and RRVCs can communicate while on-tracking, travelling on the railway and at worksites;
    - Installing of data recorders on RRVs;
    - The suitability of the current braking system on Type 9B RRVs where an indirect rail wheel braking system is in place; consideration should be given for the requirement to have all RRVs fitted with direct rail wheel braking systems;
- Recommendation 2019004-04 – IÉ-IM are to engage with the RRV contractors in relation to updated CCE Plant and Machinery Standards; and, give clear guidelines on when these new requirements come into full effect;
- Recommendation 2019004-05 – In relation to existing RRVs, IÉ-IM should assess the operation of existing RRVs to satisfy itself, on the basis of a risk assessment, that there are adequate technical and operational controls to prevent loss of control of RRV occurrences in the future;
- Recommendation 2019004-06 – IÉ-IM should include, in their post-occurrence procedures, a requirement to verify the performance of RRVs (including braking performance) involved in accident, incidents or dangerous occurrences (near misses) to ensure the requirements of the CCE Plant and Machinery Standards are met in full; this should involve the completion of a full post-occurrence examination of the RRV by the contractor. A requirement that RRVs involved in accidents, incidents or dangerous occurrences (near misses) are not permitted back onto the IÉ

network until the post-occurrence procedures have been completed and the RRV is confirmed fit and safe for use;

- Recommendation 2019004-07 – IÉ-IM should update their CCE Plant and Machinery Standards to include requirements for RRV contractors to provide RRV information: at the acceptance stage; and, at later dates where modifications are made to RRVs. Where this information is not provided, and the requirements of the updated CCE Plant and Machinery are not met, the RRVs involved should not be allowed to operate on the IÉ network;
- Recommendation 2019004-08 – IÉ-IM must develop a suitable RRVO training course which must incorporate both theory and practical elements for the operation of RRVs; there should be an assessment on completion of this initial training. When a person passes this initial training, they must complete and log supervised hours of RRV operation; and present for a final through assessment. This process should be risk assessed to determine the: number of days training; practical training requirements; number of supervised hours; and, final assessment requirements;
- Recommendation 2019004-09 – IÉ-IM should develop a competency management system for the management of RRVOs competencies; this system should also include instructions related to re-training and monitoring of RRVOs after they have been involved in an accident;
- Recommendation 2019004-10 – IÉ-IM should conduct a thorough review of their suite of Safety Management System (SMS) documentation and CCE Plant and Machinery standards, related to RRV contractors, to identify deficiencies in terms of the management of contractors and their plant. Where deficiencies are identified, IÉ-IM should develop new systems for the management of plant on site, and, for their safety tour and compliance verification processes to ensure contractors regularly inspect and maintain their plant in good condition; rather than the continued issuance of corrective action notices;
- Recommendation 2019004-11 – IÉ-IM should review the ways in which it promotes a positive safety culture that encourages contractors to report accidents, incidents and dangerous occurrences (near misses); this can be achieved through RRVO workshops and the absence of disciplinary procedures on the reporting of occurrences;
- Recommendation 2019004-12 – IÉ-IM should ensure appropriate procedures are in place for drugs and alcohol (D&A) screening for IÉ-IM and contractor staff post RRV occurrence;
- Recommendation 2019004-13 – IÉ-IM should update their CCE Plant and Machinery Standards to ensure that RRV contractors are either provided with, or required to identify, the hazards associated with track gradient, rail contamination (or other low adhesion conditions) and RRV orientation and position on track through:
    - Assessing documentation on the site-specific hazards associated with RRV and ensuring these are addressed in contractor's safety documentation;
    - Setting requirements in relation to the spacing between RRVs when travelling in convoy (e.g. 100 metres (m)) and putting in place a regime to ensure these requirements are met;

  - Training RRVCs/RRVOs on the risks associated with track gradient, rail contamination and RRV orientation and guidance on how to manage these risks in a braking emergency;
- Recommendation 2019004-14 – IÉ-IM should conduct an audit on RRV contractor's safety documents with a view to identifying deficiencies in terms of safety and ensuring the appropriate safety documentation is produced for the works; IÉ-IM should support and offer guidance to the RRV contractors in terms of the identification of hazards and methods of working on a railway network.
- Recommendation 2019004-15 – IÉ-IM should make changes to the IÉ Rule Book to ensure that all relevant requirements set out in their CCE Plant and Machinery Standards related to RRVs are incorporated into the IÉ Rule Book;
- Recommendations 2019004-16 – IÉ-IM should update their CCE Plant and Machinery Standards to include the requirements set out in Section Q 2018 of the IÉ Rule Book related to the collection of pre-operation checklists by the RRVCs from the RRVOs; and ensure these requirements are enforced through compliance verification activities.
- Recommendations 2019004-17 – IÉ-IM should clearly define, document and explain the role and function of the RRVC in the management of RRVs in Section Q of the IÉ Rule Book and/or relevant CCE Plant and Machinery Standards. This should include:
  - Location of RRVC when on-tracking, during work, and off-tracking;
  - The sighting requirements of RRVCs (i.e. an RRVC should be able to see RRVs in their control at all times);
  - The allocation of RRVCs per quantity RRVs (i.e. how many RRVs per RRVs);
- Recommendations 2019004-18 – IÉ-IM should review and update the training requirements of RRVCs with a view to incorporating:
  - Basic infrastructure training (e.g. points);
  - Training in communications with relevant staff;
  - Practical RRV training to ensure they have confidence in accepting pre-operations checklists from RRVOs as set out in the IÉ Rule Book;
- Recommendations 2019004-19 – IÉ-IM should brief Signalmen on RRVs operations during possessions (i.e. accessing and egressing worksites and well as travelling to worksites training in terms of RRVs operating in possessions) to ensure points are set correctly for the RRV movements. Training material for Signalmen on the roles of RRVs should be updated to reflect this;
- Recommendations 2019004-20 – The CRR and IÉ-IM should review their processes of closing out findings from CRR audits; with a view to identifying opportunities to close out findings, such as updates to the IÉ Rule Book.

Contents

SECTION A: INTRODUCTION TO THE RAIU INVESTIGATION

Part 1 – Introduction

1 To portray the findings of this investigation in a clear concise manner, the report has been presented in the following sections:

- Section A: Introduction to the RAIU investigation;
- Section B: Factual Information – General;
- Section C: Factual Information – RRV occurrences;
- Section D: Analysis;
- Section E: Actions taken by IÉ-IM & the CRR;
- Section F: Immediate Causes, Contributory Factors, Underlying Causes & Root Causes;
- Section G: Conclusions & Safety Recommendations;
- Section H: Additional Information.

Part 2 – RAIU investigation

RAIU decision to investigate

2 In accordance with the Railway Safety Act 2005 and S.I. No. 258 of 2014 European Union (Railway Safety) (Reporting and investigation of Serious Accidents, Accidents and Incidents) Regulations 2014, the RAIU investigate all serious accidents, the RAIU may also investigate and report on accidents and incidents which under slightly different conditions might have led to a serious accident.

3 During March and June 2018 there were three collisions between RRVs which were operating in convoys; prior to 2018 the RAIU had never received a notification of any RRV incidents or accidents. Under slightly different circumstances, any of these collisions may have led to a serious accident, with the potential for fatalities or serious injuries to IÉ-IM or contractor staff; as a result, the RAIU made the decision to investigate these three accidents.

4 The decision was then made to expand the investigation to include other RRV occurrences, on the IÉ network, between January 2015 to December 2018, in order to see if there were any trends into the types and causations of RRV occurrences.

5 Excluded from the investigation were the RRV incidents resulting from non-compliance with *possession* requirements e.g. RRVs which entered the IÉ network without correct possession arrangements in place.

Scope of investigation

6 In total, this RAIU investigation reviewed sixteen RRV occurrences which occurred on the IÉ network from January 2015 to December 2018. The RAIU identified three main types of occurrence:

- Loss of control of RRVs resulting in collisions with other RRVs – Where the operator of an RRV lost control of the RRV resulting in a collision with another RRV;
- Collisions – Where an RRV struck another object (rolling stock, OTMs, RRV or infrastructure);
- Points run-throughs – Where an RRV ran-through points which were not set for the route, resulting in damage to the points and in one instance the derailment of the RRV.

7 The occurrences are as follows:

- Loss of control of RRVs resulting in collisions with other RRVs:
    - Between Athy/Sallins and Ballybrophy, 24th September 2015;
    - Between Ballymote and Boyle, 18th November 2016;
    - Near Edermine Level Crossin (LC), Wexford, 6th December 2017;
    - Between Dublin and Cork, 22nd March 2018;
    - Between Sallins and Newbridge, 10th April 2018;
    - Between Skerries & Drogheda, 16th June 2018.
- Collisions – RRV striking another object (rolling stock, OTMs or infrastructure); namely RRV collision with:
    - Overhead Line Equipment (OHLE) structure (CY22), Church Rd Junction, 13th February 2016;
    - Locomotive handrail between Newbridge and Kildare, 25th February 2016;
    - An OTM at Kildare Station, 27th June 2018;
    - A stabled 29000 in a siding at Connolly, 14th November 2018.
- Points run-throughs at:
    - Points 704 (Inchicore) on the 29th September 2015;
    - Points MN266 (Maynooth) on the 26th August 2016;
    - Points BR116 (Bray) on the 22nd August 2017;
    - Points CL252 (Clonsilla) on the 6th October 2017;
    - Points 750 (Lisduff) on the 26th June 2018;
    - Points PN842 (Portarlington) on the 23rd November 2018.

8 Investigating the occurrences, the RAIU must establish the scope of the investigation to ensure that only pertinent information is recovered and reviewed. Therefore, for this investigation, the RAIU have defined the following scope:

- Establish the sequence of events leading up to the occurrences;
- Establish, where applicable, the immediate causes, contributory factors, underlying factors and root causes;
- Examine the relevant elements of the certification of RRVs;
- Examine the framework agreement for *plant* hire services for RRVs;
- Examine the monitoring and auditing of RRV contractors;
- Examine the training and competency management system in place for RRV operators;
- Examine the relevant elements of IÉ-IM's SMS.

Investigation and evidence

9 During this investigation the RAIU collated and logged the following evidence:

- Witness testimonies from IÉ-IM and contractor personnel;
- Certifications associated with RRVs;
- IÉ-IM documentation related to training competency management of RRV operators;
- IÉ-IM documentation related to the RRV machinery (including plant & machinery standards);
- IÉ-IM investigation reports into RRV incidents and accidents;
- Contractor documentation associated with inspection of RRVs;
- Contractor documentation associated with safe work method statements;
- Contractor SMSs;
- European and Irish standards related to RRV operations;
- Rail Accident Investigation Branch (RAIB) (United Kingdom (UK)) investigations associated with RRVs;
- Rail Safety and Standards Board's (RSSB) Rail Industry Standards;
- Railway Safety Act 2005 in relation to new rolling stock assessments;
- IÉ-IM Framework Agreements with RRV contractors.

SECTION B: FACTUAL INFORMATION – GENERAL

Part 3 – Parties & roles directly and indirectly involved in the occurrences

Parties directly involved in the occurrences

Iarnród Éireann

10 IÉ-IM is the *infrastructure manager* (IM) who owns and operates their railway infrastructure in Ireland and operates under a Safety Authorisation certificate issued by the CRR. The IM Safety Authorisation is issued in conformity with Commission Regulation (EU) 1169/2010; the authorisation was renewed in 24th March 2018 for a period of four years.

11 The IÉ-IM departments involved in the occurrences and relevant to this investigation include:

- IÉ-IM CCE's Department – responsible for the design, inspection, maintenance and renewal of the railway's structural infrastructure and the management of risks associated with these assets e.g. ballasting works conducted under possession;
- IÉ-IM CCE Safety Department – Department which issued bulletins in relation to the safe operation of RRVs after accidents;
- IÉ-IM Centralised Traffic Control (CTC) – responsible for the efficient management of track use across most of the IÉ network, in particular over lines that are directly supervised through signalling control. CTC also grant possessions;
- IÉ-IM Signalling, Electrical and Telecommunications (SET) Department - responsible for the design, installation and maintenance of signalling equipment i.e. responsible for the functionality of the points;
- IÉ-IM Safety Department – Responsible for safety, including carrying out investigations into RRV occurrences and managing safety/ briefing contractors after such occurrences.

Contractors

12 There are several independent contractors who own, supply and operate RRVs for IÉ-IM. The contractors have not been directly identified, by name, in this investigation report.

13 Contractors operate on the IÉ network through the IÉ-IM CCE's, SMS document, CCE-SMS-005 entitled Contractors and Permit to Access (to be referred to as CCE-SMS-005 for the remainder of this report), Version 1.0 operative since the 30th November 2010, with the current version, Version 5.0 re-issued on the 12th March 2018. CCE-SMS-005 will be further discussed in paragraphs 118 to 122.

14 There is also CCE Plant and Machinery Standard, I-PLM-5110 entitled "Management of Plant on Site" (to be referred to as I-PLM-5110 for the remainder of the report) which has been operative since 2008. I-PLM-5110 will be further discussed in paragraphs 111 to 113.

Roles involved in the occurrences

IÉ-IM roles involved in the occurrences

15 The main roles involved in RRV occurrences, as set out by Section T Part Three and Section Q of the Rule Book are as follows (it should be noted that not all these roles are involved in all of the occurrences):

- IÉ-IM Person In Charge of Possession (PICOP) – The person responsible for: ensuring that the necessary protection is provided for the possession; authorising movements entering or within the possession to ensure their safety; and ensuring that the possession is given up properly so that normal working is safely resumed (Paragraph 9.1, Section T Part Three of the Rule Book);
- IÉ-IM Engineering Supervisor (ES) – The person responsible for ensuring that the necessary marker boards are provided to indicate the limits of the worksite; to authorise movements entering or within the worksite to ensure safety; and, to ensure the worksite is clear when work is finished so that the possession may be safely given up (Paragraph 10.1, Section T Part Three of the Rule Book);
- Track Safety Co-ordinator (TSC) – The person responsible for making arrangements to prevent anyone in your group being endangered by trains (Section 6.0, Section B Part Two of the Rule Book);
- Person In Charge (PIC) /RRV Controller (RRVC) – The person responsible for directing the movement of the RRV (Section Q). Note: For occurrences in and prior to 2017, the correct terminology for the person responsible for directing the RRV is the PIC. For occurrences in 2018, the correct terminology is RRVC. The roles and responsibilities of the PIC/RRVC are further outlined in Part 6 of this report;
- A person may hold one or more of the above titles at a given time.

Contractor roles directly involved in the occurrences

16 The contractor roles involved in the occurrences are outlined in the sections referring to the individual occurrence, however, the main contractor role associated with the occurrences is the:

- Operator of RRV/ RRV Operator (RRVO) – The person responsible for the operation of the RRV. This person must hold a valid certificate for the specific type of RRV (excavator, dumper, etc.) under the construction skill certificate scheme and are generally employed by the owner of the RRV in use. Note: For occurrences in and prior to 2017, the correct terminology is Operator of RRV; for occurrences in 2018, the correct terminology is RRVO.

17 It was found through the RAIU investigation, that all the RRV Operators /RRVOs were certified as competent, in terms of the current competency requirements, to carry out the works allocated. The training of Operators of RRVs/RRVOs will be outlined in Part 7 of this report.

Parties not directly involved in the occurrences

SNC-Lavalin Rail & Transit

18 SNC-Lavalin Rail & Transit (to be known as SNC-Lavalin for the remainder of the report), formerly Interfleet, are a UK based company accredited with the necessary certification mandated under CCE Department's Plant and Machinery Standard, I-PLM-5001, entitled 'Certification of Road/Rail Vehicles' (to be referred to as I-PLM-5001 for the remainder of the report) to conduct works related to the RRVs. Version 1.3 is the version relevant to all the occurrences under investigation in this report and was published on the 1st January 2015.

19 SNC-Lavalin can act as a representative for IÉ-IM and grant *Engineering Acceptance Certificates* (EAC).

Commission for Railway Regulation

20 The CRR is the national safety authority, whose statutory mandate is to ensure that each railway organisation has developed, implemented, and is complying with its SMS and that it conforms to the legislative requirements in accordance with the Railway Safety Act 2005 and the European Railway Safety Directive.

21 The CRR are committed to advancing railway safety, the maintenance and further development of high performing and sustainable railway systems and ensuring fair access to the Irish conventional railway network in Ireland through regulation, monitoring, encouragement and promotion.

22 The CRR is required to ensure that each railway organisation operating in Ireland understands and effectively manages the risk to safety associated with its activities.

23 The role of the CRR in terms of the Safety Assessment of New Rolling Stock will be discussed in paragraphs 34 to 37; and in terms of audits related to RRVs will be discussed in paragraphs 160 to 163.

Part 4 – General description of the railway

Infrastructure

24 The lines involved range from single track bidirectional lines to two track unidirectional lines. The majority of the track is flat bottom continuously welded rail (CWR) mounted on concrete sleepers in ballast. No factors related to the condition of the track were found to have contributed to the occurrences.

25 OHLE is installed along the DART line sections to supply traction power at 1,500 volts direct current to electric trains. The OHLE is supported by a mixture of portal, headspan and cantilever structures. No factors related to the condition of the OHLE were found to have contributed to the occurrences.

26 Railway points are mechanical installations enabling trains to be guided from one track to another such as at a junction or where a siding branches off. No factors related to the condition of the points were found to have contributed to the occurrences.

Signalling and Communications

27 The lines involved in the occurrences were controlled by PICOP during T3 Possessions at various locations on the IÉ network.

28 The routes were generally fitted with two, three, and four aspect colour light signals. Trains are signalled under Track Circuit Block regulations and train detection is achieved by a combination of track circuits and axle counters.

29 The means of communication between the relevant staff involved in T3 Possessions is via telephone (including mobile telephone and signal post telephone).

Operations

Possessions & Protection

30 IÉ Rule Book, parts of Section T must be in place on any line that may be fouled or obstructed by an RRV. Relevant to the RAIU investigation are T3 Possessions[1] which are possessions taken for an agreed period without the facility to run passenger trains in the area during that period until such time as the holder of the possession decides to relinquish it.

31 The RAIU investigation will not outline the complete protection arrangements for all RRV occurrences in detail, as in the majority of cases the actual arrangements were planned, arranged and executed to the requirements of the IÉ Rule Book. In most cases, the RAIU will just reference the fact that the possession was granted and taken by the IÉ staff; any anomalies in these arrangements will be outlined.

[1] Sometimes referred to as TIII or Absolute Possession

Part 5 – Road Rail Vehicles

General description

32 An RRV as a self-propelled machine that can run on rails and ground (Note 1: It is normally a road vehicle adapted for running on rail also but can be a specially designed rail vehicle for running on the ground also. Note 2: It does not imply that the machine is suitable for use on the public road). RRVs may only operate within a possession and are exclusively used for infrastructure plant.

33 IÉ-IM are not the RRV asset owners of the RRVs involved in the occurrences associated with this investigation; but rather the RRVs are hired through a central procurement tender agreement from several contractors. The contractors also supply the Operators of RRV/RRVOs to drive and operate the RRVs.

Are RRVs Rolling Stock?

RAIU Determination

34 As set out in the Railway Safety Act 2005, *rolling stock* is any *train* or any type of other vehicle with flanged wheels which is designed to operate on the railway. The RAIU consider that RRVs are rolling stock as RRVs are vehicles with flanged wheels; and, as such are subject to the requirements set out in Section 43 of the Railway Safety Act 2005 (with substitutions by the European Union (Railway Safety) Regulations 2013 (S.I. No. 444 of 2013) which requires that a *railway organisation* shall not bring into operation new rolling stock unless[2]:

(a) It has submitted a safety assessment (referred to in this section as a "new rolling stock assessment") to the CRR containing such information—

(i) As it considers appropriate to demonstrate to the satisfaction of the CRR the safety of the new rolling stock; or,

(ii) Submit a safety management document, using guidelines prepared by the CRR in relation to the content of the safety management document, such as the appropriate technical principles and specifications;

(b) The CRR, where satisfied as to the safety of the new rolling stock on the basis of information contained in the new rolling stock assessment (or revised new rolling stock assessment), has communicated in writing its acceptance of the new rolling stock to the railway organisation.

35 As a result, IÉ-IM (who would have been IÉ in 2005), who are a railway organisation, would have been required to submit a new rolling stock assessment, for RRVs, to the CRR; and, the CRR did not request a new rolling stock assessment. This is due to the fact that IÉ-IM do not believe that RRVs are rolling stock; and, the CRR, although agreeing in principle that RRVs are rolling stock,

[2] Note: Some sections of the Railway Safety Act 2005 are abridged for ease of reading.

that a rolling stock safety assessment is not required; the reasons are set out in the following paragraphs.

CRR Opinion

36 The CRR's position in relation to the classification of RRVs is that "it is the CRR position that RRVs are in principle rolling stock, however, they do not operate on the **live railway**. RRVs are operated by contractors as part of their construction equipment during TIII possessions and not operated by RUs or an IM. A TIII possession in which RRVs operate would in the view of the CRR be a **construction site**. RRVs as rolling stock are not brought into operation by a railway undertaking or an infrastructure manager but rather by the contractor themselves. They are owned, operated and maintained by contractors in connection with the **construction work** that is being undertaken. In this context Section 43 of the RSA 2005 is not seen as applicable to RRVs. The focus of the use of the RRVs is on a **closed** railway and therefore members of the public or rail passengers are not impacted. Those exposed to risk are employees working at the site during the TIII possession. The construction activity associated with the TIII will come under the Safety Health and Welfare at Work Construction Regulations 2013 as the means to assess and control risks. In addition, the supervision of such activities by the authorised infrastructure manager (IM) is done under their SMS. Applicable standards used by IMs during such supervision include IM-SMS-005 - Management of contractors, CCE-SMS-005 - Contractors Permit to Access and the Plant and Machinery Standard I-PLM-5001, Certification of Road/Rail Vehicles".

37 In response, the RAIU consider that:

- RRVs are working on a railway; there exists no definition for a "live railway" or "closed railway". Although passenger services are not running; there can be movements of engineering trains (such as the accidents identified in this report involving an RRV collision with an OTM at Kildare Station, 28th June 2018 (paragraphs 315 - 326); and the RRV collision with locomotive handrail, Newbridge – Kildare, 25th February 2016 (paragraphs 300 - 314)), the rules and regulations set out in the IÉ Rule Book, such as Section T and Section Q, apply;
- Although, there are definitions in the Safety Health and Welfare at Work (Construction) Regulations 2013 for *construction sites*, *constructions work* and structures (see glossary); the Safety Health and Welfare at Work (Construction) Regulations 2013 apply, in conjunction with the requirements of IÉ Rule Book (such as Section Q and Section T). In addition, RRVs are not solely used for construction works, they are also used for inspection and examination of structure, this is not construction work;
- Although RRVs may be operated by contractors, the movements are controlled by IÉ-IM staff;
- The work is not undertaken on a "closed worksite" with no impact to the public; although Section Q sets out instructions related to the movements of RRVs over level crossings; the RRVs do directly impact the public in that they traverse road level crossings.

IÉ-IM Opinion

38 IÉ-IM have taken issue with the RAIU omitting the definition for a vehicle (as set out in Section 2 of S.I. 70 of 2011) which defines *vehicle* as a "railway vehicle suitable for circulation on its own wheels on railway lines, with or without traction composed of one or more structural and functional subsystems or parts of such subsystems"; where subsystem means "the result of the division of the railway system as referred to in the *Interoperability Regulations*, which may be structural or functional"; where subsystems are covered by one Technical Specification for Interoperability (TSI). As no TSI exists for RRVs, RRVs should not be considered rolling stock. Also, IÉ-IM have taken issue with the term circulation, where they have made a determination that this means "circulation on the IÉ rail network".

39 In responses, the RAIU consider that:

- There is no legal basis for assuming that "circulation" means circulation on the network and the term is likely to have come from a French text of 2008/57/EC which refers to "circuler" with the English translation text being "runs on"; meaning the circulation would mean "runs on" its own wheels, rather than circulates on the IÉ the network;
- Interoperability Regulations do not specifically require that RRVs have a TSI and making an assumption that as there is no TSI does not automatically mean that an RRV is not a vehicle and therefore not rolling stock.

RAIU Response to the CRR & IÉ-IM Opinions

40 The RAIU, on reviewing the opinions from other stakeholders, and after seeking legal clarification; conclude that RRVs are rolling stock but appreciate the Railway Safety Act 2005 and amendments need to be reviewed to ensure clarity. This is not further discussed in the analysis or conclusions sections of this report, but the RAIU have made two safety recommendations in relation to the issue namely, Recommendation 2019004-01 and Recommendation 2019004-02 (paragraph 521).

41 It should be noted, although, different legislation, other European countries consider RRVs to be rolling stock, such as the Czech Republic, Denmark, Norway, Portugal, Romania, Spain and Sweden.

Standardised types of RRV

General information

42 For harmonisation with Europe, wheel configuration of RRVs have been categorised by the 'European Commission for Standardization' as Type 9 machines, of which there are three types, 9A, 9B and 9C.

Type 9A Machines – Self-Powered Rail Wheels

43 Type 9A Machines have self-powered rail wheels (see Figure 1) with the advantage that the traction and braking are directly on the rail wheels, making them more consistent with normal rail machines and hence removing the potential interface problem between rubber tyre and steel wheel or rail (RSSB, 2015)[3]. They are the only RRV that can be fitted to tracked vehicles. However, these machines are typically more expensive than the other two types of RRV.

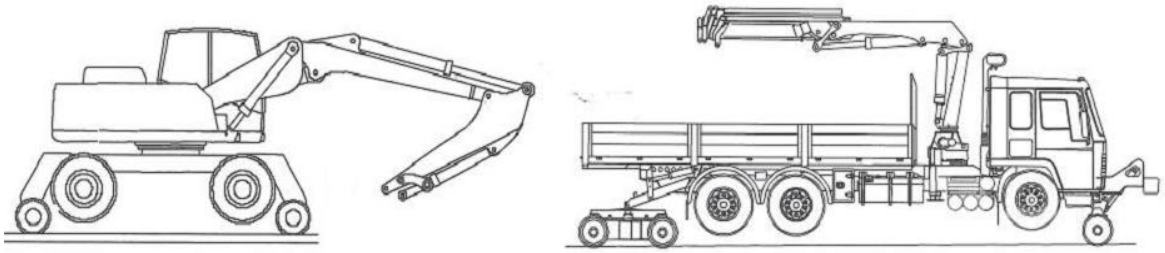

Figure 1 – Type 9A self-powered rail wheels

Type 9B – High Ride Machines

44 Type 9B High Ride Machines is where the traction is indirectly applied to the rail wheel through the road wheel, braking direct on the rail wheel (see Figure 2). Road wheels may drive the rail wheels (see A of Figure 2) or a spindle drum attached to the wheel (See B of Figure 2). Type 9B machines are recognised as a convenient and cost-effective conversion from a standard road machine. Care has to be taken in the design so that the load of the road wheel on the rail wheel is maintained during all wear of the rubber tyre.

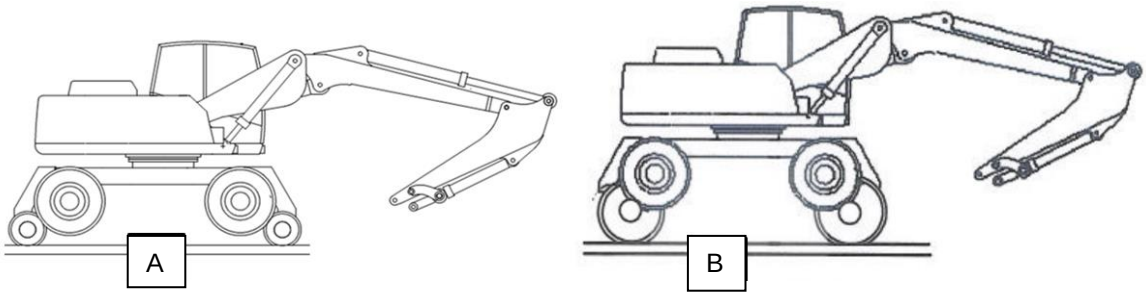

Figure 2 – Type 9B High Ride Machines

[3] Advantage and disadvantages of RRV types and figures have been taken from the Railway Safety & Standards Board (RSSB), Rail Industry Standard, RIS-1530-PLT, for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys.

45 However, there are several disadvantages, identified by the UK's RAIB[4] and RSSB, Rail Industry Standard including that:

- Traction (and braking where the rail wheels are not separately braked) relies on two interfaces: between the road and the rail wheels, and between the rail wheels and the track[5];
- Friction between rubber and steel is very variable depending on the conditions (poor when wet/contaminated. It is also dependent on the maintenance of the correct force between the rubber wheels and the rail wheels);
- Wheel slide can occur even on clean dry rails if the rail wheels lock against the road wheels;
- Unbraked conditions can occur during on/ off-tracking if the process is carried out incorrectly;
- When in rail mode driving forward, the drive train must run in reverse compared with normal on road use;
- Road wheel driving spigots act as a gear ration and results in significant increase in travel speed compared to road model;
- Use of spigots although longer, results in a smaller contact area due to the reduced diameter;
- A greater force in needed at the spigot to road wheel contact point to generate the traction or braking force required giving rise to a greater tendency for the rubber tyre-to-steel spigot interface to slide.

46 All Type 9B RRVs that were not fitted with direct rail wheel brakes have been prohibited on the Network Rail managed network due to the risks involved since September 2014. This is not an enforced requirement on the IÉ network.

Type 9C – Low Ride Machines

47 In Type 9C Low Ride Machines braking and traction is achieved by the road wheels (see Figure 3), meaning it is a simple conversion with relatively low cost. Type 9C machines have the advantage over 9B machines in that the rubber tyres are providing traction and braking directly onto the rail (i.e. one interface instead of two on the 9B) giving very good adhesion on the rail head that is clean and dry (RAIB, 2009; RSSB, 2005). In addition, Type 9C machines have extended tyre life, when compared to Type 9B machines due to less pressure required between the road wheel and the rail head.

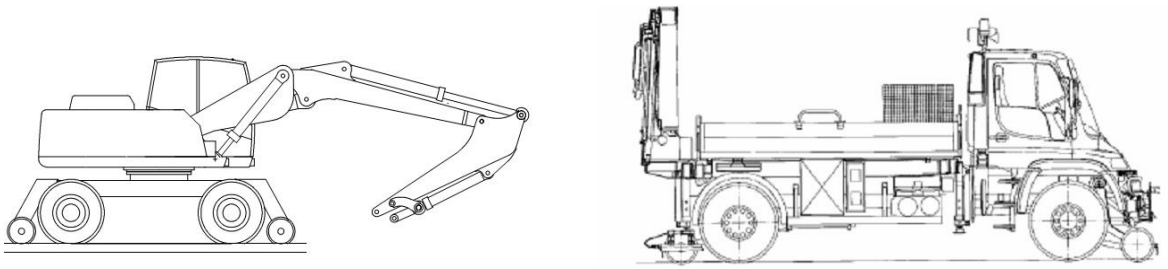

Figure 3 – Type 9C low ride machines

[4] RAIB (2009), Investigation into runaways of road-rail vehicles and their trailers on Network Rail.
[5] On the 14th September 2014, Network Rail formally prohibited all type 9B 'high ride' road rail vehicles without direct rail wheel braking systems fitted.

48 However, there are a few disadvantages (RAIB, 2009; RSSB, 2005) including:

- Care needs to be taken so that the load is shared correctly between the machine's road and rail wheels to provide adequate guidance from rail wheels and traction /braking from road wheels;
- Similarly care needs to be taken in the design for when the machine is traversing level crossings that the load on the rail wheels is not reduced;
- Can be susceptible to operator abuse by lifting the rail wheels to improve adhesion from the road wheels where adhesion conditions are poor.

49 In addition, on the IÉ network, Type 9C RRVs were reported as damaging the axle counters.

Note

50 Irrespective of type, when an RRV is in rail mode the braking distance is significantly greater than road mode i.e. the vehicle takes longer to stop.

Types of RRV on the IÉ Network

51 Paragraph 1.1 Principles in Section Q, Part One: Road-Rail Vehicles of the IÉ Rule Book (issue 10/16 published in 2016), states that "only certified RRVs and Trailers may be used", certification will be further discussed in paragraphs 58 to 62.

52 High ride RRVs (Type 9B) are the pre-dominant type of RRV on the IÉ network, with excavators and dumpers the most common conversions. The preference for high-rides on the IÉ network, according to I-PLM-5001 (5.1.2) is "due to gauging problems with road wheels in some areas" with other RRVs, the standard continues by stating that "low ride vehicles are not permitted to be used unless they meet the full requirements of this technical standard and have written permission to operate from IÉ or its representative".

53 Over seventy percent of the RRVs in operation on the IÉ network are RRVs that had been previously certified and operated on the British Rail/Rail Track and/or Network Rail infrastructure networks in the UK.

54 Relevant to the near-exclusive use of Type 9B RRVs and the fact that a vast majority are being imported from the UK; is that Type 9B RRVs, that are not fitted with direct rail wheel brakes, are now prohibited on the UK's Network Rail system (paragraph 46). Another reason for the use of Type 9B RRVs is as a result of other types of RRVs damaging axle counters (paragraph 49).

55 There are approximately one hundred RRVs operating on the IÉ network every given night; depending on the works this can be significantly more (e.g. vegetation management). As of November 2018, 378 are certified for operation on the IÉ network.

56 All RRVs involved in the occurrences outlined in this RAIU report are Type 9B RRVs.

57 In addition, it should be noted, that since the commencement of this RAIU report, a contractor has finalised the purchase of a Type 9A machine for use on the IÉ-IM network. This is a milling machine used for cutting and grinding of the rail head for rail head management, see Figure 4 for stock image of this type of machine.

Figure 4 – New Type 9A RRV on IÉ network

IÉ-IM certification of contractor RRVs

Certification of Road/Rail Vehicles, I-PLM-5001

General description

58 Certification of RRVs is carried out to CCE Department's Plant and Machinery Standard, I-PLM-5001. I-PLM-5001 refers to a number of Irish and European standards and directives; the ones which affect RRVs are:

- Safety, Health and Welfare at Work (Construction) Regulations 2006;
- Safety, Health and Welfare at Work (General Application) Regulations 2007 - Use of Work Equipment;
- EU Directive 93/68/EEC – The CE Marking Directive (which was incorrectly referenced and should have referred to 2006/42/EC – Machinery Directive, which was published on the 9th June 2006). The Machinery Directive, Directive 2006/42/EC, is a European Union directive concerning machinery and certain parts of machinery. Its main intent is to ensure a common safety level in machinery placed on the market or put in service in all member states and to ensure freedom of movement within the European Union by stating that "member states shall not prohibit, restrict or impede the placing on the market and/or putting into service in their territory of machinery which complies with [the] Directive".

59 SNC-Lavalin have been contracted by IÉ-IM, since 2009, to verify compliance and certify RRVs operating on the IÉ network under the requirements of I-PLM-5001. An EAC is then issued by IÉ-IM, or its representative (SNC-Lavalin), for an RRV when it:

- Meets the technical criteria set out in I-PLM-5001;
- Has the appropriate mandatory certification under Irish legislation, including:
    - Signed certificates from the manufacturer specifying the safe working load (SWL) of each RRV, taking account of different configurations of the RRV and any additional safety provisions;
    - The 12-monthly Report of Thorough Inspection by an independent examiner or competent person (not the owner) for each RRV (GA1);
    - The Weekly Inspection Report (GA2) by the operator/driver for each RRV.

60 The EAC must identify the vehicle, define the vehicle configuration, identify maintenance documentation and any limitations applicable for the safe use of the vehicle. EACs must be carried on the vehicle at all times and the expiry date of the certificate displayed on each side of the RRV.

61 I-PLM-5001 also addresses: structural design; statics and dynamics; gauge; braking; electrical and safety; labels; fire; personnel areas; visibility and audibility; towing and propelling; vehicle specifics; and, maintenance plans.

62 The RAIU have accepted that the EACs for the RRVs involved in the occurrences were approved to IÉ-IM's current specifications.

Braking

63 As a result of the number of RRV occurrences involving collisions of RRVs with other RRVs, lineside equipment and rolling stock, the RAIU have reviewed Section 6 'Braking' of I-PLM-5001 which requires that RRVs have a parking brake capable of holding the fully laden vehicle on a 1-in-29 gradient[6]. Compliance is demonstrated through a horizontal pull-test of the vehicle that needs to be 6% of its GVW (gross vehicle weight) without any wheel revolving.

64 In terms of the service brakes, RRVs can either have:

- A single braking system which is fail safe (i.e. loss of braking medium applies the brake) and capable of stopping the vehicle in the stopping distances shown in Figure 5.
- Two independent braking systems which are capable of stopping the vehicle in the stopping distances shown in Figure 5.

Vehicle Speed (km/h)	Stopping Distance (m)
8	6
16	18
24	36
32	60

Figure 5 – Stopping distances

65 All braking tests should be conducted on level dry rail, and the demonstration of three stops is required in each condition to prove compliance.

Maintenance Plans

66 According to Section 14 of I-PLM-5001 each vehicle must have an approved maintenance plan that will ensure the vehicle and associated equipment is kept in compliance with I-PLM-5001 throughout its working life. The maintenance plans are controlled documents kept within the contractor's quality system; and records should be kept demonstrating that the maintenance plans are being followed. The plans must include details on:

- Staff – Identifies the minimum level of competence of staff involved in RRV maintenance;
- Facilities – Sets the minimum facility requirements such as clean, dry, covered accommodation with adequate illumination;
- Base vehicle documents – Including manufacturer's manuals prior to conversion;
- Maintenance Frequency – Time periods for maintenance, such as: daily, weekly, six-monthly and annually;
- Job description – Each maintenance plan must contain a job description for each component or system that requires attention and at what frequency;

[6] There are additional requirements where an RRV is towing a trailer, however, not relevant to the RAIU investigation.

- Component-specific requirements – Examples of componence-specific requirements as set out by I-PLM-5001 are as follows:
    - Brakes – Each maintenance plan must detail brake test instructions. As a minimum, there must be an annual brake test of the vehicle in worst-case conditions. In addition to checking that the vehicle meets the stopping distance requirements, its performance should also be compared to previous results. If these differ significantly, further checks must be conducted;
    - Rail Wheels – The maintenance plan must detail the maintenance requirements of rail wheels and detail the wear limits for that particular wheel type. These requirements should at least detail minimum wear diameters, maximum size of defects (including flats, cavities, cracks and false flanges) and back-to-back dimension;
    - Road Wheels – When vehicles are used in high-ride mode (Type 9B) with road wheels driving and braking the rail wheels, it is also important to define the maintenance requirements for the road tyres. This should include minimum wear limits, tyre type, tread pattern and interference with the rail wheel.

Part 6 – RRV Standards

European Standard & Irish Standards

European Committee Standardization (CEN) Standards

67 European Committee for Standardization (CEN) have two documents, first published in 2010, relevant to RRVs:

- Railway Applications - Track - Road-rail Machines and Associated Equipment Part 1: Technical Requirements for Running and Working, EN15746-1+A1 (to be referred to as EN15746-1 for the remainder of the report) was approved on the 21st April 2010 and amended on the 21st October 2011;
- Railway applications – Track – Road-Rail machines and associated equipment – Part 2: General safety requirements, EN 15746-2:2010+A1 (to be referred to as EN 15746-2 for the remainder of this report) was approved by the on the 11th March 2010 and amended on the 13th September 2011.

68 EN 15746-1 and 15746-2 are Type C standards according to EN ISO 12100 - General principles for design. Type C standards are machine safety standards dealing with detailed safety requirements for a particular machine or group of machines e.g. RRVs.

69 CEN members (of which Ireland's national standards body is a member) are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. However, it should be noted that European Standards are "voluntary" which means that there is no automatic obligation to apply them i.e. meaning that there are no Irish laws that make EN 15746-1 and EN15746-2 compulsory for IÉ-IM to adopt for RRVs operating on the Irish IÉ network.

70 The RAIU consulted other European countries in relation to the use of EN 15746-1 and EN 15746-2 and found that these are used with either directly or indirectly (through Railway Industry Standards) by the Netherlands, Norway, Portugal, Romania, Spain, Germany and the U.K. and are used as guidelines in Sweden. The RAIU did not received responses from all European countries, but noted that other countries have contributed to EN 15746-1, such as from Belgium, Czech Republic, Denmark, Germany, Finland, France, Italy, Luxemburg, Austria, Switzerland, and Poland; where some countries include additional devices for RRVs, such as data recorders (France) and light configurations (Luxemburg, Austria, Switzerland, Denmark and Italy).

71 EN157-61-1 outlines the types of RRVs, gauges requirements, running configurations, wheels requirements, loading design requirements, safety equipment and design requirements.

72 EN 15726-2 is a sixty-nine-page document, which details approximately seventy subjects related to the hazards and hazardous situations common to self-propelled RRVs which arise due to the adaptation for their use on railway networks. It covers the common hazards during assembly and installation, commissioning, travelling on/ off track, use including setting, programming, and

process changeover, operation, cleaning, fault finding, maintenance and de-commissioning of the machines. The common hazards dealt with include the general hazards presented by the machines, also the hazards presented by the following specific machine functions: a) excavation; b) ballast *tamping*, *ballast cleaning*, *ballast regulating, ballast consolidating*; c) track construction, renewal, maintenance and repair; d) lifting; e) overhead contact line system renewal / maintenance; f) maintenance of the components of the infrastructure; g) inspection and measurement of the components of the infrastructure; h) working in tunnels; i) shunting; j) vegetation control; k) emergency rescue and recovery; during commissioning, use, maintenance and servicing.

National Standards Authority of Ireland

73 The National Standards Authority of Ireland (NSAI) has transposed EN 15746-1 and EN 15746-2, into standards:

- I.S. EN 15746-1:2010+A1:2011, Railway Applications - Track - Road-rail Machines and Associated Equipment Part 1: Technical Requirements for Running and Working, published on the 16th July 2018;
- I.S. EN 15746-2:2010+A1:2011, Railway applications – Track – Road-Rail machines and associated equipment – Part 2: General safety requirements, published on the 16th July 2018.

74 The NSAI website states that “A standard is an agreed way of making a product, managing a process, delivering a service or supplying materials. Standards can be agreed for all aspects of how we live, from standards for quality, product performance and safety to standards for building design and services. Standards create a climate of trust in the marketplace for goods and services. For customers, a product or service which is certified to a standard is a badge of quality. For businesses, compliance with standards can provide protection against unfair competition and help instil consumer confidence. NSAI Standards, as a member of CEN CENELEC (European Committee for Electrotechnical Standardisation), is committed to complying with CEN CENELEC membership requirements and participates in a regular review process to ensure ongoing compliance. This includes a commitment to the following: transparency; openness and sustainability; impartiality and consensus; effectiveness and relevance; coherence; viability and stability”. The NSAI further states that “Within Ireland, NSAI develops standards through a consultative process, which usually involves the following stages: identifying the need to set a standard; defining the scope of the standard (e.g. the technical, environmental or safety specifications which need to be set); consulting with other interested parties with a view to achieving a consensus; publishing the agreed standards for the relevant product or service issuing certification

75 These NSAI standards include the same details of the CEN Standards; and, as with the CEN Standards, I.S EN 15746-1 and I.S. EN 15746-2 are voluntary.

76 IÉ-IM have stated that they were not consulted by the NSAI prior to the publication of these standards, although, it is noted that there is no requirement for consultation.

Requirements set out in EN 15746-1 & EN 15746-2

General

77 Only topics set out in EN 15746-1 and EN 15746-2 related to the RAIU investigation will be highlighted in this report (as I.S. EN 15746-1 and I.S. EN 15746-2 are effectively the same as the CEN documents, these will not be referred to directly), which are:

- Visibility from the cabs (EN 15746-2);
- Operators controls and indicators (EN 15746-2);
- Braking systems (EN 15746-2);
- Emergency stopping devices (EN 15746-2);
- Warning systems (EN 15746-2);
- Communications between work positions (EN 15746-2);
- Movement limiting devices (EN 15746-1);
- Visibility and audibility of the machine (EN 15746-1).

Visibility from the cab

78 According to Section 5.4.7.1 of EN 15746-2, in terms of visibility from the cabs, operators shall have a direct or indirect view, e.g. by means of a monitor, of the working tools that they control and along the track as far as needed for safe operation. This includes that the operator shall have direct or indirect visibility of any part of the track where persons can be endangered during intended use, and as far forward as necessary to stop before an obstacle.

79 In respect to in running configuration (section 5.4.7.2 of EN 15746-2), the track and signals shall be visible from the driving position by direct line of sight when running. If such visibility is not achievable in reverse direction because of the physical design of the machine, then:

a) A working place shall be provided for an assistant (provided with controls for stopping the movement of the machine and for sounding a warning), who has sufficient visibility by direct line of sight to be able to stop from maximum speed clear of any track obstruction; or,

b) Closed circuit television (CCTV) shall be provided in the cab with field of view both in the immediate vicinity of the rear of the machine and into the distance along the track sufficient to be able to stop clear of any obstruction when travelling at maximum speed. The screen shall be capable of distinguishing between red, yellow and green lights in all lighting conditions. Where the view along the track in the direction of movement is achieved by using CCTV then the machine shall be designed so as to limit the speed to not greater than 20 km/h.

80 Relating to working configuration (section 5.4.7.3 of EN 15746-2), the operator shall have a clear view of the work being undertaken and where this cab also controls movement along the track sufficient forward visibility by direct line of sight to be able to stop clear of any obstruction when moving along the track at maximum working configuration speed. If not possible, (a) and (b) in paragraph above apply, or:

c) Devices, e.g. ultrasonic[7], shall be placed at each machine end which shall stop the movement, if persons or obstacles in the movement area are detected and before they are reached; or,

d) In the event of technical impossibility of all the preceding choices: means of communication with another operator on the ground to control movement along the track in conjunction with the operator, with the speed limited to 4 km/h.

Operators controls and indicators

81 Section 5.14 of EN 15746-2 includes Table 4 which sets out requirements in terms of operators controls and indicators; these include: brake pressure gauge; contact pressure gauges, lift height limiter indicator, overload warning, etc. Of particular note, is the requirement for a warning and display indication for speed in both directions (as a digital or analogue display). It should be noted that not all RRVs operating on the IÉ network have speedometers fitted. Where speedometers are fitted they may not operate in the reverse direction and may only give an indication of the speed of the road wheels i.e. it is not the true speed of the RRV as the road wheels and rail wheels are different diameters.

Braking systems

82 According to Section 5.24 of EN 15746-2 the machine in rail configuration the manufacturer shall ensure that machines meet the requirements for slowing down, stopping, braking and immobilisation so as to ensure safety under all the operating, load, speed and gradient conditions allowed for. As a minimum RRVs shall have one of the following two options:

- Two separate and independent braking systems each capable of stopping the fully loaded machine and any unbraked trailing load permitted by the manufacturer, on level track, in dry conditions, within the distance given in Table 6 of EN 15746-2 (see Figure 6). At least one of the independent braking systems has to work independently of the engine power source; or,

[7] Although noted that EN 15746-2 references ultrasonic devices, the RAIU consider that a Global Positioning System (GPS) ACD is more appropriate for the prevention of collisions; and can be fitted/worn by both the RRV plant and the staff on site (e.g. the RRVC who is controlling the movements of the RRV.

- A single braking system that can be demonstrated to be fail safe (i.e. a system where no single point failure, including the absence of energy supply, leads to an unbraked machine and where the single failure is normally rapidly detected and the probability of a second failure following a detectable initial failure is low) capable of stopping the fully loaded machine and any unbraked trailing load permitted by the manufacturer, in rail configuration, on level track, in dry conditions, within the distance given in Table 6 of EN 15746-2 (see Figure 6).

Machine speed	Maximum stopping distance on level track of machine and any permitted (by the manufacturer) unbraked trailing load
km/h	m
8	6
10	9
16	18
20	27
24	36
30	55
32	60
40	90
50	155
60	230
70	300
80	400
90	500
100	620

Figure 6 – Stopping distances, EN 15746-2

83 For Category 9B (high ride) machines the manufacturer shall design the braking system to ensure that the coefficient of friction between road and rail wheel is greater than 0.3 and thus will not be the limiting factor for grip.

84 It should be noted that EN 15746-2 does not specify that brake lights must be fitted.

Emergency stopping devices

85 According to 5.12 of EN 15746-2 the manufacturer shall determine the number, location and effect of emergency stopping devices on the basis of a risk assessment; and should be designed in accordance with EN ISO 13850 “Safety of machinery – Emergency stop function – Principles for design” and as a minimum be placed inside the working cabs and in the vicinity of working equipment on both sides of the machine. The activation of any emergency stopping device shall always allow the operation of the braking system described in paragraph 82. The activation of any emergency stopping device located on the outside of a machine shall cause the brakes to apply and the machine to stop moving along the track within the stopping distances shown in Figure 6.

86 There is no improvement on the braking performance through the application of the emergency stopping device.

Warning Systems

87 Although paragraph 5.26 of EN 15746-2 does refer to acoustic and visual warning systems to warn personnel of machinery movement it does not refer to any warning systems in terms of warning personnel in the event of an emergency e.g. loss of control of an RRV.

Communications between work positions

88 Paragraph 5.9 of EN 15746-2 states that “where working cabs and cabs combined for both work and travel as well as permanent work places outside of cabs are designed for simultaneous occupation, they shall have a means of voice communication with each other, e.g. intercom”.

Working limit

89 Section 5.2.3 of EN 15746-1 requires that RRVs and their moveable component parts shall be designed and built wo work without unintentional interference with the kinematic envelope necessary for the running of RRVs. Movement limiting devices can ensure the avoidance of accidental intrusion into the kinematic envelope; and height and rotation limits can be applied to suit each working location.

Visibility & audibility of the machine

90 Section 5.15 of EN 15746-1 sets out the requirements in relation to the visibility and audibility of the machine.

91 In terms of visibility, three white marker light in a triangular formation are required at each end and should be illuminated for the direction of travel; and two red taillights, at each end, the opposite end to the direction of travel. The document also sets out the light intensity ratings, candela (cd), for the operating configurations. Optical warning devices should be installed on both sides of the RRV.

92 In terms of audibility, Section 5.15.8 sets the acoustics of the horn, in measurements of decibel (dB); Section 5.16 sets the acoustics in terms of audibility in the event of an emergency.

Certification of RRVs in relation to EN 15746-1 & EN15746-2

93 At the time of engagement of SNC-Lavalin in 2009 to develop I-PLM-5001, EN 15746-1 and EN15746-2 had not been published; although it should be noted that EN 15746 was published one year later in 2010 and has remained active as of 2018.

94 Although EN 15746-1 and EN15746-2 are voluntary standards, SNC-Lavalin have not used any of the guidance available in the documents, stating “we do not directly assess the machine under the requirements of European Standard EN 15746 as that it is not part of our remit”.

IÉ-IM adherence with EN 15746-1, EN 15746-2, I.S. EN 15746-1 & I.S. EN 15746-2

95 IÉ-IM do not conform with the CEN or NSAI standards, although it should be noted, that both are voluntary. It was noted that several countries have adopted the EN 15746 standards, either directly or indirectly (paragraph 70).

Part 7 – Training and competency management of Operators of RRVs/RRVOs

Training requirements

Overview of requirements

96 According to I-PLM-5001, RRV Operators must be competent to operate their vehicles when on IÉ track, and must be in possession of up-to-date:

- Personal Track Safety (PTS) Certificate;
- Safe Pass Certificate;
- Construction Skills Certification Scheme (CSCS) Certificate;
- IÉ-IM's RRVO Safety Training Course.

Personal Track Safety (PTS)

97 PTS is a one-day railway safety awareness programme aimed at people accessing the railway corridor and other sites on the IÉ network. The aim is to outline the individual health and safety risks associated with working on the railway. The programme is classroom based, except for a short walk on ballasted track.

Safe Pass Certificate

98 Safe Pass is a one-day safety awareness programme aimed at construction workers. The aims of the programme are to raise the standard of safety awareness in the construction industry and that all construction workers after completing the programme can make a positive contribution to the prevention of accidents and ill health while working on a worksite.

Construction Skills Certification Scheme (CSCS)

99 CSCS provides for the training, assessment, certification and registration of non-craft operatives within the construction sector. CSCS is provided under S.I. No. 291 of 2013 of Schedule 5 of the Safety, Health & Welfare at Work (Construction) Regulations 2013, which provides a list of tasks that require the successful completion of training. Included in the list of tasks, is the operation of dumper and excavator machinery (i.e. like those used for RRV conversions).

100 For both these machines, the programme consists of:

- Three days training on the machine, which is broken down into:
    - One day of theory training (site induction, review of safe operation of plant and machinery and introduction to the machine);
    - Two days practical training (servicing and pre-start checks, introduction to the controls, operation of machinery, manoeuvring around site, operating on gradients);
    - One-hour practical assessment and the issuance of a "Provisional CSCS Card" and a logbook which allows the operator to work, under supervision, on work experience;
- Two-hundred hours of logged hours, under supervision, on the machine in a minimum of six months and maximum of two years;
- One day of full testing on the machine, on completion of the 200 hours, before a full CSCS card will be issued.

RRVO Safety Training Course

101 As and from the 20th November 2017, RRV Operators/RRVOs were required to undertake a safety training course (as required by I-PLM-5001) to establish a basic knowledge of the IÉ-IM rail infrastructure (including all rail assets). The main points of learning are related to the:

- Speed of RRVs within a possession and in worksite;
- Environmental conditions that may affect rail head conditions and the subsequent impact on the stopping distances of RRVs;
- Training on how to identify the position of the points;
- Person/s authorised to give instructions.

102 The training is a one-day theory training course covering the above items. There is no practical element to the training.

103 It should be noted that of the sixteen occurrences reviewed by the RAIU as part of this trend investigation, eight had completed the RRVO Safety Training Course. In relation to those who had not received the training, there were eight occurrences over a period of twenty-three months; and, of those that received the training, there were eight occurrences over a period of thirteen months.

Competency requirements

104 PTS Certification is valid for a period of three years for contractors, after which a refresher course is required.

105 Safe Pass Certificate is valid for four years, after which a one-day refresher is required.

106 CSCS Certificate is valid for five years, after which a new card must be requested (the main purpose of renewal is to change the photograph). There is no refresher course required.

107 IÉ's RRVO Safety Training Course is a one-off training course with a multiple-choice assessment; and, does not require a refresher course.

Re-training after an occurrence

108 Between 2015 and 2018 there was no formal training or re-training for RRVOs after an occurrence. The RRVO was required to meet with the Safety Manager CCE who discusses the occurrence with the RRVO before the Safety Manager CCE decides whether the RRVO can return to work.

109 Between 2016 and 2018 there was also no requirement for additional monitoring and support over a period of time, similar to that of train drivers.

Experience of RRVOs

110 During the RAIU's investigation process, the RAIU requested information from RRVOs and RRVCs in relation to the general driving skills of the RRVOs in rail mode; the RAIU made the following findings:

- RRVOs can report to work on the IÉ network without ever having driven an RRV;
- Inexperienced RRVOs often have difficulty on-tracking RRVs and require additional support from RRVCs;
- RRVCs manage inexperienced RRVOs by segregating them from other RRVs, where possible; issuing warnings to other staff to maintain a safe distance from the inexperienced RRVO;
- RRVCs support RRVOs in gaining experience and guide them on how to operate RRVs;
- In some cases, RRVCs have difficulty getting new RRVOs to operate to their directions.

Part 8 – Management of Plant on Site, I-PLM-5110

111 I-PLM-5110 is a very high-level document which sets out procedures, in terms of safety and performance which staff must follow on site when managing plant provided by contractors; and, standard covers Plant supplied to IÉ-IM by plant suppliers whose operators then work under the direct supervision of IÉ-IM staff (which is the case for RRVs).

112 The document is a short seven-page document which sets out details in relation to implementation of works at the:

- Planning Stage – Including planning of the work activities, movements of plant, protection arrangements and confirmation of certification of contractor's plant and staff;
- Commencement of Works – Including IÉ-IM checks on contractor plant and staff and the briefing of IÉ-IM and contractor staff. The briefing should include the identification of responsibilities, the works to be undertaken, the site boundaries and protection arrangements, details of specific/hidden infrastructure to be avoided, site-specific hazards and general safety arrangements and design;
- During the Works – The works are done under the instruction of IÉ-IM staff who are responsible for the implementation and management of safe work;
- Post-Works – IÉ-IM safe must ensure that works have been completed safely as regards train operation, passengers and personnel; the protection arrangements removed, and the relevant documentation sent to the Divisional Offices.

113 There is one reference to RRVs which states "Additional requirements apply where road/rail vehicles are to be provided and operated by a contractor. Refer to the Safety Manager, CCE".

Part 9 – IÉ-IM's Safety Management System

Introduction

114 There are a number of SMS documents relevant to this RAIU investigation, they include:

- CCE-SMS-001, CCE Safety Management System – Describes the CCE's SMS and the activities, accountabilities and roles of CCE staff in the management of workplace and/or worksite, Occupational Safety, Track Safety, Plant & Machinery Safety, Buildings & Facilities Safety, Buildings and Facilities Mechanical and Electrical Safety and Structures Safety. It was first published in 2010 and is currently on Version 6.0. It will be referred to as CCE-SMS-001 for the remainder of this report;
- CCE-SMS-005, Contractors Permit to Access (previously Permit-to-Work) – Sets out the requirements for the selection, management and monitoring of contractors at all CCE Locations that engage in minor civil engineering works for the CCE Department and/or provide plant and labour services for the maintenance and upkeep of the IÉ-IM infrastructure. Operative since 2010 and currently operating from Version 5.0. It will be referred to as CCE-SMS-005 for the remainder of this report;
- CCE-SMS-007, Reporting of Accident & Incidents – It is the policy of the CCE Department to meet the statutory obligations and IÉ-IM obligations regarding reporting and investigation of accidents and incidents in order to improve the technical and workplace practices so as to reduce the level of risk in the workplace and with regard to track and structures. Previously published in 2013, its current version is Version 4.0. It will be referred to as CCE-SMS-007 for the remainder of this report;
- CCE-SMS-008, Safety Tours and Compliance Verification – Its aim is to meet the statutory and IM obligations regarding the monitoring of safety and to execute Safety Tours and Compliance Verification in order to reduce the level of risk in the workplace and at worksites. First published in 2010, and now on Version 4.0. It will be referred to as CCE-SMS-008 for the remainder of this report.

SMS, CCE-SMS-001

115 In terms of RRVs, these are included under the Plant & Machinery requirements of CCE-SMS-001; the Chief Civil Engineer is responsible for attending all CCE Safety Steering Group meetings to review safety performance at the CCE Department and ensuring that all the actions and initiatives related to occupational safety and Plant & Machinery Safety (e.g. risk assessments, audits, hazard reports, etc.) are progressed and concluded in a timely manner by the CCE Department. In terms of contractors, safety accountability includes ensuring regular Safety Tours are done to verify that Contractors using contracted or their own equipment do so in a manner consistent with their method statement and in accordance with the intended purposes and in a

manner consistent with safe operation for the application and use in question; this will be discussed under CCE-SMS-008 (paragraphs 124 - 125).

116 Line Managers (through Regional Managers and Supervisors) must ensure that contractors comply with their Permit to Access (Section 6.11) and work within their parameters; discussed in CCE-SMS-005 (paragraphs 118 - 122).

117 Infrastructure Managers are responsible for ensuring that contractors follow a safe method of working by having the required systems in place for working safely and do carry out the works safely.

Contractors Permit to Access, CCE-SMS-005

118 Under 'Monitoring and Inspecting of Contractors' (Section 3.6, V 5.0) the Accountable Line Manager is accountable for ensuring that all contractors working in or at that their location are regularly monitored and inspected according to CCE-SMS-005 and CCE-SMS-001, specifically, that contractors are regularly inspected on Safety Tours (as in CCE-SMS-008) to ensure they work strictly in accordance with the method statement/safe system of work for the activity being undertaken.

119 Under 'Auditing of Contractors' (Section 3.7, V 5.0) the local Safety Executive for the CCE Location is accountable for regular audits of those contractors working in or at the CCE Location by managing, controlling and implementing a Contractor Audit Programme and will record the findings of such audits including details of any non-compliance and follow up with corrective actions where required. Details of major and / or consistent non-compliance will be recorded and raised at local safety meetings with CCE management and at the Contractor Safety Review Workshop; and a Corrective Action Notice (CAN) may be issued.

120 A CAN (Section 3.8. V 5.0) is a document issued to the contractor at the time of audit, outlining the observed non-compliance and required corrective actions to address the issues detailed; a response must be returned, by the contractor, with forty-eight hours. Follow-up audits must occur and the actions are closed out at the Safety Review Workshop.

121 In terms of 'Accident Reporting' (Section 3.14, V 5.0) the contractor shall immediately report all accidents (whether minor or those incurring lost time), dangerous occurrences and "near misses" as soon as possible to the IÉ-IM Line Manager or his representative on site. Contractors must carry out their own formal investigation into all accidents, dangerous occurrences and "near misses", and submit written reports to the IÉ-IM CCE Department.

122 As per CCE-SMS-001 and CCE-SMS-005 a Contractor's Safety Review Workshop is held by the Head of Engineering Safety every two months, the key objectives include identifying contractor's hazards (through Safety Tours, Hazard Report Forms, Accident Reports, findings from Risk Assessments, etc) and agree on the appropriate actions to be taken.

Reporting and Investigation of Accidents and Incidents, CCE-SMS-007

123 CCE-SMS-007 requires that all employees alert their supervisor and/or Line Manager to incident and accidents in the workplace, whether related to Occupational Safety, Plant & Machinery Safety, Track Safety or Structures Safety.

Safety Tours and Compliance Verification, CCE-SMS-008

124 Plant & Machinery Safety accountability requires that regular Safety Tours are carried out to verify that Contractors using contracted or their own equipment does so in a manner consistent with their method statement and in accordance with the intended purposes and in a manner consistent with safe operation for the application and use in question (Section 3.1.5).

125 These Safety Tours should be completed in a thorough and complete manner and ensuring that managers/supervisors/inspectors do the required number of Safety Tours to the same standard.

Compliance with CCE SMS documentation

Overview

126 The RAIU requested and received information in relation to IÉ-IM's CCE-SMS-001, CCE-SMS-005 and CCE-SMS-008. It appears that IÉ-IM are conducting these at the right frequency and requesting all the information from the contractors, as well as carrying out follow-up checks (i.e. where a contractor has said work has been done, IÉ-IM have visually checked) and IÉ-IM have issued a number of CAN Forms (paragraph 120).

Findings related to RRV Plant

127 From a sample selection of CAN Forms provided to the RAIU, it can be seen that, there are a number of items regularly reported which require the completion of CAN Forms as a result of non-compliance with I-PLM-5001, such as:

- Expired EACs;
- Broken/missing mirrors;
- High-volumes of RRVs being left unlocked, unsecured and in some cases with the keys "hidden" on the RRV;
- High-volumes of issues related to the road tyres fitted to the RRVs in all areas on the network, for example:
    - There are several requests for tyres to be replaced (see Figure 7 for an example of a tyre identified by IÉ-IM as needing to be replaced), and CANs have been raised as a result of the inspections;
    - Notification of delamination of tyres;
    - In an email dated the 15th February 2016, based on an audit carried out the day before a Regional Manager (Limerick Junction North) from IÉ-IM states "Where foam filled tyres

may not pose the same surface or sidewall defects as pneumatic tyres, my concern is where the rubbed tyre has been cut in to or severely separated from the inner tyre wall; is there sufficient resistance for the driver to stop and control the dumper when required, for example, when approached staff on site…" and in relation to one of the contractors the emails continues that the contractor in question "has a history of poor quality tyres on their machines and was requested previously to change tyres… I believe a contractor should be pro-active in their maintenance of tyres, etc, rather than waiting for IÉ-IM staff to raise issues with their vehicles";

- Another inspection carried out by IÉ-IM on the 24th November 2018 found that there was "two bad tyres" on an RRV dumper owned by a contractor which the inspector requested to be changed and the contractor informed IÉ-IM they were changed, however, the inspector followed up on site on the 27th November2018 and only one tyre had been changed.

Figure 7 – Tyre identified by IÉ-IM which needs replacement

Findings related to RRVOs

128 From a sample selection of CAN Forms provided to the RAIU, it can be seen that RRVOs:

- Regularly do not carry out the weekly inspection reports for the RRVs using the GA2 inspection form (paragraph 59) as set out in I-PLM-5001;
- Have not been briefed on method statements;
- Do not have suitable PPE/ are not wearing suitable PPE.

Liquidated Damages

129 Where contractor conditions are not satisfactory, IÉ-IM can claim for liquidated damages as a result of any findings during inspection, tours or otherwise. These liquidated damages are set out in the Performance Regime Table of the Contractor's Framework Agreement. Example damages are set out in Figure 8.

Performance Regime		
Conditions (as set out in Framework Agreement)		**Liquidated Damages**
Health & Safety	Breach of any health and safety requirements of the Framework Contract.	€1,000 each & every breach
Punctuality/ Availability	Each and every instance of lateness/non-availability from the commencements of schedules shift.	€100 - €250 per person/machine
Unsuitable Plant	Plant which fails to meet the requirements of the Framework Contract.	€250 per machine
Unsuitable Operatives	Operative who fail to meet the requirements of the Framework Contract.	€250 per person
Unsuitable Vehicle Documentation	Vehicle documentation which fails to meet the requirements of the Framework Contract.	€100 per machine
Non-compliant Documentation	Documentation which fails to meet the Framework Contract.	€100 per purchase order line item

Figure 8 – Performance Regime

130 IÉ-IM Contracts Management applied liquidated damages to RRV contractors on Framework Agreements on approximately ten occasions for issues related to health and safety breaches. Also, in two case, the "ultimate sanction" of termination from a Framework Agreement was imposed on RRV contractors for issues related to EAC certification and GPS reports.

Part 10 – IÉ Rule Book, Section Q & other relevant documentation

Introduction

131 Section Q of the IÉ Rule Book must be applied to RRVs when: going on or near the line; *on-tracking; travelling; working; off-tracking.* The RAIU investigation is examining RRV occurrences from 2015 – 2018. During this time period there have been two versions of Section Q:

- Section Q 2007 – Section Q, 'Protection and Working of Self-Propelled On-Track Machines and Road/Rail Vehicles', Issue 11/07 was issued in 2007;
- Section Q 2018 – Section Q, issue 10/16 was briefed in December 2017, and became operational on the 1st January 2018. It is a three-part document, with Part One addressing RRVs.

Section Q 2007 versus Section Q 2018

Section Q 2007

132 Only clauses which are relevant to this RAIU investigation are included in this section. The roles involved and clauses relevant in Section Q 2007 (Clauses 1.0 – 3.6) are as follows:

- Operator of RRV – A competent person to drive and operate an RRV, who operates under the direction of the PIC;
- PIC – A competent person who arranges possessions and protection for RRVs and instructs the Operator of the RRV. A PIC may drive and operate an RRV in addition to carrying out the duties of PIC.
- RRVs are not permitted to work outside the limits of a possession and protection must be provided on any adjacent line or sidings open to traffic;
- Speeds must not exceed 15 mph over points and crossings;

133 Clauses 4.0, 'Instructions to PICs of RRVs' requires that under 4.1 'General Instructions' PICs:

- "Must be familiar with and present at the location where the vehicles is placed on and removed from the line and where it works";
- Check that the vehicles are authorised; and the Operator is competent to drive and operate under instructions and not start work or make any movement unless authorised by the PIC.

134 In terms of placing/removing the vehicle on/from the line (Clauses 4.2 and 4.6, respectively):

- The vehicle may be placed on the line only at a location authorised by the CCE;
- Check the correct possession and protection arrangements are in place;
- Obtain permission from the PICOP to enter, cross or foul the possession; or the ES to enter a work site;
- Tell the PICOP/ES when the vehicle is completely clear of all lines.

135 When the vehicle is moving or working, the PIC must ensure that:

- The vehicle is not permitted to move or work outside a possession/protection;
- Crane jibs (where attached) are secured;
- Arrange for any unworked points to be secured before permitting work nearby.

Section Q 2018

136 Only clauses which are relevant to this RAIU investigation are included in this section.

137 As mentioned previously, Section Q 2018 became operational on the 1st January 2018. IÉ-IM Procedures Unit carried out a number of presentations to brief staff, and the changes were highlighted in the Weekly Circular (WC).

138 Section Q 2018 renames the roles of the Operator of the RRV and PIC to RRV Operator (RRVO) and RRV Controller (RRVC), respectively. The RRVO may carry out the duties of the RRVC if competent to do so, in this case, another RRVC is not required. Section Q 2018 states that the RRVC is responsible for making sure: the protection arrangements are in place; any other line that may be affected is protected; emergency equipment is readily available. The RRVC must be present when an RRV is: about to go on or near the line; on-tracking; travelling; working; off-tracking.

139 The main principles outlined in 1.1 relevant to the occurrences under investigation are as follows:

- RRVs are not permitted to work outside the limits of a possession and protection must be provided on any adjacent line or sidings open to traffic (which is similar to Section Q 2007). The RRVC makes these arrangements;
- In addition, for the IÉ network only, RRVs may still only be used within T3 or T4 arrangements but, there is now a rule allowing RRV to travel from one to the other (Clause 4.1);
- Speeds must not exceed 5 mph over points and crossings (which is a reduction of 10 mph from Section Q 2007), in addition, they must not exceed 5 mph in a worksite or 20 mph outside a worksite.

140 It should be noted, that I-PLM-5001 requires that the maximum speed over checkrails is 2 km/h. This is not addressed in Section Q 2018.

Section Q, Instructions to the RRVO

General Instructions

141 Paragraphs 3.0 – 3.5 of the 'Instructions to the RRVO', in Section Q Part One of the IÉ Rule Book sets out the instructions for RRVOs. The sections relevant to the occurrences discussed in this report are outlined in this section of the report.

142 RRVOs must have been given permission by the RRVC before: going on or near the line; on-tracking; making rail movement with the RRV; and, off-tracking.

143 RRVOs must never exceed 20 mph (32 km/h) in rail mode; and must never exceed 5 mph (8 km/h) when in a worksite or passing over points and crossings. However, RRVOs must make all movements at a speed that will allow the RRVO to stop the RRV within the distance you can see is clear.

144 RRVOs are responsible for making sure that all points are in the correct position for the safe movement of the RRV before passing over them.

Checking the RRV

145 Prior to going on or near the line with an RRV the RRVO must:

- Carry out the checks and tests shown on the pre-operation checklist (all tests must be done prior to the RRV going on or near the line, apart from the test that can only be done when rail-mounted);
- Hand the pre-operations checklist to the RRVC. However, a paragraph in WC 3798 for the week ending the 24th December 20017, entitled 'Revision to Rule Book Section Q', it states "The Rules state the checklist must be collected by the RRVC however this requirement is not being implemented on the IÉ Network at this time"; the RAIU understands this is due to an Industrial Relations issue with RRVCs which is under review by IÉ-IM at this time.

Travelling in convoy

146 Where authorised by a PICOP or ES you can be directed to travel in convoy under the control of the RRVC.

147 When travelling in convoy, the RRVO must understand:

- How far the movement is to proceed;
- The conditions of the movement;
- Where the RRVC will be controlling the movement from;
- That they must maintain a safe distance between the RRV the RRVO is responsible for, and the other RRVs in transit.

Section Q, Instructions to the RRVC

General Instructions

148 Paragraphs 4.0 – 4.10 of the 'Instructions to the RRVC', in Section Q Part One of the IÉ Rule Book sets out the instructions for RRVCs. The sections relevant to the occurrences discussed in this report are outlined in this section of the report.

149 The RRVC must be present and have knowledge of the lines when/where an RRV is: about to go on or near the line; on-tracking; travelling; working; off-tracking.

150 Before allowing an RRV to start travelling or working, you must have a signed copy of the RRVOs pre-operation checklist (which is not occurring at this time as explained in paragraph 145);

151 In IÉ-IM only, the RRVC can control more than one RRV under the following conditions:

- The RRVC informs the PICOP or the ES;
- The RRVC informs each RRVO: how far the movement is to proceed; the conditions of the movement; where the RRVC will be controlling the movement from; ensuring a safe distance is maintained between RRVs in transit.

152 When working near points, the RRVC must make sure all points are in the correct position for the safe movement of the RRVs over them.

IÉ-IM internal recommendations in relation to Section Q

153 On the 24th December 2014, IÉ-IM published 'Report of investigation into Run Through of Points No. DN610B at Howth Junction 17th January 2014" in relation to an RRV points run through. The report made three recommendations, one of the recommendations: 'The IM Rules Group to review Section Q in relation to PICs controlling RRV movements', was made on the basis that 'it does not specify in the Rule Book the number of PICs required for worksites with multiple RRVs'.

154 This was made in relation to Section Q 2007, however, it is noted by the RAIU the Section Q 2018 still does not specify how many PIC/RRVCs are required for worksites.

Contractors & Section Q 2018

155 By way of example, the RAIU reviewed one of the contractor's Safety Statements, which was revised in May 2018 (after the introduction of Section Q 2018). The document, which was over one hundred pages, included typical elements associated with a Safety Statement, such as: responsibilities; training, personal protective equipment, training hazard identification and control and emergency procedures.

156 As part of the document, the contractor identified a hazard associated with 'Working At, On or Around Rail Tracks' including a list of hazards (see Figure 9). The hazard associated with collisions between two RRVs, operating in convoy or otherwise, was not identified.

LIST OF HAZARDS

1. Machinery movements during sweeping operation.
2. Slip, trip or fall hazard on uneven surface during works, and on rails.
3. Lifting of heavy equipment.
4. Collision between train and RRV.
5. Collision between RRV and road vehicles at Level Crossings.
6. Collision with persons carrying out other works in the possession.
7. Derailment at Points or Points run-through.
8. Contact with overhead power lines.
9. Failure of the RRV to clear the possession due to breakdown.
10. Derailment of train due to track fault after work being carried out on the line.

Figure 9 – List of Hazards – Working At, On or Around Rail Tracks

157 The section continued with a list of control measures/ systems for hazards associated with working at, on or around the rail tracks, including:

- The RRV must not exceed 15 mph (25 km/h) when: approaching or crossing any level crossing; passing through a worksite; or, driving over points;
- The PICOP/ES must arrange to stop the RRV before any points and examine the points to ensure that they are correctly set for the chosen route before proceeding.

158 Given, that this document was revised in May 2018, the above two are incorrect, in that the correct speeds for the above are 5 mph (8 km/h); and, the RRVO and the RRVC are both responsible for checking the points. In addition, the controls do not mention that the RRVO must work under the direction of the RRVC only (the role of the RRVC is not mentioned in the document).

Part 11 – CRR Audits in relation to RRVs

General description of CRR Audits

159 The CRR[8] set purposes and scopes for audits with a view to identifying any *Major* or *Minor Non-Compliances, Action-Required* items, *Scope for Improvement* (SFI) items and *Good Practice* item; and making recommendations to address the findings. The RAIU found that the audits submitted to the RAIU, related to RRVs, appear to be thorough and made a number of findings. The audits reviewed by the RAIU as part of this investigation are as follows:

- RSC Audit of – 15/14-A Iarnród Éireann's Safety Management System, Vertical slice audit – CCE SMS, published July 2014;
- IÉ-IM's Management of OTMs and RRVs in Possessions, Supervision Activity No. 37/14-A, published November 2014;
- RSC Audit No. 05/15-A.
- A Location specific audit – Iarnród Éireann's Infrastructure Manager (IÉ-IM) CCE Division 5, published in August 2015;
- Iarnród Éireann – Infrastructure Manager, Chief Civil Engineer's Department: The Management of Track, CRR Audit No. 116/16-A, published in April 2017;
- Supervision Activity No. 32/17-A, An Audit of - Iarnród Éireann Infrastructure Manager Chief Civil Engineers - Risk Control Measures Related to the Supply of Safety Critical Components, published in December 2017.

[8] Known as the Railway Safety Commission (RSC) at the time.

Allocation of the PIC/RRVC

160 The CRR carried out an audit as part of their supervision activities (Supervision Activity No. 37/14-A) between July and August 2014. The audit included a number of possession inspections by CRR Inspectors with a particular focus on compliance of OTMs and RRVs. The audit resulted in the CRR identifying one Minor Non-Compliance, seven Action-Required items, seven SFIs items and one *Good Practice* item; and making recommendations to address the findings.

161 IÉ-IM appear to have addressed the recommendations in all case; however, the RAIU note the following recommendation related to an SFI item related to the clarification of the role of the PIC (now the RRVC):

- IÉ-IM CCE should clearly define, document and brief the role of the PIC in the management of RRVs. This should include:
    - Location of PIC in possessions and work sites (i.e. inside or outside of an RRV);
    - The sighting requirements for a PIC of RRVs (i.e. should a PIC be able to see an RRV under his/her control at all times?);
    - The allocation of PICs per quantity of RRVs.

162 Between November and December 2016, the CRR conducted another audit, Audit No. 116/16-A. In relation to the recommendation above the audit notes “To date, this role has not been implemented. The CRR could consider conducting supervision activities in the area of the RRVC at an appropriate time upon completion of this audit to check how this role is being implemented and managed by IÉ-IM”; and follows by make the following recommendation “CRR should consider conducting supervision activities in the area of the RRVC at an appropriate time upon completion of this audit (circa 6 months) check whether this role has been put fully in place”.

163 To date, the CRR have not undertaken these supervision activities in relation to RRVs (but have undertaken some inspections in relation to OTMs); in addition, there has been no further correspondence between the CRR and IÉ-IM in relation to RRVs. It is noted by the RAIU that the CRR have scheduled to undertake a number of inspections in 2019, with a focus on the operation of RRVs.

Contractor Management

164 The RSC's Vertical Slice Audit (15/14-A) carried out in May 2014 published July 2014 the audit states, in terms of contractor management "On the ground post contract award, there is a requirement on IÉ-IM to monitor the performance of the contractor", In terms of RRVs the audit states "A number of interviewees identified the area of RRV management as an area of concern. It was indicated that due to the contractual arrangements, it was not possible for the experienced operatives familiar with the railway to be kept long term. This item fell outside the scope of the audit, however the audit team recommend undertaking some supervision activity on the area of the coordination and management of RRV's in possessions". The RSC made the following finding "The area of RRV management, and in particular competence was raised as an area of concern by a number of interviewees" and the associated Audit Trail (15/14-A-AT1) associated with the Performance of RRV Operatives "The CCE and/or the RSC should consider undertaking a review on the management and the performance of RRV contracted services".

165 The CRR proceeded to carry out a review, based on this Audit Trail finding; and during the course of "Supervision Activity No. 32/17-A, An Audit of - Iarnród Éireann Infrastructure Manager Chief Civil Engineers - Risk Control Measures Related to the Supply of Safety Critical Components" identified a Minor Non-Compliance against IÉ-IM, stating "There should be procedures within the SMS to verify the competence of contractors (including subcontractors) and suppliers. CCE-SMS-009 goes some way in achieving this, however, it does not provide sufficient detail of the processes being implemented. In this regard the procedure should at a minimum outline the steps involved and the responsible persons and interface".

Possession Management

166 As part of the location specific audit of CCE Division 5, conducted in May 2015, RSC Audit No. 05/15-A, the RSC observed briefings, communications, possession and contractor management and general safety at a possession. The RSC noted that: "staff were working well together"; "briefings were done accordingly"; possession and worksite forms were completed; and, GA1 and GA2 Certificates were completed and seen my the RSC (see paragraph 59 for information on GA1 and GA2 Forms); with the RSC concluding that "Overall, the auditors felt the possession management activity at this location was being carried out in a safe manner and that all persons involved appeared diligent and competent in carrying out their task on the night".

SECTION C: FACTUAL INFORMATION – RRV OCCURRENCES

PART 12 – Loss of control of RRVs resulting in collisions with other RRVs

Loss of control of RRV resulting in a collision with another RRV, Athy/Sallins – Ballybrophy, 24th September 2015

General description of the worksite & possession arrangements

167 On the night/morning of the 23rd /24th September 2015 a T3 Possession was in place between Ballybrophy and Athy/Sallins for works associated with the ballast cleaning project on the Dublin to Cork Mainline. Four RRVs (excavators and dumpers) were working on the worksite supplied by two different contractors, (see Figure 10 for similar RRV excavator).

Figure 10 – RRV with rail grab attachment

168 The RRVs were to work in pairs, loading rails onto flatbed wagons, at two different locations. RRV1 and RRV2 were located at Monasterevin while RRV3 and RRV4 were located at Kildare.

Events before the occurrence

169 On the night of the 23rd both pairs of RRV operators were given site specific briefings by their respective PICs on what works were to be undertaken and the method of working (PIC1 briefed operators of RRV1 and RRV2 at Monasterevin and PIC2 briefed operators of RRV3 and RRV4 at Kildare), which entailed each pair of RRVs taking turns in collecting sixteen metre rails from the six foot and loading the rails onto six flatbed wagons (which were attached to a locomotive).

170 RRV1 and RRV2 departed Monasterevin, under the control of PIC1, and travelled to the worksite and began loading the rails onto the wagons, travelling together, backwards and forwards, without issue. The operators of RRV3 and RRV4 had difficulty changing the attachments on one of the RRVs to a rail grab to facilitate the work and arrived at approximately 03:00 hrs under the control of PIC2. On arrival, the work was suspended for the ES (who was supervising a number of worksites in the area) to re-brief the Operators of RRVs on the works to be undertaken and the method of working. Both sets of RRVs now started to load the wagons from either end taking turns to place the rails on the flat wagons.

171 During the work, the train moved several times to lessen the distance the RRVs would have to travel loaded. When the train was moved adjacent to a steep embankment, there was no room for PIC1 and PIC2 to control the movements of the RRVs from the ground; so, the ES decided that PIC1 and PIC2 should position themselves at either end of the train to control the RRV movements.

Events during the occurrence

172 RRV3 and RRV4 then commenced loading the front wagons and in doing so went out past the locomotive to collect the rails. When they were reversing back to place the rails on the wagons the locomotive's headlight was illuminated, causing the view on the reversing camera in the cab of the lead RRV, RRV4, to become blurred. The Operator of RRV4 continued, with the view blurred, until he passed the locomotive's headlight, and the view of the camera became clear again. It was then, that the Operator of RRV4 saw the other sets of RRVs (RRV1 and RRV2) in close proximity, with RRV1 loading rails onto one of the front wagons. He braked, and sounded the horn; however, it was too late, and RRV4 struck RRV1 at a speed of approximately 8 km/h (5 mph). There were no injuries as a result of the collision. There was superficial damage to RRV1.

Events after the occurrence

173 The ES failed to immediately report the accident to his supervisor and allowed the RRVs continue working. The ES reported the accident some hours later; as a result, no D&A screening occurred.

IÉ-IM investigation report findings, actions taken & recommendations

174 The IÉ-IM investigation report into the accident, 'Report of Investigation: Collision of RRVs within a TIII Possession between Sallins and Ballybrophy 24th September 2015', published on the 14th April 2016, identified the immediate cause of the accident as:

- The Operator of RRV4 continued the reversing movement while the view in the reversing camera became obscured.

175 Casual factors were identified as:

- The image in the reversing camera became blurred by the headlight of the locomotive;
- The operator of RRV4 did not stop the movement when the view in the reversing camera became blurred and he was unable to clearly see what was in his path.

176 The following actions were undertaken after the accident:

- The Regional Manager Dublin South and East re-briefed the ES on the requirement of the timely reporting of any incidents or accidents which occur during his shift;
- The Safety Manager CCE arranged for an instruction to be issued to all Plant Hire Contractors to brief all RRV operators on the requirement to stop all movements and seek clarification from the PIC if their view of the line ahead becomes obscured for any reason.

177 The actions taken resulted in no further recommendations being made.

RAIU findings

178 The RAIU have made additional findings in relation to a number of the RRV occurrences. The RAIU made the following findings in relation to this occurrence:

- Although it is noted that had the operator of RRV4 stopped the movement when the view in the reversing camera became blurred the accident would not have occurred; it is considered by the RAIU, that had an ACD been installed (paragraph 80), the Operator of RRV4 would have realised that RRV1 was detected as being in close proximity;
- After the RRV collision, IÉ-IM did not require that the contractors carry out brake tests on the RRV involved in the accident to establish if the braking performance of the RRV was contributory to the accident. As a result, the RAIU cannot positively identify whether braking performance was contributory to the accident. It was also noted that testing of the brakes was also not required prior to the RRVs involved in the accidents being re-entered into operation on the IÉ network;
- After the collision, there was also no investigation into whether rail contamination was contributory to the accident, contamination of the railhead would result in less adhesion between the rail and the wheel of the RRV.

179 It is noted from this occurrence, and all sixteen occurrences reviewed by the RAIU that there were no data recorders fitted to the RRVs.

180 Also, it is noted, that is all the occurrences reviewed by the RAIU where Operators of RRVs /RRVOs applied the brakes in an emergency situation there was no *sanders* fitted; nor was there WSP fitted to the RRVs to assist with the braking performance.

Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016

General description of the worksite & possession arrangements

181 On the night of the 17th/18th November 2016, four members of IÉ-IM staff along with four contractor staff reported as a group at Ballymote Station for planned night work, see Figure 11. The planned works for the night entailed the distribution and sweeping of ballast at various locations along the section between Ballymote and Boyle Stations on the Sligo Line. A site safety and method statement briefing for the works was conducted by the TSC. The possession arrangements were organised by the PICOP and Controlling Signalman.

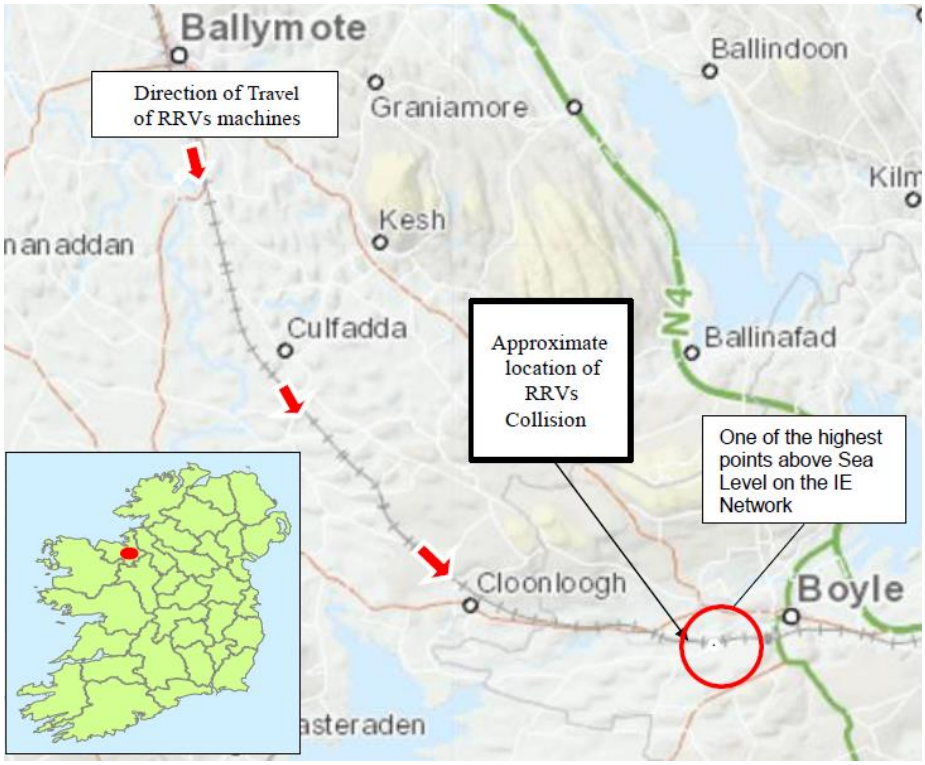

Figure 11 – Location of the accident

182 The weather conditions on the night were described as frosty with some hail and sleet showers.

Events before the occurrence

183 There were issues associated with the door and the seat in RRV2, which were temporarily resolved by adding an unfixed seat to the RRV prior to the works commencing.

184 The four RRVs (two RRV Dumpers (RRV1 and RRV2, see Figure 12 for similar vehicle) and two RRV Excavators (RRV3 and RRV4) were on-tracked in Ballymote Station. All four RRVs were assigned ESs for the setting up of work sites at the locations where they were to work at and the ESs also assumed the role of PIC for controlling the movements of their respective RRVs (and are identified as ES/PICs for the remainder of this section).

Figure 12 – Example of RRV Dumper

185 The two RRVs Dumpers had ballast placed upon them and then all four RRVs were on-tracked and accompanied by their respective ES/PICs as they travelled in the direction of Boyle with the two RRV Dumpers leading. All four RRVs carried out two controlled stops at a signal and level crossing without incident (RRV3 and its operator where removed here due to a slip and fall accident, the TSC left with the injured party, and PICOP was assigned as the new TSC). The RRVs continued and stopped again at another level crossing where there was an apparent dispute in relation to passing the level crossing signal at danger, and arrangement were made for the level crossing barriers to be closed for the RRVs crossing. The RRVs continued up an incline towards Boyle Station, before travelling around a curve and continuing downhill to the location of the ballast drop (at approximately the 111 Mile Post (MP)), see Figure 13.

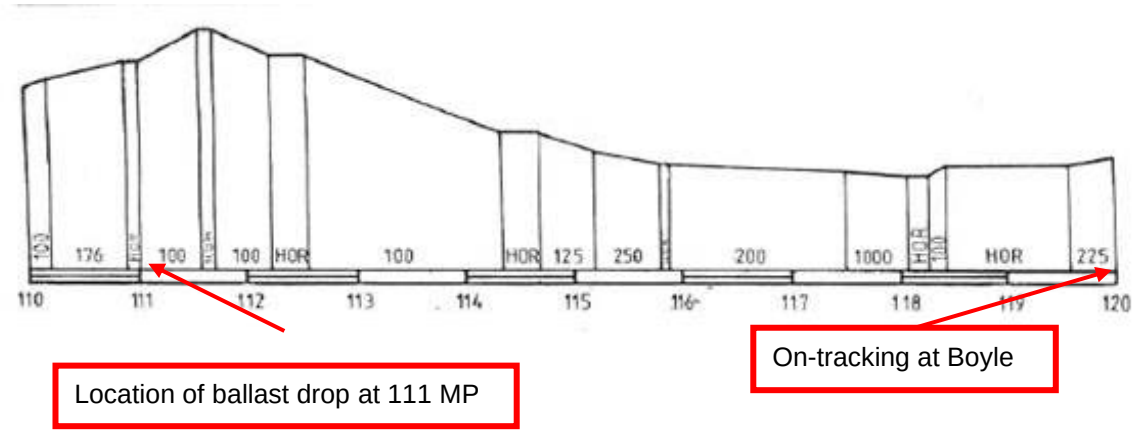

Figure 13 – Illustration of gradients at location of the accident

186 It is noted, that the location at which the accident occurred is close to one of the highest points above sea level on the IÉ network, see Figure 11.

Events during the occurrence

187 The ES/PIC travelling with RRV1 instructed the operator of RRV1 to stop, which he did. The operator of RRV2 saw RRV1 had stopped and notched down through the gears and applied the brakes, however, RRV2 went into a slide, and the bin of RRV2 collided with the cab of RRV1 at a low speed (no more than walking pace), breaking the windscreen of RRV2 (see Figure 14). The ES/PIC accompanying RRV did not see that RRV1 had stopped as his focus was on keeping the door of RRV2 closed, and as such did not issue any instructions to stop.

Figure 14 – Damage to RRV

Events after the occurrence

188 There was no post incident D&A screening carried out with any members of staff or contractors involved in the collision as the Regional Manager Athlone East had not been notified of any incidents previously and was unaware of his obligations to carry out D&A screening.

IÉ-IM investigation report findings, actions taken & recommendations

189 The IÉ-IM investigation report into the accident, 'Report of Investigation Collision between 2 RRV Dumpers on the Sligo line 18th of November 2016' issued on the 9th June 2016, identified the immediate cause as:

- The Operator of RRV2 did not have RRV2 under adequate control so as allow sufficient time to enable him to bring RRV2 to a stop before colliding with the rear of RRV1.

190 Causal factors were identified as:

- The ES/PIC accompanying RRV2 did not control the movements of RRV2 in a manner to allow adequate time and distance for RRV2 to be brought to a safe stop before the collision;
- The prevailing weather conditions on the night with the presence of ice on the rails increasing the braking distance required to bring RRV2 to a safe stop before colliding with RRV1.

191 There were a number of actions taken after the accident, including: that the ES/PIC accompanying RRV2 relinquished his duties; the IM Athlone was reminded of the importance of D&A screening; the Operator of RRV2 was re-briefed on the importance of weather conditions and their effect on braking capabilities; a second seat was added to RRV2 (a temporary seat was in place at the time of the accident). IÉ-IM made two safety recommendations based on their findings:

- The Safety Manager CCE should produce a Safety Bulletin that outlines the learning points from this investigation and this to be briefed out to all IÉ-IM staff and communicated to all contractors who provide RRVs on the IÉ network;
- The Chief Civil Engineer should examine the feasibility of checking the plant on site prior to work commencing.

RAIU findings

192 The RAIU notes from the investigation report, that there were a number of conflicting statements given by those involved in the accident, related to:

- Improper mobile phone usage;
- Pressure from IÉ-IM staff, on contractors, to pass signals at danger, without authority;
- Improper talking by the ES/PICs while the RRV operators were driving.

193 The RAIU also consider that the gradients at the location may have been contributory to the accident, given that the RRVs had to travel up an incline, around a curve and then continue downhill towards the worksite (paragraph 185) i.e. the accident occurred when the RRV was travelling downhill (see Figure 13); the RAIU found that the staff had not been adequately briefed on the gradients for the location of working.

194 The RAIU also noted that had the convoy been travelling in a bin-to-bin / cab-to-cab orientation (see Figure 15), the damage to the RRV would probably be less. It is noted by the RAIU that some RRV suppliers, require that RRVs travel in this orientation, but also understand, that this is not always possible due to the type of work to be carried out.

Figure 15 – Cab-to-cab / bin-to-bin orientation

195 It was noted that IÉ-IM did not require that the contractors carry out brake tests on the RRV involved in the accident to establish if the braking performance of the RRV was contributory to the accident. As a result, the RAIU cannot positively identify whether braking performance was contributory to the accident. It was again noted that testing of the brakes was also not required prior to the RRVs involved in the accidents being re-entered into operation on the IÉ network.

Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford), 6th December 2017

General description of the worksite & possession arrangements

196 On the night of the 5th/ 6th December 2017 the PICOP/ES/PIC (who was acting as PICOP, ES, TSC and PIC) met with a group of contractor staff (who were to operate RRVs) at Macmine Old Station to make possession arrangements for the planned re-ballasting works to be undertaken that night on the Wexford line. The PICOP/ES/PIC contacted the Signalman (located in Greystones) when he had made the possession arrangements and the possession was granted.

197 There were two worksites planned for the possession (see Figure 16 for location of the accident):

- Worksite 1 – Loading of ballast at Macmine Old Station, to be distributed to the north of Edermine LC (XR140) (Worksite 1 Drop-Off) using four RRVs Dumpers and two RRV Excavators (one RRV Excavator was to load the ballast at Macmine Old Station and one Excavator was to regulate the ballast at the drop-off at Edermine LC). These works were to be carried out under the instruction of the PICOP/ES/PIC;
- Worksite 2 – Vegetation control works located south of Macmine Old Station using two RRV Excavators with hydraulically operated flail heads. These works were to be carried out under the instruction of the ES.

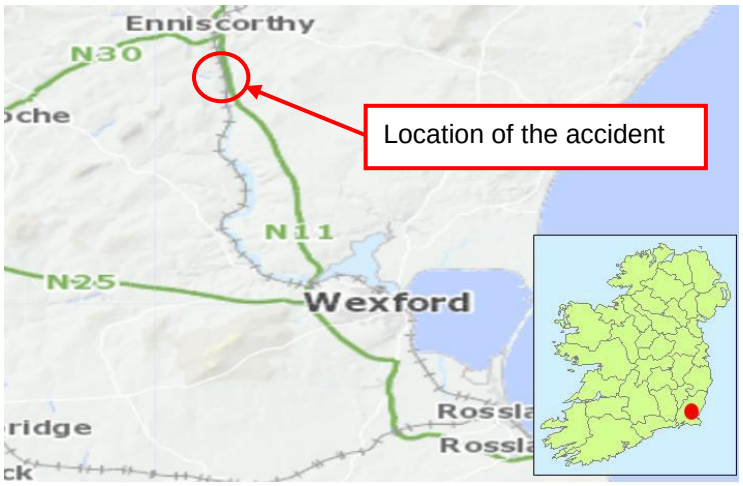

Figure 16 – Location of the accident

Events before the occurrence

198 The PICOP/ES/PIC carried out the Site Safety Briefing, and briefed the Method Statement produced for the works, which was signed by all the RRV Operators and the ES (Worksite 2). The PICOP/ES/PIC then gave instructions relating to the movements to be undertaken by the RRVs. The PICOP/ES/PIC also warned the RRV Operators in relation to the weather conditions (7.5 mm of rainfall) and the requirement for RRVs to maintain as safe distance from one another and to allow sufficient time for braking while travelling to Worksite 1 Drop-Off.

199 The ES (Worksite 2) gave separate briefings and instructions to the two Operators of the RRV Excavators. He on-tracked the two RRV Excavators, erected his marker boards, contacted the PICOP/ES/PIC for permission to commence work, which was granted.

200 The PICOP/ES/PIC then:

- Erected the worksite marker boards 100 m form the southern side of Macmine Old Station;
- Directed the on-tracking of one RRV Excavator and four RRV Dumpers (the bins were facing north for the first two RRV Dumpers and south for the second two RRV Dumpers) at Macmine Old Station;
- Instructed the remaining unmounted RRV Excavator to load the RRV Dumpers with ballast (this RRV remained at this location for the remainder of the night);
- Boarded the on-tracked RRV Excavator (which was leading the convoy) and departed Macmine Old Station for Worksite 1 Drop-Off (north of Edermine LC);
- Stopped the RRV Excavator in rear of the Up Stop Signal for Edermine LC and waited for the rest of the RRV convoy to arrive and stop;
- Contacted the Mallow Local Crossing Control Centre (MLCCC) to request the barriers be lowered to facilitate the crossing of the RRVs, to continue to Worksite 1 Drop-Off.

201 The LC barriers were lowered by the MLCCC Operator and the RRVs travelled through the LC and arrived at Worksite 1 Drop-Off shortly afterwards.

202 The PICOP/ES/PIC dismounted the RRV and erected the worksite marker boards 100 m ahead of the RRVs.

203 At Worksite 1 Drop-Off, the four RRV Dumpers discharged the ballast and the RRV Excavator became regulating the ballast with a specially adapted bucket. The four RRV Dumper then prepared for the return journey to Macmine Old Station to be re-loaded.

204 The PICOP/ES/PIC travelled on the first RRV Dumper (RRV1) in the convoy (consisting of RRV1, RRV2, RRV3, RRV4) toward Macmine Old Station, adopting the same procedure as before to cross Edermine LC. On arrival at the ballast stockpile, the RRV Dumpers were loaded with ballast. The convoy then began travelling back downhill towards Edermine LC (see Figure 17 illustrating a 1:150 gradient), with the PICOP/ES/PIC travelling on the lead RRV Dumper.

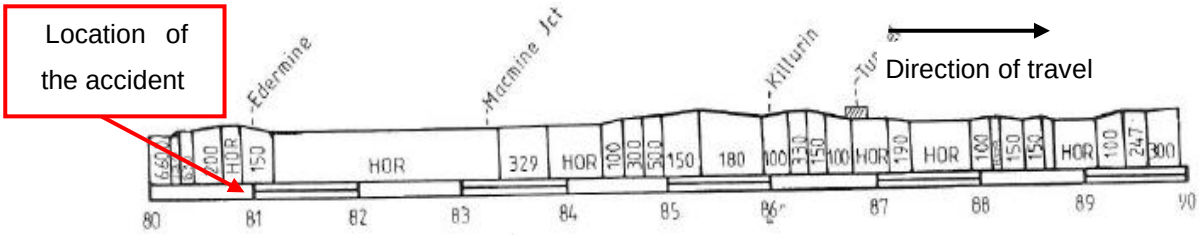

Figure 17 – Illustration of the gradient at the location of the accident

205 On the approach to Edermine LC, RRV1 (accompanied by the PICOP/ES/PIC) slowed and stopped the RRV in rear of the Up Stop Signal for Edermine LC and waited for the remainder of the convoy to arrive so he could call MLCCC as before (paragraph 200). It should be noted that the brake lights are inoperative while the RRVs are in rail mode, in addition, the RRVs were not fitted with speedometers.

Events during the occurrence

206 They were waiting for a few minutes when the PICOP/ES/PIC saw the lights of the RRV2 approaching RRV1 with the lights flashing and the horn being sounded. The PICOP/ES/PIC warned the driver of RRV1 that they were going to be struck by the RRV2.

207 The Operator of RRV2 had applied the brakes (similar to the first approach to the Up Stop Signal for Edermine LC). However, the Operator of RRV2 stated that RRV2 seemed to slide and accelerate towards RRV1.

Figure 18 – Damage to RRV

208 The front bin of RRV2 then struck the cab of RRV1, causing the glass in the cab of RRV1 to break with ballast from RRV2 discharging into the cab of RRV1 (see Figure 18) injuring the PICOP/ES/PIC's arm. The operators of RRV1 and RRV2 were uninjured.

Events after the occurrence

209 The two RRV operators and PICOP/ES/PIC dismounted the RRVs and the PICOP/ES/PIC contacted the ES from Worksite 2 to request that he take over PICOP duties as he was injured. The ES terminated the works at Worksite 2 and travelled to Worksite 1 Drop-Off where he relieved PICOP/ES/PIC of his duties.

210 The PICOP/ES/PIC contacted the Signalman to inform him that the ES was now the PICOP, however, he did not inform the Signalman that there had been a collision between the RRVs (stating that he did not think he was required to report the accident as there was no damage to infrastructure).

211 The PICOP/ES/PIC was taken to Wexford Hospital by another staff member, after examination he was discharged.

212 The ES arranged for the removal of the RRVs from Worksite 1 and handed the possession back to the Signalman without issue. It was during the handing back that the ES reported the accident to the Signalman, who in turn reported it to Traffic Regulator (CTC).

213 The ES then contacted the area Regional Manager (RM) CCE and reported the collision; with the RM arranging D&A screening for all staff involved, including the PICOP/ES/PIC (with the tests returning negative results).

IÉ-IM investigation report findings, actions taken & recommendations

214 The IÉ-IM investigation report into the occurrence, 'Report of investigation, Collision between two RRV Dumpers on the Wexford line, 6th of December 2017", published on the 13th September 2018, made a number of statements/findings in relation to the accident in terms of the RRV plant, speed of RRV2 and the application of instructions for RRVs operating over CCTV Level Crossings.

215 In terms of the RRV Dumper plant (which was supplied by a contractor), RRV1 and RRV2 had EACs, issued on the 1st August 2017 (which is valid for five years) by SNC Lavalin. The RRV Dumpers had passed the pull-test (see paragraph 63 for details for the pull-test). However, as part of the IÉ-IM investigation, IÉ-IM requested from the contractor, details of the sub-contractors used to carry out the modifications and the modifications undertaken to the dumpers to transform them into RRVs, but the contractor failed to supply this information.

216 In relation to the speed of RRV2, during the second run towards Worksite 1 Drop-Off, the maximum speed of the RRVs should have been 5mph (8 km/h) as they were travelling within a worksite, within a possession. RRV2 had been fitted with a Global Positioning System (GPS) device which included snap-shots of speeds and locations (i.e. the GPS did not show how long the speeds were maintained) of RRV2. The GPS for RRV2 showed that:

- RRV2 travelled at speeds of 7 km/h to 27 km/h (on two occasions);
- At the time of the accident, RRV2 was travelling at approximately 12 km/h (it should be noted that there was no speedometer on the RRV).

217 In addition, the amendments to the Rule Book, Section Q 2018, in terms of RRVs operating over CCTV Level Crossings was not fully adhered to; although it is noted that these actions were not contributory to the accident.

218 IÉ-IM identified the immediate cause of the accident as:

- The second RRV Dumper (RRV2) was unable to stop before colliding with the rear of the RRV Dumper in front (RRV1).

219 Causal factors were identified as:

- The evidence available indicated the second RRV Dumper may have been operated at a higher speed than permitted;
- The second RRV Dumper Operator did not allow adequate time or sufficient distance for the RRV Dumper he was operating (RRV2) to be brought to a safe stop before colliding with the rear of the RRV Dumper in front (RRV1);

- The Operator of the second RRV Dumper (RRV2) may not have taken into account the prevailing weather conditions on the night, that may have impacted on the braking distance required to bring the RRV Dumper to a stop.

220 The IÉ-IM investigation report did not identify any underlying causes.

221 IÉ-IM took several actions as a result of the accident, namely:

- An IM Safety Alert Bulletin was produced by the IE Procedures Unit on the day after the occurrence which was circulated to all relevant managers and staff, highlighting the details of the accident, including the precautions that must be taken while RRVs are travelling in convoy with possessions;
- The PICOP was re-briefed on the importance of reporting accidents; and the instructions related to movements at CCTV level crossings.

222 The IÉ-IM report made two recommendations, namely:

- The CCE should examine the feasibility of introducing the requirement that all RRVs operating over the network should be fitted with speedometers;
- The CCR should conduct a review into the feasibility of brake lights being operative on RRVs operating in rail mode.

RAIU findings

RRV machine

223 It is noted that had the bin-to-bin / cab-to-cab orientation (see Figure 15) been adopted in this instance, it is likely that there would have been no injuries to the RRVC.

224 RRV2 was not fitted with a speedometer, nor in there any requirement to have them fitted for travelling in the “reverse” direction.

225 Again, it was noted that IÉ-IM did not require that the contractors carry out brake tests on RRV2 to establish if the braking performance of RRV2 was contributory to the accident. As a result, the RAIU cannot positively identify whether braking performance was contributory to the accident. It was again noted that testing of the brakes was also not required prior to the RRVs involved in the accidents being re-entered into operation on the IÉ network.

Operation of RRVs

226 The RAIU consider that the gradient may be been contributory to the accident, given that the track is level until there is a change in gradient at Edermine LC (see Figure 17). In addition, the staff were not adequately briefed on the gradients for the location of working.

227 Also, rail contamination was not identified as contributory, and the IÉ-IM report does not identify whether any inspection was conducted.

Loss of control of RRV resulting in a collision with another RRV, between Dublin & Cork, 22nd March 2018

General description of the worksite & possession arrangements

228 The work planned for the night of the 21st/22nd March 2018 was for embankment removal works as part of preparatory works for the Ballast Cleaning Programme at Kilbricken Compound, County Laois, on the Dublin to Cork Mainline located at approximately the 63¼ MP, see Figure 19 for location of the accident. The T3 Possession was to be arranged between Laois Train Care Depot and Thurles.

Figure 19 – Location of the accident

229 The works were to utilise four RRV Dumpers (two mounted on the Down Line and two RRV Excavators mounted on the Up Line, see Figure 20 for RRV similar to those involved in accident. The RRVs and the RRVOs were supplied by two different contractors.

Figure 20 – RRV Dumper similar to RRV involved in the accident

Events before the occurrence

230 On Wednesday night the 21st of March 2018 the contractors, along with IÉ-IM staff members arrived at Kilbricken Compound for the planned work. An appointed TSC carried out a site safety briefing with all IÉ-IM staff and contractors present which also included instructions to RRVOs. The TSC stated the instructions delivered on the night included the speed of the movements within the possession, weather conditions (which were not contributory to accident) along with specific details of the work; no issues were raised by the RRVOs and the briefing was signed for by all staff.

231 At 22:39 hrs the T3 possession was granted to the PICOP by the controlling Signalman (CTC). The PICOP contacted the RRVC at Kilbricken Compound and gave him authority for the six RRVs to be on-tracked to travel to the nominated work site as planned.

232 The RRVC on-tracked all RRVs (RRV1 (leading), RRV2, RRV3, etc) and travelled on RRV1 (the leading RRV); the four RRV Dumpers were on the Down Line and the RRV Excavators were on the Up Line (as set out by the TSC).

Events during the occurrence

233 When RRV1 arrived at the worksite the RRVC dismounted RRV1 to speak to the ES. RRV2 came to stop behind RRV1; however, the RRVO of RRV3 did not notice that RRV2 had stopped, and when he did notice he attempted to stop RRV3, however, it collided into the rear of RRV2 as it stood stationary at the worksite; resulting in damage to RRV3.

Events after the occurrence

234 The ES reported the collision to the PICOP who in turn reported it to the A-Class Inspector. The RM was contacted and made arrangements for the contractors involved in the collision to undergo post incident D&A screening as per IÉ-IM post-incident D&A policy.

235 The works continued with the other RRVs on-site, without further incident.

IÉ-IM investigation report findings, actions taken & recommendations

236 IÉ-IM conducted an investigation into the accident, publishing report “Report of Investigation Collision between 2 RRV Dumpers on the Cork line 22nd March 2018” on the 5th October 2018.

237 As part of the investigation, the GA1 (yearly inspection), GA2 (weekly inspection) and EACs were requested. It is noted that one of the contractors, upon request, failed to acknowledge or answer IÉ-IM’s request.

238 IÉ-IM identified the Immediate Cause of the accident as:

- RRV3 was unable to stop before colliding with the rear of RRV2 in front.

239 Causal Factors were identified as:

- The Operator of RRV3 did not allow adequate time or sufficient distance for the RRV Dumper he was operating to be brought to a safe stop before colliding with the rear of RRV2 stopped in front;
- The Operator of RRV3 did not observe that RRV2 had come to a stop in front.

240 No Underlying Causes were identified.

241 As a result of the accident The RRVO of RRV3 attended the RRVO safety training course conducted by members of the CCE Safety Department.

242 In addition, a CCE Safety Bulletin, "Topic – Incident Alert – RRVs Travelling in Convoy" (to be referred to as the "April 2018 Safety Bulletin" for the remainder of this report); was produced by the CCE Safety Manager in the weeks after the occurrence which was circulated to all relevant managers, staff and contractors on the 28th April 2018 (see Figure 21). The April 2018 Safety Bulletin states that: speed, inadequate distance between RRVs travelling in convoy and lack of co-ordination are the main issues related to the RRV collision. The bulletin also issues instructions (pending the result of the IÉ-IM investigation), requesting that:

- RRVs travelling in convoy must keep a minimum distance of 100 m from the RRV in front;
- RRVOs must pay particular attention to the RRV in front to watch for it either slowing or stopping as most RRVs are not equipped with brake lights.

No: CCE SB April (24) 2018

Chief Civil Engineers Dept Safety Bulletin April 2018

TOPIC – Incident Alert – RRVs Travelling In Convoy

This bulletin is for the attention of and must be briefed to:

- All staff who plan or control movements of RRVs
- All RRV service providers
- All RRVOs

Background:

There have been a number of RRV Collisions on the CCE infrastructure over the past 18 months, two of which are still under investigation. Some of these incidents have resulted in injuries to staff while all have resulted in damage to plant. These incidents have the potential to cause serious injuries or fatalities to both staff / operators travelling in the machines and to staff operating in the vicinity.

The main issues relating to the cause of these incidents include:

- Speed of the RRVs
- Inadequate distance between RRVs travelling in convoy
- Lack of proper co-ordination of RRVs travelling in convoy

INSTRUCTION – PENDING INVESTIGATION FINDINGS:

- **RRVs travelling in convoy to a work location must keep a minimum distance of 100 mtrs from the RRV in front.**
- **RRVOs must pay particular attention to the RRV in front to watch for it either slowing or stopping as most RRVs are not equipped with brake lights while in Rail Mode.**

Figure 21 – Incident Alert issued in April 2018

RAIU findings

Failure to supply RRV information to IÉ-IM upon request

243 It is noted by the RAIU that one of the contractors failed to provide IÉ-IM with certificates associated with an RRV operating on the IÉ network. It is noted that IÉ-IM failed to apply any sanctions as a result of this. In addition, the RRV is still permitted to be used on the IÉ network at a later date without these checks.

The 100 m distance between RRVs travelling in convoy

244 The RAIU requested information in relation to the April 2018 Safety Bulletin about the decision to maintain a distance of 100 m between RRVs operating in convoy. IÉ-IM responded: "This distance was decided through discussion within the CCE Department. RRVO training currently states that sufficient distance be kept between machines which left a lot of discretion to the operator. 100 m was chosen as it would seem to be an adequate stopping distance for a machine travelling at maximum permissible speed. This decision was also made in the knowledge that it will be accompanied by start/stop indicators installed on the machines. This process is currently being explored".

245 The current maximum speed for an RRV travelling outside a worksite is 20 mph (32 km/h); referring to I-PLM-5001 and EN15746-2 the corresponding stopping distance for this speed is 60 m, which is less than the 100 m i.e. IÉ-IM have allowed 40 m extra stopping distance.

246 The RAIU further requested how this 100 m separation distance was enforced on site. IÉ-IM responded that "IÉ-IM acknowledges the enforcement of the 100m separation between RRVs travelling in convoy is heavily dependent on compliance with the instruction that was sent and briefed to all relevant staff on the 25th of April 2018. The introduction of slow/stop indicators is designed to further enhance the improvement in safety that was been brought about by the issue of this instruction. In addition the IÉ-IM has a suite of regular monitoring and assurance checks for all activities."

247 It is noted that IÉ-IM failed to make any formal recommendations based on the above requests as in the case of the first request the Rule Book still states that you must ensure when travelling in convoy that you understand a safe distance must be maintained between your RRV and other RRVs in transit i.e. there is no defined distance in the Rule Book or other document associated with RRVs.

Braking

248 Again, it was noted that IÉ-IM did not require that the contractors carry out brake tests on the RRV involved in the accident to establish if the braking performance of the RRV was contributory to the accident. As a result, the RAIU cannot positively identify whether braking performance was contributory to the accident. It was again noted that testing of the brakes was also not required prior to the RRVs involved in the accidents being re-entered into operation on the IÉ network.

249 In addition, it cannot be established whether rail contamination was a contributory factor.

Loss of control of RRV resulting in collision with another RRV, between Sallins & Newbridge, 10th April 2018

General description of the worksite & possession arrangements

250 The works planned for the 10th April 2018 was for the ballast cleaning preparatory work at the CCE's Carragh Compound (County Kildare), on the Dublin to Cork Line, as part of the ongoing Ballast Cleaning Project, see Figure 22. A T3 Possession was to be granted was from Sallins to Portlaoise on the Up and Down Lines.

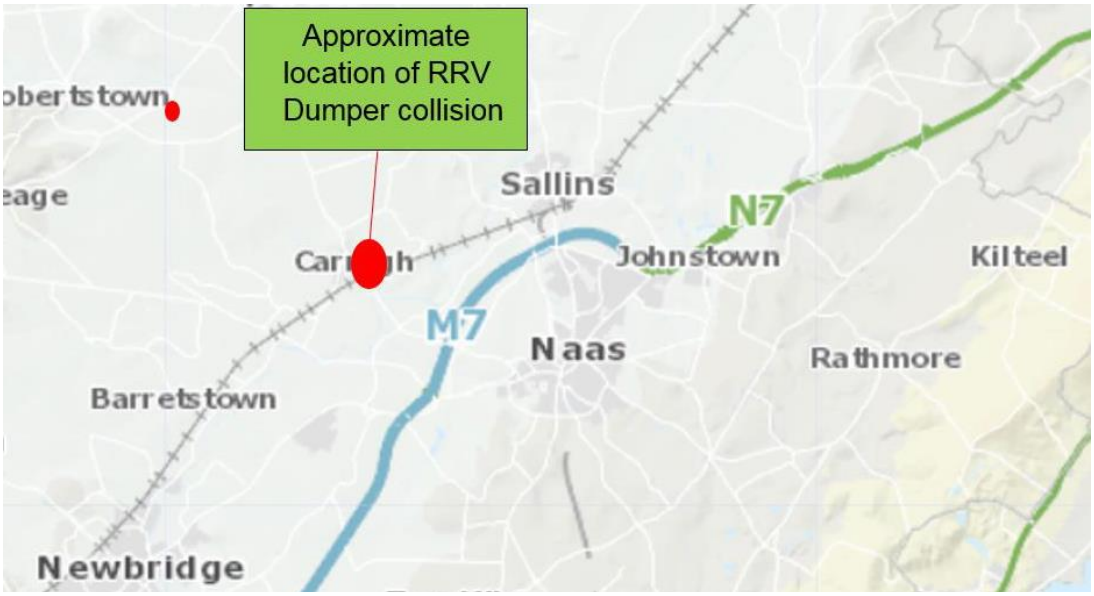

Figure 22 – Location of the accident

251 Ballast was to be distributed using five RRV Dumpers (two mounted on the Down Line).

Events before the accident

252 On Monday 9th April daytime, three RRVOs attended IÉ-IM's RRV Safety Training Course, which finished at 15:00 hrs.

253 On Monday night the 9th April 2018 a group of contractors along with IÉ-IM staff arrived at Carragh Compound for the work (the RRVO involved in the accident was one of several RRVOs who had attended IÉ-IM's RRV Safety Training Course that day). An appointed TSC carried out a site safety briefing with all staff and contractors present which also included instructions to the RRVOs; including the speed of the movements and the weather conditions prevailing on the night. The briefing was signed by all RRVOs.

254 At 00:32 hrs after the necessary possessions arrangements were in place, the T3 possession was granted to the PICOP by the Controlling Signalman (CTC). The PICOP contacted the RRVC at Carragh Compound and gave him authority for the five RRVs to be on-tracked for travel towards the worksite.

255 The RRVC on-tracked the five RRVs (RRV1 leading, followed by RRV2, RRV3, etc) and the RRVC on-tracked RRV1 and headed towards the worksite in the direction of Newbridge. All five RRVs were on-tracked and began to make their way, one-by-one, to the worksite.

Events during the accident

256 As RRV3 was leaving the compound, the RRVO turned around to switch off the interior cab light in RRV3 and when he turned back he was coming close to the RRV2 in front; the RRVO of RRV3 then applied the brakes and began flashing his lights to warn RRV2. RRV3 did not stop in time and collided with the rear of RRV2 in front, causing the windscreen of RRV3 to shatter. Neither RRVO (RRV2 and RRV3) were injured as a result of the collision.

Events after the accident

257 The RRVC contacted the A-Class Inspector and informed him of the collision; who in turn contacted the ES and PICOP. The local RM Regional Manager was informed, and arrangements were made for post-incident D&A screening; with the results returned as negative.

258 RRV2 and RRV3 were removed from the line; and the work continued, without further incident, using the remaining RRVs.

IÉ-IM investigation report findings, actions taken & recommendations

259 IÉ-IM investigated the accident, publishing report "Report of Investigation Collision between 2 RRV Dumpers at Carragh on the Dublin to Cork line on the 10th April 2018" on the 9th January 2018 (nine months after the accident).

260 The investigation found that the RRVs involved had a valid EAC and GA1 certificates were in date.

261 On the 9th April 2018, the day before the accident, the RRVO of RRV3 underwent a one-day RRVO safety training course. The training course includes the movements and controls of RRV. The training course finished at approximately 15:00 hrs on the 9th April 2018, with the RRVO reporting for work that night at approximately 22:00 hrs. Two other RRVOs working on the night of the accident had also attended in the training course.

262 The IÉ-IM investigation found that the immediate cause of the accident was:

- The RRVO of RRV3 was unable to bring the RRV to a stop before colliding with the rear of RRV2 in front.

263 Causal factors were identified as:

- The RRVO of RRV3 did not observe that RRV2 had slowed down in front;
- The RRVO of RRV3 became distracted from his primary function of operating the RRV by switching off the cab interior light;

- The RRVO of RRV3 did not allow adequate time or sufficient distance for the RRV he was operating to be brought to a stop before colliding with the rear of RRV2 that had slowed in front;
- The RRVO of RRV3 may not have had sufficient rest before taking up duty at Carragh Compound, at approximately 22:00 hrs on the 9th April, as he had attended an RRVO training course in North Wall that finished at approximately 15:00 hrs on the same day.

264 There were no underlying causes identified.

265 IÉ-IM took the following actions as a result of the accident:

- An IM Safety Alert Bulletin was produced by the Safety Manager CCE in the weeks after the occurrence which was circulated to all relevant CCE Managers and staff, highlighting the details of the incident including, the precautions that must be taken while RRVs are travelling in convoy within possessions;
- The Safety Manager CCE has corresponded with the relevant RRV contractors reminding them of their obligations under the time and work act with regard to RRVOs having adequate rest period between shifts.

266 It is noted by the RAIU that the Safety Alert Bulleting is the same Safety Alert Bulletin referenced in the "Collision between two RRVs between Dublin & Cork (63.44MP), 22nd March 2018" accident, see Figure 21.

267 IÉ-IM made the following safety recommendations as a result of the accident:

- The Safety Manager CCE should arrange for the RRV Operator to receive corrective coaching, paying particular attention to the precautions that must be taken while RRVs are travelling in convoy within possessions;
- The Safety Manager CCE should examine the feasibility of installing slow/stop indicators on all RRVs operating on the IÉ Network.

268 It is noted that this accident was partly the reason for the issuance of the "April 2018 Safety Bulletin".

RAIU investigation findings

269 The RAIU note that contractors have been reminded of their obligations under the Organisation of Working Time Act 1997.

270 There was no brake testing carried out after the accident.

Loss of control of RRV resulting in a collision with another RRV between Skerries and Drogheda, 16th June 2018

General description of the worksite & possession arrangements

271 The work planned for the night of the 16th June 2018 was ballast sweeping and associated works, utilising two RRV Excavators on-tracked on the Up lines. One RRV was equipped with a ballast brush (RRV1) and the other RRV was equipped with a ballasting bucket (RRV2). There were two RRVCs in attendance, one of whom also acted as the TSC and ES for the works (to be referred to as the RRVC/TSC/ES for this section of the report). The RRVs were to access the track at Laytown (County Louth), on the Dublin to Belfast line.

272 The T3 possession was granted, to the PICOP from the Controlling Signalman CTC, from Skerries to Drogheda on the Up and Down Lines.

273 The accident occurred during the hours of darkness and at the time of the occurrence it was reported to be raining heavily, with Met Éireann (Dunsany) recording that there was 4.1 mm of rainfall and the mean wind speed was recorded at 11.8 knots; see Figure 23 for location of the accident.

Figure 23 – Location of the accident

Events before the accident

274 The RRVC/TSC/ES carried out a site safety briefing with IÉ-IM staff and the RRVO contractors present. The briefing included: instructions for the RRVOs; the nature and location of the work; the speed of the movements taking place; and, the weather conditions prevailing at that time. The briefing was signed by all present with no issues being raised.

275 After the possession was granted to the PICOP, the PICOP contacted the RRVC/TSC/ES and other RRVC and gave the authority for the two RRVs to be on-tracked and to travel to the worksite to commence work.

276 The RRVs were on-tracked, on the Up Line, by the RRVOs and the RRVC/TSC/ES and other RRVC on-tracked the RRVs (one RRVC per RRV). RRV1 (excavator with the ballasting bucket) was on-tracked ahead of the RRV2 (with the brush box), with RRVO1 and RRVO2 operating, respectively. They travelled towards the worksite, in the direction of Drogheda Station, at slow speed as they tried to establish the exact location for the commencement of the ballast sweeping.

277 They located the worksite and RRV1 and RRV2 came to a stop. RRV2 waited for RRV1 to travel back towards him as RRV1 would have to commence ploughing back the ballast before RRV2 could commence the brushing work.

Events during the accident

278 At this stage of the night, it was raining very heavily as RRVO1 slewed the excavator around and started to travel back (downhill) to RRV2 at a slow speed, see Figure 24. On approach to RRV2, RRVO1 applied the brakes but the rail wheels "locked-up" resulting in RRV1 going into a slide and colliding with the brushbox attached to RRV2. Both RRVs sustained minor damage and there were no injuries to staff.

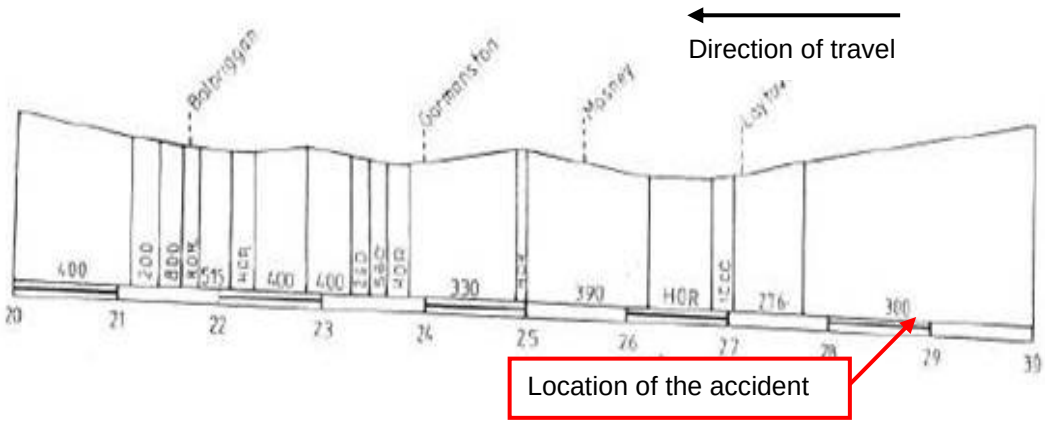

Figure 24 – Illustration of the gradients at the location of the accident

Events after the accident

279 One of the IÉ-IM staff contacted the A-Class Inspector and reported the accident; he in turn contacted the local Regional Manager who instructed that the RRVs be removed from the track and the staff taken for D&A screening, the testing was returned as negative.

IÉ-IM investigation report findings, actions taken & recommendations

280 IÉ-IM investigated, publishing "Report of Investigation Collision between RRVs within a possession between Skerries and Drogheda 16th June 2018" on the 08/03/19. The investigation found that the staff had their required competencies and the RRVs were fully certified. The report also found that speeding was not likely an issue; and there was no method statement for the works.

281 The report identified the immediate cause as:

- RRV1 was unable to come to a stop before colliding with the brush box attached to RRV2.

282 Causal factors were identified as:

- RRVO1 did not allow adequate time or sufficient distance for the RRV he was operating to be brought to a safe stop before colliding with the brushbox attached to RRV2;
- The heavy rain at the time of the collision, may have affected the braking distance required to allow RRV1 to come to a stop before colliding with the brush box attached to RRV2.

283 There were no underlying factors identified.

284 No actions were taken as a result of this accident.

285 The report made one recommendation:

- The Safety Manager CCE should arrange for the RRVO1 to receive corrective coaching, paying particular attention to the braking distances required in different weather conditions.

RAIU investigation findings

Safe work method statement

286 It is noted that IÉ-IM do not consider that the absence of a method statement was contributory to the accident. A safe work method statement is a document that details the way a work task or process is to be completed; by outlining the hazards and risks involved and including a step by step guide on how to do the job safely. If applied, in the case of this accident, it should have identified certain hazards (such as heavy rain); the risk posed by this hazard (loss of control of RRV on wet rail); and, the process of operation (very slow movements in heavy rail conditions). As such, the RAIU consider that the absence of a safe work method statement was contributory.

Corrective coaching

287 In terms of the recommendation made in terms of corrective coaching for the RRVO, the recommendation states that the “Safety Manager CCE should arrange for RRVO1 to receive corrective coaching, paying particular attention to the braking distances required in different weather conditions”.

Brake test

288 There was no brake testing carried out after the accident.

Operation of the RRV

289 The RAIU consider that the gradient of the track may also have been contributory to the accident as when the RRV1 was travelling back towards RRV2, it was travelling downhill (see Figure 24); and that the staff had not been adequately briefed on the gradients for the location.

PART 13 – RRV COLLISIONS WITH LINSIDE EQUIPMENT, OTMs & ROLLING STOCK

RRV collision with OHLE structure (CY22), Church Rd Junction, 13th February 2016

Events prior to & during the occurrence

290 At 01:25 hrs on Sunday 14th February 2016 authority was given by the PICOP to the ES/PIC (who was undertaking the roles ES, TSC and PIC for seven RRVs) for work to start at the worksite at East Wall Bank, see Figure 25. The ES/PIC gave a safety briefing before work commenced, reminding the Operators of the RRVs about the presence of the OHLEs and the requirement to report any occurrences. The works to be carried out was panel relaying.

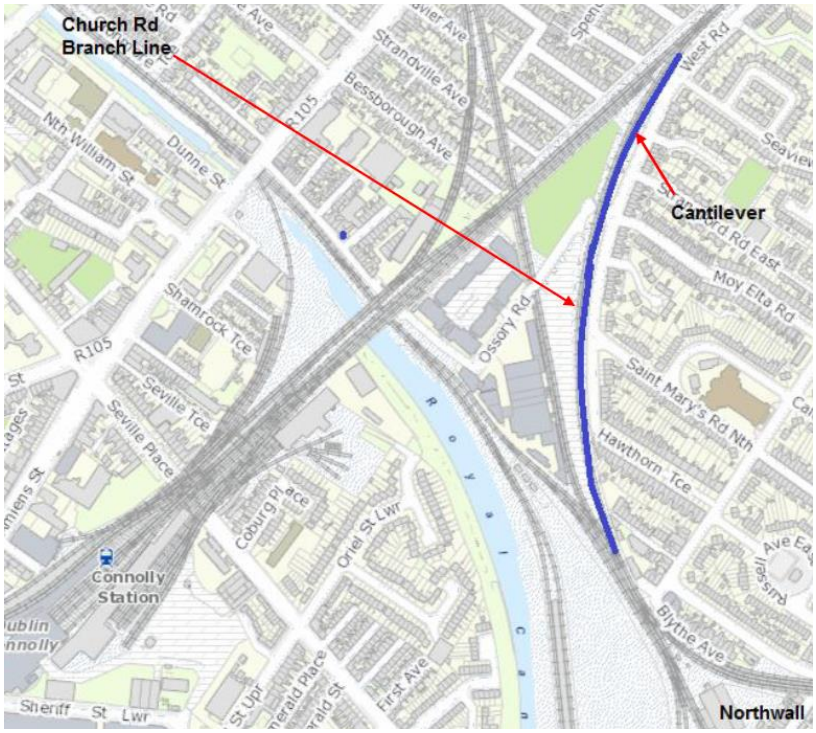

Figure 25 – Location of the accident

291 When the ES/PIC got permission from the PICOP, he arranged the on-tracking of two RRVs (RRV1 and RRV2) and brought them to the worksite; he then returned to the on-tracking location to bring another two RRVs to the worksite.

Events after the occurrence

292 On arriving back at the worksite, the operator of RRV1, RRV Operator 1, informed the ES/PIC that RRV2 (operated by RRV Operator 2) had struck the OHLE wires. The ES/PIC then went to the scene and saw that there was damage to the OHLE cantilever and not the wires (see Figure 26). When the ES/PIC returned to talk to the Operators of the RRVs, they informed him that RRV2 had not struck the OHLE cantilever, only the wires.

Figure 26 – Damage to the cantilever

293 The ES/PIC contacted the OHLE Inspector to report the damage and stated that none of the RRVs with him had struck the OHLE cantilever, so the damage must have occurred sometime in the previous days. The OHLE Inspector made his way to North Wall from Shankill at 03:30 hrs to assess the damage and discovered that the top bar and strut of the cantilever were bent; there was no damage to the OHLE wires.

IÉ-IM investigation report findings, actions taken and recommendations

294 The IÉ-IM investigation report, 'Report of Investigation: RRV collision with lineside structure near signal CY22 Church Rd Jctn 13th February 2016' published on the 21st August 2017, identified the immediate cause of the accident as:

- RRV Operator 2 reported striking the OHLE wire but denied coming into contact with OHLE Cantilever. No IÉ-IM staff were present when this occurred.

295 Causal factors were identified as:

- There was no PIC with the RRVs as they were working;
- If the OHLE Cantilever was damaged at a time other than when the OHLE wire was struck, then it was not reported by the RRV Operator concerned.

296 An underlying cause was identified as:

- There is no method of alerting staff or recording when an RRV comes into contact with a lineside structure.

297 In addition, IÉ-IM identified that apart from Personal Track Safety (PTS) training RRV operators working on the IÉ network do not receive any training with regard to the IÉ network.

298 Some actions reported to have taken place at the time are:

- A programme of training RRV Operators has commenced and is ongoing. This Designated Plant Operator (DPO) training provides IÉ Rule Book training for RRV operators;
- Section Q of the IÉ Rule Book has been redrafted and will be re-issued to all relevant staff. Clause 4.1 states that a PIC/RRVC must be present when an RRV is: about to go on or near the line; on-tracking; travelling; working; off-tracking (note: this has now been done).

299 In addition, the report made two recommendations:

- The Director IM should examine the feasibility of having sensors installed on RRVs that will alarm and/or record if any part of the RRV comes into contact with any lineside structures;
- The Contractor Safety Manager should ensure a briefing is issued to all contractors who operate RRVs reminding them that if the RRV they are operating collides with any piece of IÉ-IM infrastructure that they report this to IÉ-IM staff immediately.

RRV collision with locomotive handrail, Newbridge – Kildare, 25th February 2016

Events before the occurrence

300 On Thursday morning 25th February 2016 the ES/TSC (who was acting as the ES and TSC) gave a site safety briefing to the relevant staff who would be working at the worksite on the Dublin to Cork line; the work planned for this worksite was the loading of spoil onto the Spoil Train (which consisted of seven spoil wagons and locomotive 071 (see Figure 27 for a similar type locomotive).

301 As part of the briefing the RRV operators were instructed by the ES/TSC to load the spoil train from the middle of the train out. This arrangement was in place as a result of a previous collision between two RRVs that were loading rails onto a rail train, on the 24th September 2015 (see paragraphs 167 - 180). These new arrangements mitigated against the likelihood of the RRVs colliding during the loading of the spoil wagons, however, there was no reference to RRVs operating in close proximity to the locomotive.

Figure 27 – Locomotive with Spoil Wagons

302 At 00:17 hrs on the 25th February 2016 a T3 possession of the Up and Down lines between Portlaoise and Sallins was granted to the PICOP by the Mainline Signalman at CTC. At 00:25 hrs the PICOP gave authority to the ES/TSC to set up his worksite.

303 A PIC on-tracked two RRV Excavators and four RRV Dumpers onto the line at Newbridge Station. The ES/TSC travelled with the RRV Excavators to the worksite; and the PIC travelled with the RRV Dumpers to the Curragh Compound and set up the marker boards for the worksite.

304 The ES/TSC commenced loading the Spoil Train with the two RRV Excavators. There were seven spoil wagons to be loaded. One RRV Excavator loaded from the middle of the train towards the rear and the other RRV Excavator loaded from the middle of the train back towards the locomotive at the front.

305 When the Spoil Train was almost completely loaded the ES/TSC went to the Train Guard who was in Cab 1 of the locomotive and informed him that the work was almost complete, and the train could depart the worksite once the loading was finished.

Events during the occurrence

306 As this conversation was taking place one of the RRV Excavators, the one closest to the locomotive of the train, had passed by the locomotive as it loaded its bucket with spoil for the final time. After filling the bucket, the Operator of the RRV Excavator slewed the machine causing the balance weight at the rear of the RRV to strike the handrail of the locomotive.

307 When the Operation of the RRV Excavator was loading the wagons there was enough clearance to allow the RRV Excavator to slew around without striking the wagons however when in proximity to the locomotive there was insufficient clearance to allow the RRV Excavator to slew around without coming into contact with the locomotive.

Events after the occurrence

308 The ES/TSC went down and informed the Operator of the RRV Excavator that he had struck the locomotive; the Operator of the RRV Excavator was aware that he had struck the locomotive. The Train Guard reported the occurrence to the PICOP by phone.

309 The PICOP contacted the ES/TSC to get details and he then reported to the Regional Manager Dublin South & West was informed later that day. There was no post incident D&A testing organised as the Regional Manager Dublin South & West was not informed until later that day.

IÉ-IM investigation report findings, actions taken & recommendations

310 The IÉ-IM investigation report, 'Report of Investigation: RRV struck Locomotive Handrail during a TIII Possession 25th of February 2016' published on the 21st April 2017, identified the immediate cause of the accident as:

- The RRV Excavator Operator when in close proximity to locomotive 071 slewed the machine causing the balance weight at the rear of the RRV to strike the handrail of locomotive 071.

311 Causal factors were identified as:

- There was insufficient clearance to allow the RRV Excavator to slew around safely;
- The RRV Excavator was unaware of how close the RRV Excavator was to locomotive 071.

312 Underlying cause to the accident was identified as:

- While there was an instruction in place to mitigate against RRVs colliding there was no reference to RRVs operating in close proximity to the locomotive.

313 IÉ-IM took a number of actions based on the findings of this investigation report, namely:

- In evidence to the IM Review the contractor stated that they replaced this type of RRV Excavator with an RRV with “zero swing” meaning that the machine is capable of swinging on its own axis and so removing the potential for a repeat of this accident;
- The Safety Manager CCE issued an instruction outlining the practice to be adopted when using RRVs to load engineering trains with particular reference to instructing RRV Operators not to slew their machines in the vicinity of a locomotive;
- All Permanent Way Inspectors and their reports have received a briefing on IÉ-IM’s D&A Policy and any staff that undertake supervisory roles have been made aware of the contact details of the Test Provider to allow them to arrange testing when necessary. This action was completed on the 15th March 2017.

314 Based on the above actions, IÉ-IM made no further recommendations.

RRV collision with an OTM at Kildare Station, 28th June 2018

General description of work

315 The works to be carried out involved the tamping of the track using the OTM (Tamper) close to Kildare Station (see Figure 28). The operation involves the lifting of the track while simultaneously compacting the ballast beneath the sleepers. Tamping had occurred the previous night resulting in the ballast being low, as a result an RRV Excavator with RRV Dumpers would travel ahead of the Tamper and drop loads of ballast (using the RRV Excavator bucket) along the track to allow for efficient tamping.

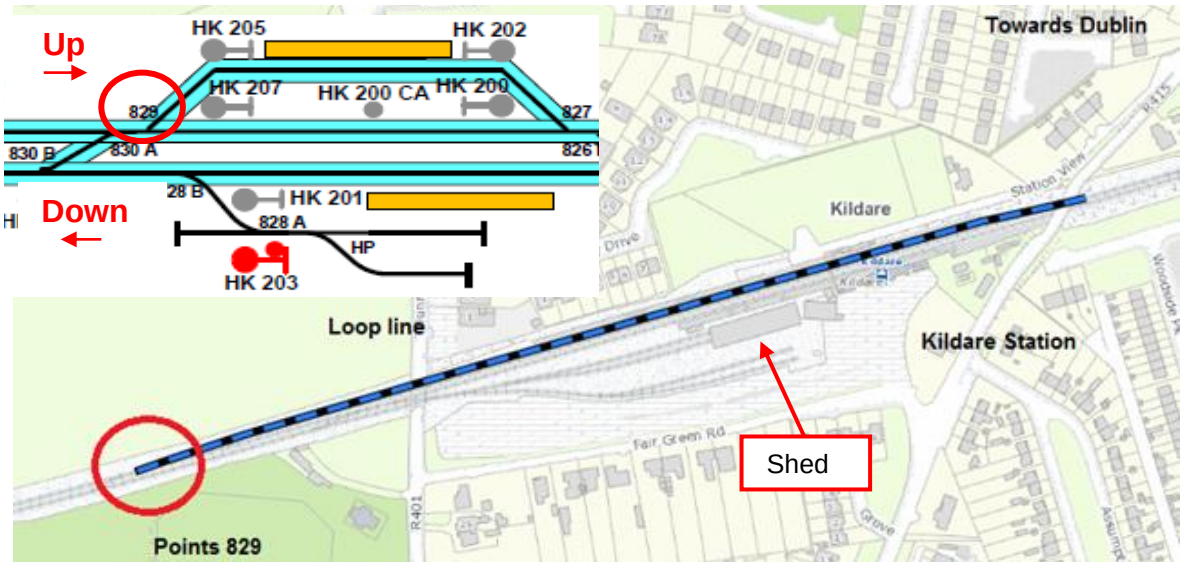

Figure 28 – Location of the accident

Events before the occurrence

316 The Tamper exited the shed at Kildare Station and travelled onto the Up Main. The RRV Excavator on-tracked on the Down Main, while the RRV Dumpers on-tracked on the Up Main and travelled towards the RRV Excavator. The RRVO of the RRV Excavator then began to scoop the ballast from the RRV Dumpers and placed it on the track.

317 After tamping the section on the Up Main, the Tamper travelled towards the loop at Kildare Station. The Tamper then travelled, in the Down direction; with the RRV Excavator leading (in the reverse direction) on the Down Main approximately an RRV Dumper length ahead of the Tamper.

Events during the occurrence

318 After completing the loop section, the Tamper then travelled back onto the Up Main, over Points 829, by the Down Main, with the RRV Excavator on the Down Main. At this point the RRV, while travelling in reverse struck the side of the Tamper. The RRVO of the RRV Excavator was unaware that the Tamper would be crossing from the loop back onto the Up Main.

319 The rubber road wheel of the RRV Excavator came in contact and caused damage to the outer casing of a stop box mounted to the frame of the machine.

Events after the occurrence

320 There were no injuries reported as a result of this accident and no reported damage to the RRV.

321 All work was suspended, and D&A testing was arranged. One of the RRVOs stated before the test that he had taken some medication that may show up on the test; the test on this RRVO was returned as positive, the tests on the other staff tested returned negative results. The RRVO was stood down awaiting results of the laboratory test on the second sample.

IÉ-IM investigation report findings, actions taken & recommendations

322 IÉ-IM carried out an investigation into the accident, with their findings included in 'Investigation Report: Collision between an RRV and a Tamper within a possession at Kildare 28th of June 2018', published on the 13th May 2018.

323 The investigation found that the immediate cause of the accident was:

- The RRV Excavator traversed past the fouling point of Points 829 and came into contact with the Tamper.

324 The causal factors were identified as follows:

- The RRV was working in close proximity to the Tamper;
- The RRVO did not observe the Tamper working behind his RRV;
- The RRVO was using a poor operating technique at the time of occurrence;
- The PIC did not observe that the RRV Excavator was working in such close proximity to the Tamper prior to the occurrence as he was at the opposite end of the P&C Tamper checking to see if much more ballast was required to fill any empty boxes.

325 There were no underlying or root causes identified.

326 IÉ-IM made a number of safety recommendations as a result of the accident:

- The Safety Manager CCE should arrange for the RRV Operator to receive corrective coaching, paying particular attention to the precautions that must be taken while RRVs are working alongside other vehicles within worksites including those travelling or working on an adjacent line;
- The Safety Manager CCE should arrange for a review to be carried out to ensure that all supervisory staff (A Class Inspector (appointed or Acting) or higher supervisory grade) have the facility on their mobile phone to contact the providers of D&A testing when it is required to do so.

RRV collision with a stabled 29000 in a siding in Connolly Station, 14th November 2018

Events before the occurrence

327 On Wednesday morning, 14th November 2018, a T3 possession was granted in Connolly Station to facilitate work on the City Centre Re-signalling Project (CCRP) by the SET Department; in conjunction with the T3 possession several T4 protections were also taken of the sidings in Connolly; including a T4 protection which incorporated Road No.16 carriage sidings in Connolly Yard which was to be used as the RRV access/egress point for RRVs.

328 There was a four-piece 29000 Diesel Multiple Unit (DMU) stabled on Road No.16 Road in Connolly Yard on the day of the accident. The train consist was 29109 leading, 29209, 29309 29409.

329 There were two worksites within the possession on the night, one worksite at CY161 points and another worksite at CY133 points where the work being carried out was digging out for the troughing for cabling; utilising three RRVs (two RRV Excavators and one RRV Dumper), which were fully certified.

330 The T3 possession and T4 protections were granted at 02:14 hrs; and the RRVC commenced on-tracking the RRVs on Road No. 16; Once on-tracked the RRVs travelled on to the Wash Road and towards the stone pad. The RRVs upon arrival at the stone pad off-tracked from the Wash Road and drove across the stone pad, before on-tracking on the Down Belfast line and driving towards Platform 4 to the worksite at CY133 points, see Figure 29.

Figure 29 – Manoeuvre locations at Connolly

Events during the occurrence

331 At approximately 04:00 hrs, upon completion of their work at the worksite, the PICOP/PIC gave permission to the RRVC for the three RRVs to leave the worksite at CY133 points to off-track at Road No.16. The RRVC informed the RRVOs that he would walk ahead of them as far as the stone pad, and upon arrival there he would get them to drive across the stone pad to on-track again on the Wash Road (see Figure 30). Upon arrival at the stone pad the RRVC brought the RRV Dumper across first and then proceeded to bring across the two RRV Excavators. Whilst the RRVC was in the process of bringing the final RRV across the stone pad, the RRV Dumper left the stone pad and began moving down the Wash Road towards the Road No.16 off-tracking location, which was located approximately twenty metres from the stabled 29000 DMU (see Figure 30).

Figure 30 – Off-tracking manoeuvres for the RRVs

332 On approach to the off-tracking point, approximately twenty feet from the stabled 29000 DMU, the RRVO of the RRV Dumper applied the brakes but was unable to stop; and, collided with the 29000 DMU, resulting in damage to unit 29109 (windscreen, wiper and some other superficial damage); there was no reported damage caused to the RRV Dumper.

Events after the occurrence

333 The RRVO reported the accident to the RRVC and the post-accident requirements were carried out correctly.

IÉ-IM investigation report findings, actions taken and recommendations

334 IÉ-IM investigation report 'Report of Investigation: RRV collision with stabled 29000 in siding under T4 at Connolly 14th of November 2018', published on the 6th September 2019 found that the immediate cause of the collisions was that: "The RRV Dumper upon arrival at the access point to off-track was unable to come to a stop before colliding with the stabled 29000 railcar".

335 Causal factors were identified as:

- The RRVO of the RRV Dumper did not allow for a sufficient braking distance for the RRV Dumper he was operating to be brought to a safe stop before it collided with the stabled 29000 railcar;
- The RRVO of the RRV Dumper made a movement towards the access point to off-track without having been authorised by the PIC.
- There was no visual indication placed by the PICOP/RRVC to indicate to the RRVO the limit of the T4 area on Road No.16 carriage siding.
- No requests were made to the station controller on duty to have the stabled 29000 railcar moved from Road No.16 carriage siding prior to the works commencing on the night.

336 An underlying cause was identified as "While the Method statement produced for the works included risk assessments for Moving Materials with Road Rail Machine and Road Rail Machinery Movements no consideration was given to the potential of a Road Rail Vehicle colliding with stationary Rolling Stock.

337 The IÉ-IM report made six recommendations:

- The IÉ-IM CCE should examine the feasibility of introducing the requirement that Method Statements produced for works identifies what access points are to be used for Road Rail Vehicles to access and egress the line for the associated works. The Method Statement would then include a risk assessment identifying the hazards, associated risks and control measures for using the said identified access point;
- The IÉ-IM CCE should undertake a review of risk assessments in relation to the operation of RRVs. This should consider but not be limited to capturing all reasonably foreseeable risks associated with the operation of RRVs including the potential for collision with objects, stabled rolling stock or persons;
- The IÉ-IM Head of Health and Safety, in conjunction with the IÉ-IM CCE should define what constitutes a suitable rail stop device;
- The IÉ-IM CCE to arrange for the procurement of such suitable rail stops to be used as required when PICs are arranging a T4 protection;
- The IÉ-IM CCE Safety Manager should arrange for the re-briefing of the RRVO involved in the accident paying particular attention to the instruction that RRVOs will not make any rail mounted movement with the RRV unless instructed to do so by the RRVC;

- The IÉ-IM IM Manager (Dublin) should arrange to re-brief the PICOP/PIC in relation to the requirement of the PIC to place a red flag during daylight and a red light (steady or flashing) during darkness or poor visibility to indicate the limit of the T4 area to the ensure compliance with IÉ Rule Book Section T Part Four.

PART 14 – RRV POINTS RUN-THROUGHS

Points run-through at Points 704 (Inchicore) on the 29th September 2015

Events before the occurrence

338 On Tuesday night the 29th September 2015 the PICOP/ES/PIC (the person who was carrying out the roles of PICOP, ES, PIC, TSC and HSM on the night) contacted the Signalman at Heuston and requested signal protection for the arranged T3 Possession. The signal protection was granted at 00:34 hrs. The PICOP/ES/PIC contacted the Signalman and informed him that the detonator protection was now in place and requested the T3 Possession, which was granted at 00:45 hrs. The PICOP/ES/PIC had also taken a T4 protection, in rear of Points 702 in the siding, which was not under T3 possession, to allow for the on-tracking of the RRVs.

339 During the conversation in relation to the possession, the PICOP/ES/PIC requested that Points 702 at Inchicore to be set in the reverse position. The Signalman confirmed this was completed, but he informed the PICOP/ES/PIC that these points could not be left in this position and so would have to be returned to the normal. The PICOP/ES/PIC stated that “once I get them out” (referring to the RRVs) he would contact the Signalman to normalise the points again.

340 At the time of the conversation, the PICOP/ES/PIC and the Signalman did not discuss Points 704a (see Figure 31); with the PICOP/ES/PIC assuming they were in the normal position, when in fact, they were lying in the reverse position. It should be noted that Section T Part 3 Clause 11.3.1 of the IÉ Rule Book states that Signalmen must “keep any points in the possession in the proper position except when a movement is to enter, leave or cross the possession there”. In this instance, the Signalman did not place/keep Points 704a in the proper (normal) position.

Figure 31 – Points 704

341 Although, not contributory to the accident, the PICOP/ES/PIC did not adhere to the Rule Book in full in that:

- The PICOP/ES/PIC placed detonator protection at Signal HN246 without informing the Signalman. Clause 9.4.3 of Section T3 of the IÉ Rule Book requires that the PICOP inform the Signalman where detonator protection is not 400 m ahead of a signal;
- The PICOP/ES/PIC arranged for T4 protection to on-track the RRV and access the T3 possession. T4 protection is designed to protect for works in sidings only. Clause 1.4 of Section Q of the IÉ Rule Book states that RRVs are not permitted on running lines outside of a possession.

Events during the occurrence

342 The PICOP/ES/PIC removed detonator protection at Points 702 to on-track an RRV and instructed the Operator of the RRV to travel over Points 702 and Points 704a and proceed to the worksite, a distance of approximately 600 m away. The PICOP/ES/PIC informed the Operator of the RRV that he would join him at the worksite once he had replaced the detonator protection at Points 702.

343 The PICOP did not remain with the RRV as it travelled towards the worksite. The RRV travelled over Points 702 without incident (which were in the correct position for the movement). As the RRV approached Points 704a, the Operator of the RRV only observed that Points 704 were not in the correct position until it was too late and was unable to bring the RRV to a stop before running through Points 704a in the reverse position i.e. they were not in the correct position for the movement.

344 The Operator of the RRV informed the PICOP/ES/PIC of the occurrence and the PICOP/ES/PIC went to inspect Points 704a and saw that the points had been run through and were now damaged.

Events after the occurrence

345 The PICOP/ES/PIC contacted the Signalman and instructed him that he could now normalise Points 702 (a different set of points). During this conversation the Signalman informed the PICOP/ES/PIC that he had lost detection on Points 704a. The PICOP/ES/PIC said he was going to talk to him about that but did not tell the Signalman that the points had been run through by an RRV (nor did the PICOP/ES/PIC report the occurrence to his Line Manager).

346 The Signalman informed the PICOP/ES/PIC that he would swing Points 704a to see if he could get detection in the normal position. After several attempts the Signalman informed the PICOP/ES/PIC he was still unable to get detection and asked PICOP/ES/PIC was there any SET staff on site to examine the points. The PICOP/ES/PIC informed him that there were, and he would have the SET staff examine the points and he would report back to him. The PICOP/ES/PIC still did not inform the Signalman at this stage that Points 704a been run through.

347 The PICOP/ES/PIC later contacted the Signalman and informed him that Points 704a had been run through by the RRV and the SET staff were going to put Points 704a into normal position and once this was done the PICOP/ES/PIC was going to arrange for Points 704a to be scotched, clipped and locked in the normal position. This was done, and the PICOP/ES/PIC informed the Signalman; and the RRV was removed from the worksite.

348 However, the Signalman assumed that because the PICOP/ES/PIC was in control of the possession that the PICOP/ES/PIC would report the occurrence to the Traffic Regulator CTC. However, the correct procedure that should have been followed is that the Signalman should have reported the occurrence to the Traffic Regulator CTC who would then report it to CTC Duty Manager and other staff as required.

349 As the PICOP/ES/PIC did not immediately report the run through to his Line Manager, no D&A testing was carried out which is not in compliance with IÉ-IM's D&A Policy regarding post incident testing of staff.

IÉ-IM investigation report findings, actions taken and recommendations

350 The IÉ-IM investigation report, 'Report of Investigation: Points run through at Inchicore during TIII Possession 29th September 2015', published on the 31st May 2016 identified the immediate cause of the accident as:

- Points 704a at Inchicore were not set to the correct position for the movement of the RRV travelling to the work site.

351 Causal factors were identified as:

- When the possession was granted the PICOP/ES/PIC did not confirm with the Signalman the lie of the points;
- The Signalman did not have Points 704a in the proper position when granting the possession as per Section T Part III Clause 11.3.1 of the IÉ Rule Book;
- The PICOP/ES/PIC did not request Points 704a to be set for the movement taking place;
- The route was not checked by the PICOP/ES/PIC to observe the position of Points 704a prior to the movement taking place;
- The PICOP/ES/PIC was not present when the RRV was travelling over Points 704a.

352 There were no underlying causes identified.

353 IÉ-IM took a number of actions as a result of this accident, including:

- Publishing a WC outlining the process for the movement of engineering trains and RRVs to and from sidings under T4 Protection and adjacent to TIII Absolute Possessions;
- Re-briefing the PICOP/ES/PIC on the duties of an ES; and the need to report all safety related occurrences to line management (in part to allow for D&A testing);

- The Signalman received corrective coaching; and was also subject to two extra unannounced monitorings;
- A signalling simulator module programme commenced in February 2016 and this programme involves signalmen dealing with various scenarios during the programme. One of the scenarios, Scenario 7, deals with the procedure for granting a T3 Possession.

354 There were two safety recommendations made:

- The Infrastructure Manager Dublin should arrange for a support and development plan to be put in place for the PICOP/ES/PIC to address all of the issues highlighted in this report;
- The Operations Control Manager East should arrange for the Signalman to be re-briefed on Section T Part III Clause 11.3.1 of the IÉ Rule Book.

RAIU investigation findings

355 There was no method statement produced for the works scheduled for the 29th September 2015. However, a copy of the Construction Regulations which contain the necessary risk assessment for the works was available in the mobile vans.

Points run through at Points MN266 (Maynooth) on the 26th August 2016

Events before the occurrence

356 On the night of the 26th August 2016 the relevant CCE and contractor members of staff reported to Maynooth Station prior to the commencement of the works. There were three work sites planned for the possession and five RRVs were to be used in the possession. Worksite 1 and 2 were for ballasting works on either side of Maynooth Yard while Worksite 3 was for vegetation control work on the Dublin end of the possession, see Figure 32 for location of the accident.

Figure 32 – Location of the accident

357 The RRVs were to be on-tracked at the ballast pad (see Figure 33) adjacent to the track access gate in Maynooth Yard which is the designated on-tracking point for RRVs.

Figure 33 – Ballast Pad (for on-tracking & off-tracking RRVs)

358 The site safety briefing was given by the PICOP who was also acting as the ES for the ballasting work site and the role of PIC; and will be referred to as the PICOP/ES/PIC throughout this section of the report. The Operators of the RRVs carried out their relevant checks on the RRVs.

359 When the possession was granted at 00:31 hrs, the PICOP/ES/PIC on-tracked an RRV Dumper (see Figure 34) and RRV Excavator (operated by RRV Operator Dumper and RRV Operator Excavator, respectively) at the ballast pad adjacent to the track access gate in Maynooth Yard

which is the designated on-tracking point for RRVs. Another RRV Excavator was on-tracked at the ballast pad for the purpose of undertaking vegetation control works at Worksite 3.

Figure 34 – Example of RRV Dumper

360 At 01:05 hrs the PICOP/ES/PIC contacted the Signalman and requested a T4 Protection of the Long Siding in Maynooth Yard, to complete the ballasting works in and around Trap Points MN266, which was granted by the Signalman. As part of this conversation the PICOP/ES/PIC requested that Trap Points MN266 be placed in the reverse position to allow the machinery to travel from the TIII possession into the T4 Protection; which was done and confirmed by the Signalman.

361 Prior to the works commencing, the RRV Dumper unloaded a rail grab attachment and placed in the six-foot area between the machinery siding and the Long Siding, close to Trap Points MN266. The RRVs proceeded into the Long Siding at Maynooth Station to carry out the ballasting works controlled by the PICOP/ES/PIC. The ballasting works around Trap Points MN266 (see Figure 35) works were undertaken and completed.

Figure 35 – Point MN266

362 At 02:52 hrs the PICOP/ES/PIC contacted the Signalman to request points change at Trap Points MN266 to allow the machinery to travel from the Long Siding via the Down Line towards the Dublin end of Maynooth Yard, to continue with the ballasting works at Points MN260 and Points

MN261. During this conversation the PICOP/ES/PIC cancelled the T4 Protection and requested that Trap Points MN266 be returned to the normal position. The Signalman confirmed that Trap Points MN266 were returned into the normal position.

363 When the works were complete on the Dublin end of Maynooth Yard the PICOP/ES/PIC instructed the RRV Dumper Operator (leading) and RRV Operator Excavator to proceed to the ballast pad adjacent to the track access gate at Maynooth Yard and remove their machinery from the line. He also dispatched a competent PIC, by road, to oversee the removal of the machinery from the line. The PICOP/ES/PIC did not accompany the RRVs back to the ballast pad.

Events during the occurrence

364 The RRV Dumper Operator, was leading, with the RRV Excavator Operator following. When the RRV Dumper Operator arrived back at the ballast pad he began securing his RRV Dumper; he then saw the RRV Excavator Operator come up in rear of his RRV Dumper, failing to stop, and continuing further up the line. The RRV Excavator Operator stated that he continued a little further down the line to talk to the RRV Dumper Operator who was in the machinery siding; the RRV Dumper Operator denied this conversation took place.

365 At 03:49 hrs the PICOP/ES/PIC contacted the Signalman and requested that Points MN263 and Points MN265 be placed in the normal position, he also stated he would contact him again to test the three sets of points (MN263, MN265, MN266) once the machinery was removed from the line. PICOP/ES/PIC phoned back at 04:02 hrs to do this; however, Track Circuit 882s was occupied (points MN265 and MN266 lay in Track Circuit 882s) and the Signalman informed the PICOP/ES/PIC of this and enquired if all the machinery was clear of the line. The PICOP/ES/PIC indicated the machinery should now be clear of the line by now and told the Signalman he would phone him back.

366 The PICOP/ES/PIC contacted the PIC (dispatched to oversee the machinery being removed clear of the line). The PIC stated as he was arriving at the entrance gate at the ballast pad and he could not observe any machinery present on the line. As the PIC walked down to the ballast pad, he saw the RRV Excavator return back to the ballast pad.

367 The RRV Excavator Operator enquired from the PIC if he could go down the line and retrieve the rail grab placed on the line earlier on the night adjacent to Trap Points MN266 (the rail grab was removed after the incident by another RRV Excavator). The PIC stated he could not and instructed the removal of the RRV Excavator from the line, which was done.

Events after the occurrence

368 The PIC who was also acting as the Handsignalman for the works was on route in preparation to withdraw his protection for the possession, when the PIC discovered Trap Points MN266 were gaping, he contacted the PICOP/ES/PIC and reported the this; who in turn phoned the Signalman to see if he had detection of Trap Points MN266. The Signalman stated that he had lost detection of Trap Points MN266 shortly after Track Circuit 882s became occupied. The PICOP/ES/PIC

reported the accident to the relevant staff and D&A testing was carried out. The PICOP/ES/PIC assembled all RRVs drivers on site and enquired if any of them were aware of any incident occurring while they were on-tracked, all of the RRV drivers denied any knowledge of any incident. The data collected from the Signal Logger from Track Circuit 882s indicates the RRV Excavator movements were the last movements in Track Circuit 882s before detection was lost, the RRV Excavator Operator again denied any knowledge of the accident.

IÉ-IM investigation report findings & recommendations

369 The IÉ-IM investigation report, 'Report of Investigation Points run through at Maynooth during a TIII possession on 26th of August 2016', published on the 22nd February 2017, identified that all staff were competent for the duties they were to perform. The investigation report identified the immediate cause of the accident as:

- An unauthorised movement took place which trap points MN266 were not set for.

370 The causal factors were identified as:

- From the evidence available the investigation found that the most likely cause of the points run through was that the RRV Excavator Operator did not stop his RRV at the ballast pad as instructed by the PICOP/ES/PIC but continued further up the line and ran through trap points MN266;
- There was no PIC present to control the movements of the RRV Excavator when it arrived at the ballast pad.

371 There were no underlying causes associated with the accident.

372 The three recommendations associated with the accident, are:

- The CCE Safety Manager should conduct a review to determine the suitability of the RRV Excavator Operator being allowed to continue to operate on the IÉ rail network;
- The Infrastructure Manager Dublin should make arrangements for the Chief Assessor CCE to hold a professional discussion with the PICOP/ES/PIC with regard to the off-tracking procedures of RRVs during possessions;
- The CCE to carry out a review of the availability from contractors of the required GPS information from RRVs working on the IÉ network.

Points run-through at Points BR116 (Bray) on the 22nd August 2017

General description of works

373 On the night of the 22nd August 2017 the ES/TSC met the two Operators of the RRVs (dumper and excavator) at Bray Station car park for a briefing in relation to the re-ballasting works to be carried out on the night.

374 The work involved loading the RRV Dumper with ballast from a stockpile at Bray Station car park, travelling to the worksite where the RRV Excavator would bucket out the ballast and spread it as required. The RRVs would then return to re-load more ballast and repeat, as necessary, until the ballasting work was complete.

Events before the occurrence

375 The RRV Dumper on-tracked at the level crossing (see level crossing CCTV XR011 in Figure 36) without issue. However, the RRV Excavator had difficultly on-tracking as he had little experience in operating an RRV and required assistance from the ES/TSC in on-tracking.

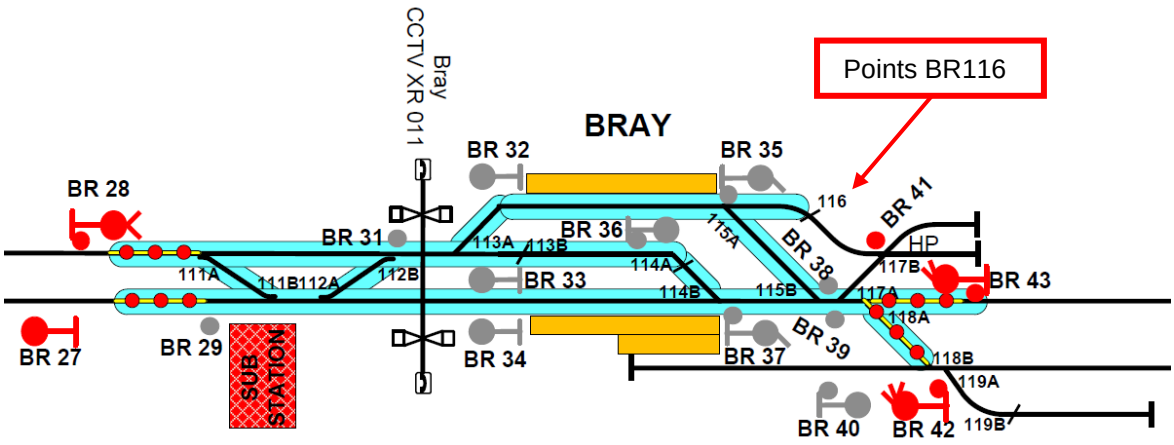

Figure 36 – Location map of Bray Station

376 Prior to commencing the ballasting works the Operator of the RRV Excavator left a grab-arm for the RRV Excavator in the cess near the level crossing as he would not require it for the ballasting works.

377 The ballasting works were carried out by the RRVs, with there being some issues with the Operator of the RRV Excavator spreading the ballast incorrectly and having difficultly operating the RRV under the OHLE. Despite this the works were completed and the PIC informed the Operators of the RRVs that the works were completed, and they were to return to the level crossing to off-track the machinery.

Events during the occurrence

378 The RRV Dumper off-tracked without issue in the presence of the PIC. However, as the ES/PIC was working to remove all possession equipment from the worksite he saw the Operator of the RRV Excavator on-tracking again and travelling towards BR116. The ES/PIC phoned the PIC, who was with the RRV Dumper, who started running towards the RRV Excavator to tell him to stop, however, the RRV Excavator ran-through Points BR116, which were set in the trap position.

Events after the occurrence

379 The Operator of the RRV Excavator then attempted to reverse off the points, causing the RRV to derail.

380 The accident was not reported to the Signalman for approximately ninety minutes.

IÉ-IM investigation report findings & recommendations

381 IÉ-IM carried out an investigation into the accident, with the initial findings were presented to the RAIU in draft format. The draft found that the immediate cause of the accident was:

- BR116 points (a set of trap points) were set in the trap position and when the RRV passed over these points it caused damage to the points and when passing back over the points became derailed.

382 Causal factors were identified as:

- BR116 points were set in the trap position to prevent any movement from the siding towards the running line;
- There were no planned or authorised movements either towards or from the siding;
- The Operator of the RRV Excavator on-tracked at Bray level crossing and moved towards BR116 points while there was no PIC present;
- There was no evidence of a clear understanding being reached between IÉ-IM staff and the Operator of the RRV Excavator;
- The Operator of the RRV did not operate under the instruction of the PIC in relation to the movement concerned.

383 There were no underlying or root causes identified.

384 A number of actions were taken as a result of the accident, including:

- The PIC is no longer carrying out safety critical duties;
- IÉ-IM met with the contractor who supplied the RRVs and the details and findings from the accident in relation to the actions of his staff were presented and discussed;
- The RM DART has briefed all staff in the Division in relation to the requirement to report immediately any unsafe actions or working conditions that they observe.

Points run-through at Points CL252 (Clonsilla) on the 6th October 2017

General description

385 By way of introduction to the location of the accident, Clonsilla Station is a junction station for the M3 Parkway branch and is a located on the main Dublin to Sligo line; Clonsilla Yard is adjacent (see Figure 37).

Figure 37 – Location of Clonsilla Yard

386 It has two running lines (Up Main towards M3 Parkway Branch via points CL 252 and Down Main), a bay road and a siding which is accessed from the south side of the station.

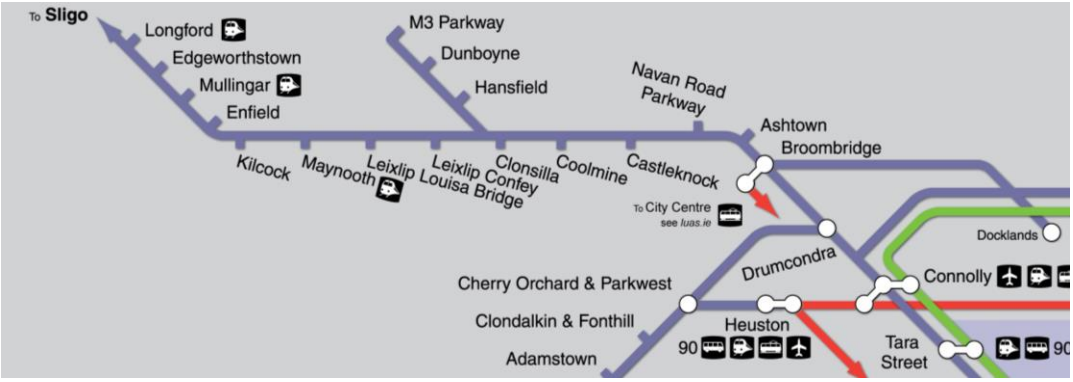

Figure 38 – Location of the accident

387 The section of track between Glasnevin Junction (west of Drumcondra Station) and Maynooth Station where the T3 possession was in place on the night is controlled by the Controlling Signalman located at Clonsilla Signal Cabin (to be referred to as the Clonsilla Signalman for this section of the report); see Figure 38 for the layout.

Events before the occurrence

388 At 23:24 hrs the Clonsilla Signalman set and cleared the route for the departure of an empty train from Clonsilla for Connolly Station (train identification C718 to be referred to as Train C718 for this section of the report); this train movement required Points CL252 to be set to the reverse position (Figure 39) in order for the train to transverse from the M3 Parkway Branch onto the Up Main (Sligo to Dublin) at Clonsilla Junction. Train C718 was the last train that was required to clear the section on the night; however, it is noted that Train C718 usually departs ahead of the train departing Maynooth towards Connolly (Train C710).

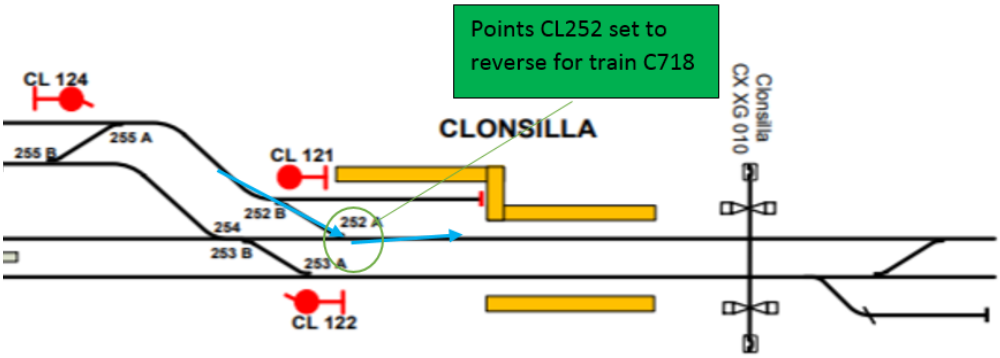

Figure 39 – Points CL252 in reverse (figure taken from IÉ-IM report)

389 Track maintenance works were to be conducted during the T3 Possession, which involved four RRVs (two excavators and two dumpers). At Foley's Yard access point, close to Barberstown Level Crossing (Clonsilla) the PIC, who was in charge of an RRV dumper was undergoing a competency assessment in the role of PIC; this assessment was being carried out by an IM Competency Assessor (IMCA). The PIC carried out a briefing on the works with all RRV operators present.

Figure 40 – RRV dumper similar to one used in accident

390 At 00:23 hrs the PICOP contacted the Clonsilla Signalman, the T3 Possession arrangements were made and granted; during the set-up process the PICOP queried the Clonsilla Signalman on the positioning of the points in the possession which the Clonsilla Signalman said they were all in the normal position (however Points CL252 remained in the reverse position for the earlier train movement, Figure 39).

391 The PICOP contacted the PIC and informed him that possession for the line was granted and he could on-track the RRVs and proceed eastwards towards Clonsilla Level Crossing where the IMCA was going to observe the PIC conducting the RRVs through Clonsilla Level Crossing as part of his practical assessment. During this conversation the PIC enquired if all points within the possession were in the normal position and the PICOP told him that he had been informed by the Clonsilla Signalman that they were all in the normal position.

392 At approximately 00:50 hrs two RRVs were on-tracked on the Up Main and two on the Down Main at Foley's Yard. The two RRVs on the Down Main travelled behind the RRVs on the Up Main also heading eastwards. The PIC travelled on the lead RRV Dumper headed in the direction of Clonsilla Level Crossing (the lead RRV Dumper was travelling cab first). The RRVs passed through Barberstown Level Crossing and continued eastwards.

393 In Clonsilla, the PIC observed from the RRV cab that Points CL254 (B end) were trailing (correct position) and travelled over them without incident. The PIC then approached facing points CL253 (B end), observing from the cab that the points lay in the correct position for the movement and the RRV passed over them without incident.

Events during the occurrence

394 As the RRV Dumper approached trailing points CL252 (A end), see Figure 41, the PIC was pre-occupied trying to make contact with the Gatekeeper for Clonsilla Level Crossing to arrange for the passage of the RRVs through the crossing; as a result, he did not check the position of Points CL252. The RRV travelled over the points at no more than walking pace and the points were trailed through by the leading bogie of the RRV, causing the leading bogie to derail.

Figure 41 – Points CLC252

Events after the occurrence

395 Directly after the points were run through the PIC contacted the A-Class Inspector on duty for the shift and reported the occurrence, who in turn contacted the Regional Manager (RM) South & East to report the points run through. The A-Class Inspector arrived on site where the RRV was

removed from the line. The SET Department were contacted to attend and carry out the necessary repairs, they reported a substantial amount of damage to the switch blades and its operating mechanisms; which was repaired later that day.

396 The RM Southeast arranged for the post incident D&A screening to be carried out with all staff on site, in line with IÉ-IM post incident procedures; the results of these tests were recorded as negative. The Clonsilla Signalman was relieved of his duties and also underwent D&A screening, the results of which were recorded as negative.

IÉ-IM investigation report findings & recommendations

397 The IÉ-IM investigation report into the accident, "Report of Investigation Points run through at Clonsilla during a T3 possession 6th October 2017" published on the 10th May 2018 found the immediate cause of the occurrence to be:

- Points CL252 at Clonsilla were not set in the correct position (Normal) for the movement of the Road Rail Vehicle.

398 Causal factors were identified as:

- The points were not set to the required position by the Signalman prior to granting the TIII possession;
- The Clonsilla Signalman did not check/ensure the points were in the normal position before granting the TIII possession;
- The reminder appliance was not used as is required in conjunction with granting a possession;
- The position of CL252 points were not checked by the RRV Operator or the PIC, prior to the RRV travelling over them.

399 There were no underlying causes or root causes identified.

400 Two actions have occurred as a result of this occurrence. Firstly, the Clonsilla Signalman has commenced a support and development plan under IMO-SMS-040, Development and Support System-CTC Signalman. Secondly the PIC has relinquished his PIC role.

401 As a result of the actions, one recommendation was made:

- The Safety Manager CCE should, arrange for the RRV Operator to receive corrective coaching, paying particular attention to the procedures for ensuring points are in the correct position prior to RRV traveling over them.

Points run-through at Points 750 (Lisduff, Co. Laois) on the 26th June 2018

Planned possession works & persons involved

402 There were three work sites planned for the duration of the possession on the night of the 26th June 2018; one worksite south of Lisduff and two worksites north of Lisduff, see Figure 42.

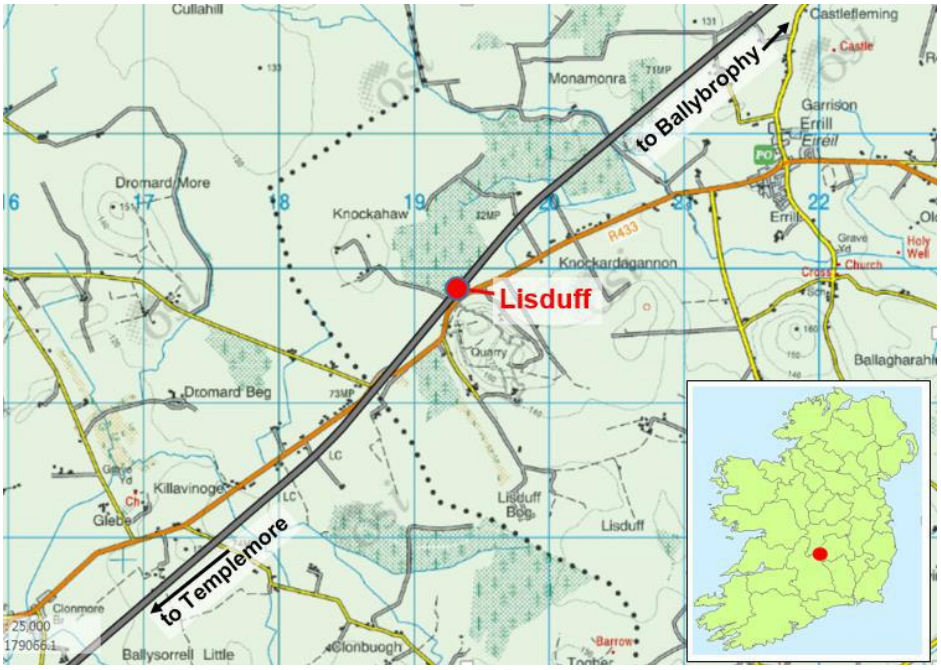

Figure 42 – Location of the accident

403 The worksites north of Lisduff involved an OTM for a ballast cleaning site on the Down line and an RRV (fitted with a brush box), see Figure 43, for the ballast brushing on the Up line; the OTM and RRV were to access the possession from Lisduff Yard.

Figure 43 – RRV with brushbox (similar to RRV involved in accident)

404 The RRVO was working under the instruction of the ES/PIC, who in turn was operating under the PICOP on the night of the accident.

Events before the accident

405 The PICOP was in contact with the Signalman at CTC in relation to the possession arrangements; during this conversation the Signalman stated that all the points were in the 'normal' position.

406 When the T3 was granted (without issue) by the Signalman, the PICOP contacted the ES/PIC at Lisduff to advise, firstly, that the possession was taken and secondly that the OTM in Lisduff Sidings was to on-track first at Lisduff Yard, traverse on to the Up line, via Points 750, and travel north towards Ballybrophy; while the RRV was to on-track at Lisduff Yard and travel to a worksite on the Down line, also north towards Ballybrophy (see Figure 44). The PICOP and ES/PIC did not discuss the RRV on-tracking or the setting of the points to reverse or normal at this stage.

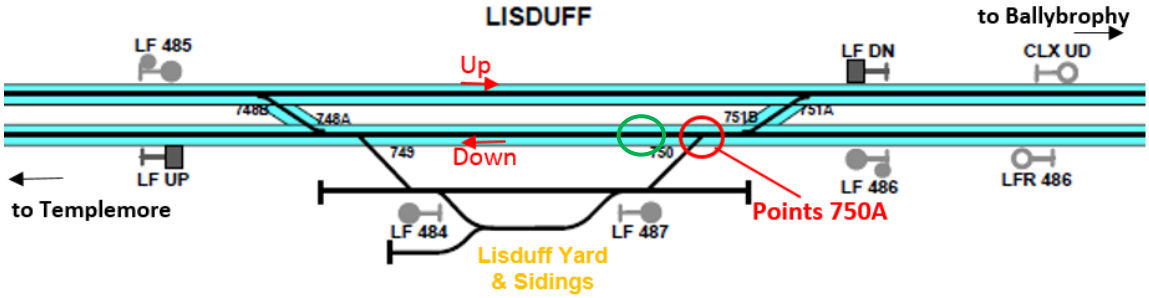

Figure 44 – Layout at Lisduff

407 During the possession arrangements the ES/PIC, at Lisduff Yard, carried out a site briefing in relation to the works to by undertaken.

408 The PICOP contacted the Signalman to inform him that the OTM was ready to enter the possession and requested Points 750 and 751 to be placed in 'reverse' to allow the OTM onto the Up line. The PICOP then requested that the OTM Operator contact the Signalman to request permission to enter the possession, pass Signal LF487 at Danger and travel onto the Up line; the PICOP also requested that the OTM Operator phone the PICOP when he was clear of all points and on the Up line; it was in intention of the PICOP to contact the Signalman after the OTM was clear to request the points be placed in the 'normal' position. The OTM Operator phoned the Signalman at 23:00 hrs and followed all instructions and travelled towards the worksite, without issue; however, he did not phone the PICOP to let him know he was clear of Lisduff.

Events during the accident

409 Approximately twenty minutes after the OTM departed, the RRVO then on-tracked the RRV onto the Down line (see green circle for location in Figure 44) under the instruction of the ES/PIC; and the ES/PIC then boarded the RRV and instructed the RRVO to continue on the Down line (in the Up direction) to the worksite, see Figure 44.

410 The RRV moved towards Points 750A; the RRVO raised the arm of the RRV (and the brush box) in order to get a better view of the points, as the brush box was obscuring the track for both the RRVO and the ES/PIC; the RRVO did not fully raise the brush box due to the presence of overhead electric cables in the vicinity.

411 The RRV continued to travel over Points 750A, and when the RRV was over Points 750A, both the RRVO and the ES/PIC heard a noise under the RRV. The RRVO immediately stopped the RRV. The ES/PIC dismounted from the RRV and looked under the RRV to see that Points 750A had not been set for the movement and that the RRV had run-through the points.

Events after the accident

412 The ES/PIC instructed the RRVO to off-track the RRV, beyond the points, and to park it safety. When the RRV was clear of the points, the ES/PIC examined the points for damage. During this examination, the PICOP phoned the ES/PIC to inform him that the Signalman had lost detection of Points 750A. The ES/PIC told the PICOP that the RRV had run-through Points 750A.

413 The PICOP contacted the Signalman and the Acting Permanent Way Inspector (APWI) to advise of the points run-through. The APWI in turn, informed the Acting Regional Manager, who requested D&A testing for the ES/PIC, RRVO and PICOP, which later returned negative results.

414 The Signalman contacted SET and the points were signed out of use by SET until repaired and signed back into use on the 29th June 2018.

IÉ-IM investigation report findings, actions taken & recommendations

415 IÉ-IM's 'Report of Investigation: Points run-through at Lisduff during T3 possession works on the 26th of June 2018', published on the 12th November 2018 identifies the immediate cause of the accident as: "Points 750 in Lisduff were not set to the correct position for the movement of the RRV". Causal factors were identified as:

- After the possession was granted the PICOP and the ES/PIC did not reach a clear understanding during a safety critical conversation. An assumption was made that the RRV was authorised to on-track and travel to the worksite on the Down line once the OTM had departed Lisduff to travel to the worksite on the Up line, but the authorisation for the RRV had not yet been relayed;
- Points 750A were not checked by the ES/PIC or RRVO prior to the RRV travelling over them.

416 IÉ-IM took a number of actions following the accident, included the temporary removal from duties of the ES/PIC, PICOP and RRVO, who after re-briefing and training were deemed competent to be re-assigned to their respective duties. The risk assessment contained within the Method Statement for the T3 possession has been amended to include the points hazard and associated control measures; this inclusion has also been communicated to all local PWIs and Engineers. As a result of the actions, no further recommendations were made.

Points run-through at Points PN842 (Portarlington) on the 23rd November 2018

Planned possession works

417 A T3 possession was in place for the night of the 23rd November 2018, the possession was for the Up and Down Lines between Portlaoise (Laois Traincare Depot (LTCD)) and Sallins, Figure 45.

Figure 45 – Location of the accident

418 There were five worksites planned for the duration of the possession on the night; the worksite of relevance to the occurrence was north of Portarlington where ballasting and tamping works were taking place. Four RRVs were arranged for the works and access to the possession was from Portarlington; three of the RRVs were to be on-tracked in the sidings, enter the Down Loop and traverse Points PN 842 onto the Down Line to travel up to the site. The fourth RRV (to be known as RRV Digger) was planned to be on-tracked on the Up Line and travel from there to the same site, working from the adjacent line to the rest of the machinery (see Figure 46 for Portarlington track layout).

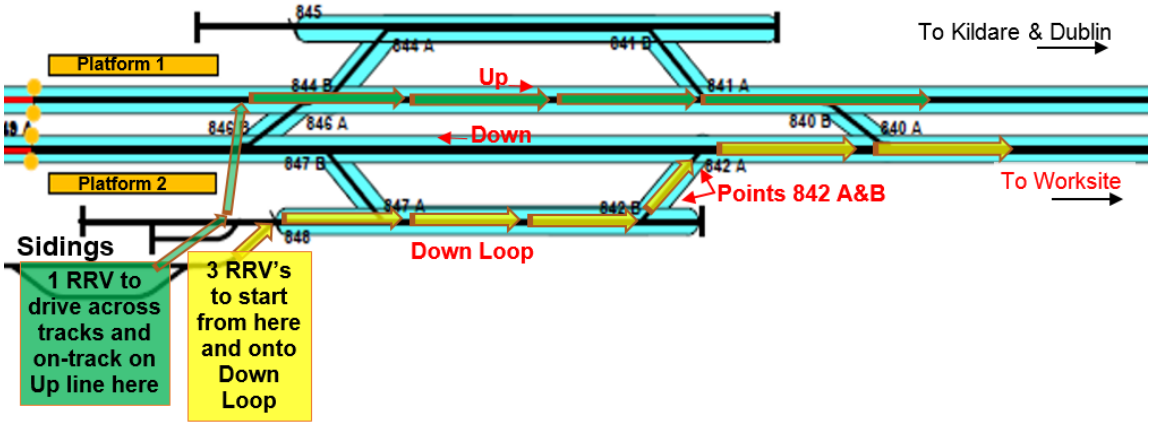

Figure 46 – Planned on-tracking of RRVs

419 The PICOP reported for duty shortly before midnight (Thursday night) at Portlaoise where he would be positioned for the duration of the T3 possession. The ES/PIC reported for duty at Portarlington Yard/Sidings shortly before midnight followed by other members of staff and contracted RRVOs.

420 The ES/PIC carried out a site safety briefing to all present prior to the commencement of works. As part of the briefing the ES/PIC advised the RRVOs that three of the RRVs would be travelling on the Down Line, via the Down Loop, from the sidings and the RRV Digger would be on-tracked directly onto the Up Line and travel from there to the worksite. The briefing form was signed by all present.

421 At 00:46 hrs, the PICOP contacted the Controlling Signalman at CTC in relation to the T3 possession arrangements. The PICOP requested the Controlling Signalman reverse Points 848 and Points 842 at Portarlington to enable the three RRVs to leave the sidings, enter and travel on the Down Loop onto the Down Line to head to the worksite. The T3 Possession was granted at 00:56 hrs.

422 The PICOP contacted the ES/PIC to advise him that the T3 Possession was granted and that the points were sets for the three RRVs to leave the siding onto the Down Loop and exit the loop at the Dublin end (via Points 842) and travel onto the Down Line; the PICOP also requested that the RRV Digger be on-tracked directly onto the Up Line (see Figure 47).

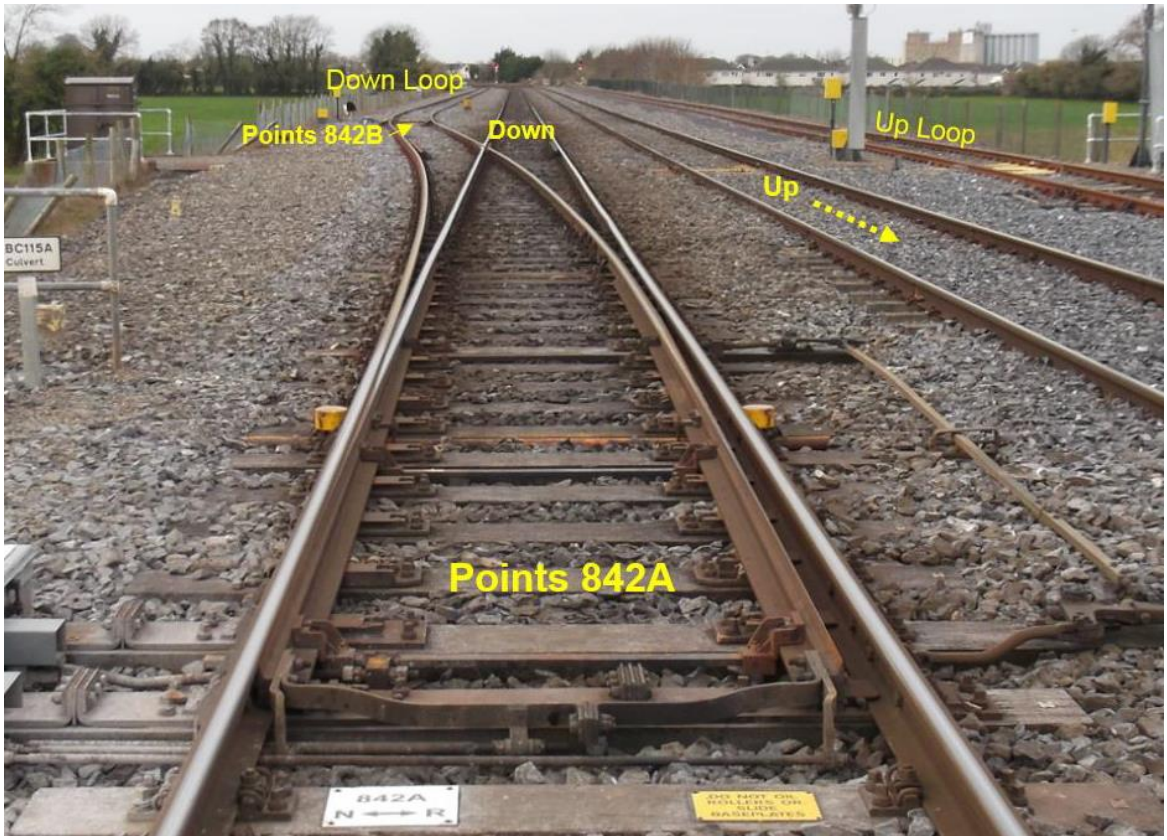

Figure 47 – Points at Portarlington

Events before the occurrence

423 The ES/PIC then arranged to on-track three of the RRVs in the sidings at Portarlington for them to travel on the Down Line. The three RRVs on-tracked, travelled up to the Down Loop and traversed onto the Down Line and on towards the worksite.

424 The RRVO of the RRV Digger drove over to on-track on the Down Line (although the RRVO should be on-tracking directly onto the Up Line). The ES/PIC then climbed into the cab of the RRV Digger and instructed the RRVO to travel towards the worksite.

Events during the occurrence

425 The RRV Digger began travelling to the worksite on the Down Line; in doing so approached the trailing end of Points 842, ran through the points, derailed and came to a stop.

Events after the occurrence

426 The ES/PIC then dismounted from the cab of the RRV Digger, inspected the points and realised what had occurred. The ES/PIC then contacted the PICOP to advise him, who in turn notified the relevant staff.

427 The A-Class Inspector arrived on-site a short time after and informed the ES/PIC, the PICOP and the RRVO that they were temporarily relieved from their duties pending further investigation and that they would be required to undergo D&A screening as part of the post incident protocol; the RRVO declined to complete the D&A screening; the other tests were returned as 'Negative'.

IÉ-IM investigation report findings, actions taken & recommendations

428 IÉ-IM carried out an investigation into the accident, and published report "Report of Investigation: Points run-through at Portarlington during T3 possession works on the 23rd of November 2018", published on the 2nd April 2019. The report found that the immediate cause of the accident was:

- The RRV was on-tracked on the Down line, instead of the Up line as planned. Subsequently, it travelled up the Down line and trailed through Points 842A and derailed.

429 Causal factors were identified as:

- Points 842A were not set for the movement of the RRV, as it was not the planned movement;
- The ES/PIC did not reach a clear understanding with the RRVO during the planning as to what line the RRV was to be on-tracked;
- Points 842A were not visually checked prior to the RRV travelling over them in accordance with Rule Book Section Q, Part 1 Clause 4.5: "You must make sure all points are in the correct position for the safe movement of the RRV(s) over them";
- The ES/PIC demonstrated a loss of situational awareness when the RRV was on-tracked on the Down Line in his presence. He then climbed into the cab of the RRV to accompany the

RRVO to the work site and travelled up the wrong line, leading to the points run-through and subsequent derailment.

430 An underlying cause was identified as:

- The risk assessment(s) produced for the possession works did not give consideration to RRVs being on-tracked during possession works, nor for movements of RRVs over points within possessions and the potential consequences.

431 IÉ-IM took a number of actions as a result of the accident, namely:

- The ES/PIC was placed on an IM Development & Support System, which included re-training and assessment; additional monitorings and examinations;
- The RRVOs PTS and RRVO Certification was revoked;
- Trailing of a new access point for RRVs at Portarlington Yard;
- Revision to method statements and risk assessments.

432 As a result, IÉ-IM made one safety recommendation:

- The CCE should arrange for risk assessments associated with possession works to be reviewed and updated to include the on-tracking of RRVs during possessions. The reviews should also include movements over points, in particular RRVs, during possessions.

RAIU findings

433 The RAIU found that there was a dearth of information in the method statements in relation to RRVs, as well as incorrect information, namely:

- The incorrect access point was given (or the RRVs were accessing incorrectly); the named access was at Monasterevin;
- No hazards associated with the on-tracking of RRVs were identified;
- No hazards associated with the movement over points were identified;
- Importantly, no reference to the 100 m to maintained when travelling in convoy was made.

SECTION D: ANALYSIS

PART 15 – RRVs

General overview of RRVs

434 RRVs are owned and operated by third party contractors which are hired by IÉ-IM through a structured tender agreement (paragraph 33). Generally, RRVs on the IÉ network are High Ride (Type 9B) RRVs (paragraphs 44 - 45), where traction and braking is indirectly applied to the rail wheel through the road wheel, running on the rail wheel; the use of Type 9Bs is favoured due to gauging issues with other RRV types associated with the road wheels. Approximately 70% of RRVs are imported from the UK (paragraph 53); with dumpers and excavators the most common RRVs on the network. The use of Type 9Bs and the UK imports is of relevance as Network Rail (UK) prohibited all Type 9B that were not fitted with direct rail wheel brakes on the Network Rail Managed Network due to the risks involved (paragraph 54).

435 There are approximately one hundred RRVs operating on the IÉ network on every given night (paragraph 55).

IÉ-IM certification of contractor RRVs

General certification of RRVs

436 Certification of RRVs is through a third-party agreement with SNC-Lavalin (paragraph 59). SNC-Lavalin who developed I-PLM-5001 in conjunction with IÉ-IM. Although I-PLM-5001 references several Irish and European Regulations and Directives, I-PLM-5001 does not make any reference to European Standard EN 15746-2, which sets out best practice, for general safety requirements for RRVs (it should be noted, that despite Ireland being a CEN member, there is no automatic obligation for IÉ-IM to apply EN 15746-2 as it is voluntary; although several other European countries have adopted the standards (paragraph 95).

437 The main European Directive referenced in I-PLM-5001 is EU Directive 93/68/EEC (which is mandatory); whose main intention is to ensure a common safety level in machinery placed on the market within the European Union (paragraph 58). Therefore, it appears the main reason for the inclusion of this is to allow the purchasing of RRVs from the UK, of which there are approximately 70% imported.

438 EACs are issued, by SNC-Lavalin, when: all the technical criteria set out in I-PLM-5001 is met; along with the appropriate mandatory certification under Irish legislation (for general plant, such as SWLs, etc); and the RRV has passed an annual inspection (by an independent party) and weekly inspections carried out by the contractors (paragraph 59).

Certification of RRVs involved in the occurrences

439 It appears that the majority of the RRVs involved in the occurrences had the appropriate EAC, which meant that they had passed the requirements set out in I-PLM-5001; however, there may have been two RRVs that were not adequately certified.

440 Also, it is noted from the safety tours and compliance verification inspections undertaken by IÉ-IM as part of the requirements of CCE-SMS-008 (paragraphs 124 - 125) and auditing conducted under Contractors Permit to Access, CCE-SMS-005 (paragraph 118 - 122) that there are some cases of expiration of EACs (paragraph 127).

Post-accident requests for certification details

441 As part of IÉ-IM's investigations into the "Collision between two RRVs near Edermine LC (Wexford) on the 6th December 2017" IÉ-IM requested information related to the modifications undertaken to the dumpers to transform them into RRVs, but the contractor failed to supply this information (paragraph 215).

442 In addition, as part of IÉ-IM's investigation into the "Collision between two RRVs between Dublin & Cork (63.44MP), 22nd March 2018" IÉ-IM requested the GA1s (yearly inspections), GA2s (weekly inspections) and EACs; however, one of the contractors, failed to acknowledge or answer IÉ-IM's request.

443 There were no sanctions applied to these contractors, by IÉ-IM, as a result of failing to provide evidence of RRV documentation and the RRVs were allowed to continue operating on the IÉ network despite their documentation not being supplied.

RRV Maintenance & Inspections

Contractor Inspections

444 From the CANs and the IÉ-IM Investigation Reports reviewed by the RAIU, it is clear to see that contractor's RRVOs regularly do not complete the Weekly Inspection Report (GA2) for the RRVs (paragraphs 128, 237, 442).

IÉ-IM Audits

445 IÉ-IM appear to be proactive in the auditing of RRV Plant in line with the requirements of CCE-SMS-005 and CCE-SMS-008 (paragraphs 118 - 125), with frequent correspondence between IÉ-IM and the contractors in relation to the condition of the RRV plant presented to the RAIU. The audits have raised frequent CANs in relation to the condition on the plant, with items such as broken/missing mirrors, unsecured vehicles, bad tyres (paragraphs 127 - 128). Specifically, in relation to the tyres, I-PLM-5001 states that it is "important to define the maintenance requirements for the road tyres. This should include minimum wear limits, tyre type, tread pattern and interference with the rail wheel" for Type 9B RRVs (paragraph 66); the condition of tyres

during IÉ-IM audits infers that contractor maintenance procedures either not effective or not being applied.

446 It appears that this CANs process is ineffective at driving a pro-active approach to maintaining inspections and faults by the contractor as the same issues regularly arise. In addition, the recovery of liquidated damages from RRV contractors has not been effective and Framework Agreements have been terminated (paragraphs 129 and **Error! Reference source not found.**).

RRV Plant & RRV Occurrences

General description

447 This section of the report highlights where the RAIU consider that the RRV plant was contributory to the occurrences.

Anti-Collision Device & Limiters

448 The RAIU consider that the use of an ACD for the detection of obstructions and emergency stopping devices to stop the movement of the RRVs may have prevented, or reduced the consequences of certain accidents outlined in this report, namely:

- RRV & collision with another RRV, Athy/Sallins to Ballybrophy on the 24th September 2015 – Whereby the Operator of the RRV (RRV4) was driving in reverse with the use of a reversing camera when the view in the camera became obscured due to a locomotive headlight. The Operator of RRV4 did not stop the RRV but continued driving in reverse until his camera came back into focus and saw two RRVs (RRV1 and RRV2); and braked and sounded the horn; however, it was too late and RRV4 struck RRV1. Irrespective of the fact that the Operator of RRV4 should have stopped and awaited instructions from the PIC, had an ACD been fitted, the Operator of RRV4 would have been alerted to the obstructions i.e. RRV1 and RRV2 (paragraphs 167 - 178);
- RRV Collision with OHLE structure (CY22), Church Road Junction on the 13th February 2016 – In this instance the RRV stuck the OHLE cantilever. Had an ACD been fitted, the OHLE obstruction would have been detected and the Operator of the RRV alerted to the obstruction. Or, in this case, had a height limiter been fitted to the RRV to restrict its height movements, the arm would not have struck the OHLE;
- RRV Collision with locomotive handrail, Newbridge to Kildare on the 25th February 2016 – In this instance the RRV did not have enough space to slew the plant without striking the locomotive. Had an ACD been fitted, the obstruction would have been detected and the Operator of the RRV alerted to the obstruction. Or, a limiter could have been applied to restrict the slewing movements in confined spaces;
- RRV collision with an OTM at Kildare Station, 28th June 2018 – Where the RRVO was operating the RRV in reverse and not paying attention to his surroundings, in particular, the

position of the OTM and as such struck the OTM (paragraphs 315 - 325). Had an ACD been fitted the RRVO would have been alerted to the presence of the OTM;

- And, in general, all RRV collisions where the RRVs are operating in convoy; for example, a distance of 100 m could be programmed into the RRV ACD; and this would ensure that the appropriate distances could be maintained as the RRVO would be alerted to any infringements.

Speedometers

449 Although it cannot be verified by the RAIU post accidents, the RAIU consider that speed may have been contributory to several of the accidents outlined in this report, in particular, the accidents involving RRV collisions with other RRVs. In one of these type accidents, Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford) on the 6th December 2017, it was found that an RRV was travelling at speeds of up to 27 km/h in an 8 km/h area (paragraphs 196 - 226).

450 It was also noted by the RAIU that many of the RRVs do not have speedometers which operate in the reverse direction; this is noteworthy given that RRVs regularly operate in the reverse direction due to the nature of the work. In addition, in most cases, where fitted, the speedometers are not giving the true speed of the RRV as the speed is linked to the road wheel which is a different diameter to the rail wheel which results in a speed discrepancy (paragraph 81).

Brake testing

451 In terms of the brake testing, requirements are set out in I-PLM-5001; and in terms of stopping distance requirements, the requirements of I-PLM-5001 (paragraph 64, Figure 5) are the same as EN 15746-2 (paragraph 82, Figure 6).

452 All RRVs, with the possible exception of the two RRVs above (paragraphs 441 and 442), had the required EAC and as a result had passed the braking requirements of I-PLM-5001.

453 However, the RAIU cannot establish if the braking capabilities were fully compliant on the days of the occurrences, as there was no requirement to carry out any brake tests on the RRVs after any of the accidents; despite, in some instances the RRVOs applying the brakes and the RRV being unable to stop in time.

454 With the absence of any RRV testing after the occurrences, RRVs were allowed back into service without any assurances that the brakes were working correctly.

455 Also, in terms of braking, it is noted, that is all the occurrences reviewed by the RAIU where Operators of RRVs /RRVOs applied the brakes in an emergency situation there were no sanders or WSP systems fitted to the RRVs to assist with the braking performance (paragraph 180).

Warning Systems

456 In the event of loss of control of RRVs where another RRV was struck or in some collision accidents, it was noted from the investigation, that the RRV Operators /RRVOs, were only able to warn other personnel of the emergency, through the use of flashing headlights and/or sounding the horn, as was in the case of four of the loss of control accidents at:

- Athy/Sallins – Ballybrophy on the 24th September 2015;
- Near Edermine LC (Wexford) on the 6th December 2017;
- Between Sallins & Newbridge on the 10th April 2018;
- Between Skerries & Drogheda on the 16th June 2018.

457 In the following two accidents no warning was given, the loss of control accidents were at:

- Ballymote – Boyle on the 18th November 2016;
- Between Dublin & Cork on the 22nd March 2018.

458 It should be noted that EN 15746-2 does not have any requirements for warning systems in the case of an emergency (paragraph 87), however, there is a requirement for communications between work positions, outlined in next paragraph.

Communications between work positions

459 There was no communication between Operators of RRVs/RRVOs and other Operators of RRVs/RRVOs or PICs/RRVOs through the use of intercoms, for example, in any of the sixteen occurrences identified in this report. EN 15446 does require communication, through use of intercom, etc, between work positions (paragraph 88).

460 The RAIU understand that some contractors have trialled the use of walky-talkies between RRVOs.

Additional requirements for RRV certified in line with EN 15746 -2

461 Although, not mandatory, had EN 15746-2 been incorporated into I-PLM-5001, the following requirements (some of which are mentioned above) may have prevented some of the accidents:

- Speedometers – The RRVs involved in the occurrences, did not have the capability of displaying the speed when operating in reverse; in addition, in most cases speeds are linked to the speed of the road wheel rather than the rail wheel resulting in discrepancies in the actual speed of the RRV;
- Speed limiters – There does not appear to be any restrictors in terms of speed (for example, speeds could be limited in certain circumstances);
- There were no suitable devices such as an ACD to detect obstacles in the movement area of the RRVs;
- There were no emergency stopping devices on the RRVs to stop the movement of the RRV on detection of obstacles.

Post-accident performance review of RRVs

462 It is noted from all the occurrences reviewed by the RAIU that no date recorders are fitted to the RRVs, as a result the braking capabilities, speeds and actions of the RRVOs cannot be reviewed (paragraph 179).

PART 16 – Operation of RRVs by RRVOs

Training requirements for Operators of RRVOs

General requirements

463 RRVOs, in line with I-PLM-5001, are required to hold certification for PTS, Safe Pass and CSCS (for their chosen machine i.e. dumper, excavator, etc). Since late 2017, they must also have completed IÉ-IM's one day IÉ-IM RRVO Safety Training Course (paragraph 96).

464 In terms of the construction industry training, firstly someone working in the construction industry must acquire a Safe Pass card through completion of a one-day theory safety awareness programme, which must be refreshed every four years (paragraphs 98 and 105). The machinery training for dumper, excavators, etc is done through a three-day CSCS training course which is divided into one-third theory and two-thirds practical, with a practical examination at the end. To successfully hold a valid CSCS card, the machinery operator must complete 200 hrs of supervised operation (paragraph 99) and complete a full-day assessment; resulting in training that is both structured and supervised. Operators must re-apply for a new card every five years (paragraph 106); there are no re-assessment or competency management elements i.e. it is a "one-time" training programme. The holder of these two cards (Safe Pass and CSCS) allows the holder to operate machinery on roads and constructions sites.

465 In terms of the railway training, all staff, contractors, etc, entering the IÉ network must hold a PTS card, which can be acquired through completing a one-day safety awareness programme (paragraph 97) and refreshed every three years (paragraph 104). To allow operator of machinery to operate RRVs on the IÉ network they must complete IÉ-IM's Safety Training Course, introduced in 2017, is a one-day theory course (paragraph 101). There is absolutely no practical element in relation to the operation of RRVs (paragraph 102). As a result, RRVOs are arriving onsite having never operated an RRV on the IÉ network and requiring assistance in on-tracking machinery, driving the RRV and carrying out work on the IÉ network (paragraph 110).

466 In addition, there is some doubt as to the efficacy of the IÉ-IM RRV Safety Training Course, given that half of the occurrences reviewed by the RAIU involved RRVOs that had attended the course (paragraph 103).

Re-training of RRVOs after an occurrence

467 At the time of the occurrences involved in this report, a formal re-training process for RRVOs was not in place); the RRVO would have to meet with IÉ-IM's Safety Manager CCE in relation to re-briefing (paragraph 108); after this there is no additional monitoring or support for the RRVO (paragraph 109). There is some doubt as to the efficacy of this process given that the initial training for the RRVOs lacks any practical elements and staff who attended the RRVO Safety Training Course were involved in accidents the very same day as the course was taken.

Experience of RRVOs

468 It is clear from the training requirements alone, that RRVOs are permitted to enter the IÉ network without ever having operated an RRV, which has led to RRVOs encountering difficulties on-tracking and operating RRVs onsite (paragraph 110). RRVs operate very differently in on-track mode opposed to road mode, as Type 9B RRV wheels are steel resulting in a steel-on-steel interface instead of a rubber-on-road interface, respectively. Therefore, when an RRV is in rail mode the braking distance is significantly greater than road mode i.e. the vehicle takes longer to stop (paragraph 50); and, as already discussed the speedometers are not always accurate (paragraph 81).

Operation of RRVs & RRV Occurrences

General description

469 This section of the report highlights where the RAIU consider that the training and competency management of RRVOs was an underlying cause to the occurrences.

470 The RAIU consider that the operation of the RRVs by the Operators of RRV / RRVOs was an underlying cause to the following accidents, namely:

- Loss of control of RRV resulting in a collision with another RRV, Athy/Sallins – Ballybrophy, 24th September 2015 – The Operator of the RRV (RRV4) was driving in reverse with the use of a reversing camera when the view in the camera became obscured due to a locomotive headlight. The Operator of RRV4 did not stop the RRV as required but continued driving in reverse “blind” leading the RRV to strike another RRV onsite (paragraphs 167 - 178), whereby the training requires that the Operator should have stopped and sought instruction from the PIC;
- Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016 – The Operator of the RRV (RRV2) was unable to bring the RRV to a stop before colliding with another RRV in frosty weather with hail and sleet. In this instance, RRV2 was likely to be travelling too fast for the weather conditions and did not maintain sufficient clearance between the RRVs. Another point to note from this accident was the fact that the RRVs were travelling bin-to-cab which is likely to have increased the damage to the RRV (paragraphs 181 - 195);
- Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford), 6th December 2017 – As with the accident above, the RRVs were operating in bad weather conditions (heavy rainfall). One RRV (RRV1) was stationary at Edermine LC when another RRV (RRV2) which was operating in the same convoy tried to brake to stop behind RRV1; however, the Operator of RRV2 could not stop the RRV. It is likely that RRV2 was travelling too fast for the weather conditions and did not maintain sufficient clearance between the RRVs to be able to stop clear of other RRVs (paragraphs 196 - 227);

- Loss of control of RRV resulting in a collision with another RRV between Dublin and Cork, 22nd March 2018 – Whereby there was six RRVs travelling in convoy (RRV1, RRV2, etc); when RRV1 and RRV2 stopped at the worksite, RRV3 did not immediate notice immediately that they had stopped and then did not have sufficient time to get his RRV under control, resulting in a collision. It is likely that the RRVO of RRV3 was travelling too fast and did not maintain sufficient clearance between the RRV in front of him to be able to stop clear of the other RRVs (paragraphs 228 - 248);
- Loss of control of RRV resulting in a collision with another RRV, between Sallins & Newbridge, 10th April 2018 – The RRV (RRV3) was only after departing the on-tracking area when he collided into another RRV (RRV2) which was travelling in convoy in front of him. It is likely that the RRVO of RRV3 did not leave sufficient place in front of the RRV travelling directly in front of him and was travelling too fast on departing the on-tracking area. Another important note in the case of this accident is that the RRVO had attended the RRVO Safety Training Course that day, illustrating that the training course is not fit for purpose. Also, in attending the course the RRVO did not have sufficient rest time before operating the RRV (paragraphs 250 - 270);
- Loss of control of RRV resulting in a collision with another RRV between Skerries & Drogheda, 16th June 2018 – In this instance the RRVO (RRVO1) and the other RRVs had stopped at the worksite when the RRV (RRV1) began to travel back towards RRV2 when the rail wheels went into a slide and RRVO1 could not get RRV1 under sufficient control. It is likely that RRVO1 was not operating the RRV appropriate to the weather and gradient conditions (paragraphs 271 - 289);
- RRV collision with a stabled 29000 in a siding in Connolly Station, 14th November 2018 – Where the RRVO from the RRV Dumper did not apply the brakes in enough time to brake the RRV Dumper at the off-tracking area (paragraphs 327 - 337);
- RRV collision with an OTM at Kildare Station, 28th June 2018 – Where the RRVO was operating the RRV in reverse and not paying attention to his surroundings, in particular, the position of the OTM and as such struck the OTM (paragraphs 70 - 326325);
- Points run-through at Points 704 (Inchicore), 29th September 2015 – In this accident the Operator of the RRV did not check the position of the points before travelling over the points in reverse position (although it should be noted that in 2015 the IÉ-IM RRVO Training Course was not in place at the time of the accident), (paragraph 340);
- Points run-through at Points MN266 (Maynooth), 26th August 2016 – The Operator of the RRV Excavator continued past the ballast pad and through Points MN266; although not permitted to conduct the movement, the Operator of the RRV Excavator did not realise the points were not made for the movement (although it should be noted that in 2016 the IÉ-IM RRVO Training Course was not in place);

- Points run-through at Points BR116 (Bray), 22nd August 2017 – The Operator of the RRV Excavator, although conducting an unauthorised movement, did not realise that the points were not made for the movement (although it should be noted that in 2017 the IÉ-IM RRVO Training Course was still not in place). It was also noted that the Operator of the RRV Excavator was having trouble carrying out the works due to lack of experience;
- Points run-through at Points 750 (Lisduff), 26th June 2018 – The RRVO did not adequately check the position of the points before travelling over the points (it should be noted that the IÉ-IM RRVO Training Course was in place at the time of the accident); although, it should be noted that he was having difficulty seeing the points due to the brushbox attachment on the RRV;
- Points run-through at Points PN842 (Portarlington), 23rd November 2018 – Although the RRVO on-tracked on the incorrect line, the RRVO did not check the position of the points prior to travelling over them.

471 It is noted that in at least three of the accidents outlined in the paragraph above that weather conditions were an external contributory factor to the accidents as the rain resulted in lower rail adhesion; and as there is no mechanism fitted to the RRVs to increase rail adhesion (e.g. sanders), the RRVs involved in the following accidents went into a slide:

- Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016;
- Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford), 6th December 2017;
- Loss of control of RRV resulting in a collision with another RRV between Skerries & Drogheda, 16th June 2018

PART 17 – IÉ-IM and Contractor Safety and Plant & Machinery Documentation

General Overview

472 The management and safety of RRV plant and operations in through a number of IÉ-IM and contractor documents outlined in Section B of this report. This section of the report analyses the efficacy of the application of these documents; in particular: IÉ-IM's SMS; I-PLM-5110; and, contractor's safety statements.

IÉ-IM's SMS documentation

SMS, Permit to Access, Safety Tours & Compliance

473 IÉ-IM have a comprehensive suite of documents in relation to the CCE's SMS requirements, contractor's permit to access, safety tours and compliance and reporting of accidents and incidents (paragraphs 114 - 125).

474 In relation to contractor's permit to access (CCE-SMS-005) and safety tours and compliance (CCE-SMS-008) IÉ-IM appear to be carrying out the requirements of these documents, in that contractors are regularly inspected on safety tours in terms of the RRV plant and method statements activities. As part of this process, IÉ-IM are issuing CANs where there are observed non-compliances with requirements for corrective actions to address the issues identified (paragraph 126).

475 The RAIU found that CANs are regularly issued for the same non-compliances, RRVs regularly left unsecured, high volumes of issues with tyres and failures to complete the weekly inspection checks (GA2s) on the RRVs (paragraphs 127 - 128). It is noted that IÉ-IM's process for the recovery of liquidated damages as a result of these CANs (paragraphs 129 - **Error! Reference source not found.**) has resulted in the termination of contracts. The regular issuing of CANs has not been identified by IÉ-IM as a contractor hazard. The RAIU would consider this a hazard, given the regular reporting of tyres in poor condition (especially given that the braking of Type 9B RRVs is an indirect braking system through the RRV road wheel). These contractor issues have not been raised by the Head of Engineering Safety at the Contractor's Safety Review Workshop (as per CCE-SMS-001 and CCE-SMS-005) to and agree on the appropriate actions to be taken (paragraph 122).

Reporting of Accidents

476 In terms of 'Accident Reporting' for contractors, Section 3.14, V 5.0, of CCE-SMS-005 requires that contractors shall immediately report all accidents (whether minor or those incurring lost time), dangerous occurrences and "near misses" as soon as possible to the IÉ-IM Line Manager or his representative on site (paragraph 121). In the following accidents, the contractors denied any knowledge of the damage to the infrastructure:

- Points run through at Points MN266 (Maynooth), 26th August 2016 - There was no PIC on the RRV Excavator when it returned to the ballast pad to off-track. The Operator of the RRV Excavator continued past the ballast pad and through Points MN266; he later denied he had run through the points despite evidence proving otherwise (paragraph 368);
- RRV Collision with OHLE structure (CY22), Church Rd Junction, 13th February 2016 – In this accident, the Operator of the RRV denied that he had struck the OHLE cantilever, despite IÉ-IM conclusively illustrating that the structure was struck at the time that the RRVs were present on-site. It is noted that no sanctions were placed on the contractor as a result of the accident (paragraph 292).

477 In terms of the requirement to report accidents the RAIU found that there were issues in terms of IÉ-IM staff and contractors reporting the occurrences and failing to complete D&A screening, such as in the following occurrences:

- Loss of control of RRV resulting in a collision with another RRV, Athy/Sallins – Ballybrophy, 24th September 2015 – Whereby the ES failed to immediately report the accident and continued working; resulting in no D&A testing being arranged;
- Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016 – Whereby the Regional Manager was unaware of his obligations to arrangement D&A testing after an accident;
- Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford) on the 6th December 2017 – This accident was only reported when the possession was being handed back, despite one member of IÉ-IM staff having to be taken to hospital for his injuries. D&A screening was then undertaken for the remaining staff;
- RRV Collision with locomotive handrail, Newbridge to Kildare, 25th February 2016 – This accident was only reported to relevant staff later in the day, as a result no D&A screening was undertaken;
- Points run-through at Points 704 (Inchicore), 29th September 2015 – The PICOP/ES/PIC did not immediately inform the Signalman of the run-through despite talking to him several times about the non-detection of the points. The failure to immediately report the incident, also meant that D&A screening was not carried out;
- Points run-through at Points BR116 (Bray), 22nd August 2017 – The PIC did not immediately report the accident, instead waiting ninety minutes to report to the Signalman.

Management of Plant on Site Standard, I-PLM-5110

478 This document requires the setting of procedures, in terms of safety and performance from the planning stage, to the commencement of works, during the work and post-works; and specifically requires the identification of site-specific hazards for the works. However, the hazards associated with gradients and rail contaminations are not highlighted and have not been considered contributory by IÉ-IM in any of the occurrences, however the RAIU have identified the following loss of control accidents, where gradient (and possibly rail contamination) may have been an issue:

- Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016 (paragraph 193);
- Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford), 6th December 2017 (paragraph 226);
- Loss of control of RRV resulting in a collision with another RRV between Skerries and Drogheda, 16th June 2018 (paragraph 289).

479 In addition, there is no information in relation to the orientation of RRVs on the line, when operating in convoy, for example, there was potential for the elimination of injury and/or reduction of the amount of damage to RRVs had the RRVs been oriented in a bin-to-bin set-up for the following accidents:

- Loss of control of RRV resulting in a collision with another RRV, Ballymote – Boyle, 18th November 2016;
- Loss of control of RRV resulting in a collision with another RRV near Edermine LC (Wexford), 6th December 2017.

480 The absence of these considerations maybe due to the lack of depth in I-PLM-5110, with only one reference to RRVs which refers to the Safety Management, CCE for additional requirements (paragraphs 112 - 114). There is no reference to how to brief this information to RRVOs.

Contractor's SMS documentation

481 A review of a contractor's Safety Statement does not identify all the hazards associated with the operation of RRVs, in particular, the risks associated with the collision between RRVs operating in convoy (paragraphs 155 - 156).

482 In addition, the contractor's document had errors associated with the requirements of the IÉ Rule Book e.g. it had the incorrect speeds and incorrect points checks (paragraph 157).

PART 18 – IÉ Rule Book & Other Relevant Documentation

Functions of the PIC/RRVC & Operators of RRVs/RRVO

Rule Book Requirements – Section Q

483 The RAIU reviewed RRV incident/accidents between 2015 and 2018, during this period of time there were two iterations of Section Q of the IÉ Rule Book, Section Q 2007 and Section Q 2018 (paragraph 131).

484 Section Q 2007, states that the PICOP arranges possessions and protection for RRVs and the PIC/RRVC instructs the Operator of the RRV. A PIC may drive and operate an RRV in addition to carrying out the duties of PIC. Check that the vehicles is authorised; and the Operator is competent to drive and operate under instructions and not start work or make any movement unless authorised by the PIC. Section Q 2007 further states that the PIC "Must be familiar with and present at the locations where the vehicles is placed on and removed from the line and where it works" and that RRVs are not permitted to move or work outside a possession/protection (paragraphs 132 - 135).

485 Section Q 2018 was introduced by the IÉ-IM Procedures Unit by means of presentation and WCs and became operational on the 1st January 2018. It renames staff to RRVOs and RRVCs and identifies the RRVC as being responsible for making sure: the protection arrangements are in place; any other line that may be affected is protected; emergency equipment is readily available. The RRVC must be present when an RRV is: about to go on or near the line; on-tracking; travelling; working; off-tracking. Section Q 2018 also sets the limits for the RRVs (within possessions using T3 and T4 arrangements); whilst also reducing the speed limit over points and crossings to 5 mph (8 km/h) and limiting speeds in worksites to 5 mph and 20 mph outside a worksite (paragraph 137 - 139).

486 It should be noted, that I-PLM-5001 requires that the maximum speed over checkrails is 2 km/h; this is not included in Section Q 2018 (paragraph 140).

Requirements of the RRVO and RRVC

487 Pertinent to this investigation, RRVOs/RRVCs must

- Carry out (RRVO)/ receive (RRVC) the checks and tests shown on the pre-operation checklist and give the pre-operations checklist to the RRVC; however this is not being implemented by IÉ-IM at this time (paragraphs 145 and 150);
- Have been given permission (RRVO) / give permission and be present (RRVC) before: going on or near the line; on-tracking; making rail movement with the RRV; and, off-tracking;
- Travel within the correct speed limits (RRVO) (paragraphs 148 - 152);
- Ensure that all points are in the correct position for safe movement (RRVO/RRVC) (paragraph 144 and 152);

- Understand (RRVO)/ instruct (RRVC) when operating in convoy: how far the movement is to proceed; the conditions of the movement; where the RRVC will be controlling the movement from; that they must maintain a safe distance between the RRV the RRVO is responsible for, and the other RRVs in transit (paragraphs 146 - 147).

488 The RRVC can control more than one RRV under the certain conditions, however, there is no limit set for the number of RRVs which a RRVC can control at one time, meaning that, in theory the RRVC can control any number of RRVs at one time (paragraph 151). The RAIU investigation has found that the RRVCs find it difficult controlling large convoys and an informal system of having an RRVC in the front and last RRVs of the convoy (i.e. two RRVCs present) has been adopted by some areas. It is noted that in December 2014 IÉ-IM made a recommendation in relation to an RRV accident, stating: 'The IM Rules Group to review Section Q in relation to PICs controlling RRV movements', made on the basis that 'it does not specify in the Rule Book the number of PICs required for worksites with multiple RRVs' (paragraphs 153 - 154). In addition, the CRR made a similar recommendation in 2014 to be discussed in paragraphs 495 to 496.

489 This was made in relation to Section Q 2007, however, it is noted by the RAIU the Section Q 2018 still does not specify how many PIC/RRVCs are required for worksites.

490 In addition, some areas have adopted a system of travelling bin-to-bin and cab-to-cab in convoys (paragraph 194), in order to reduce the risk of injury to RRVCs and RRVOs.

IÉ Rule Book & RRV Occurrences

491 There are a number of RRV occurrences where the IÉ Rule Book was not adhered to, these instances are as follows:

- Collision between two RRVs near Edermine LC (Wexford) on the 6th December 2017 – During this accident it was found that there were two instances of speeding, whereby the RRV travelled at speeds of up to 27 km/h in an 8 km/h limit area (paragraph 216);
- Collision between two RRVs near Edermine LC (Wexford) on the 6th December 2017 – The PICOP/ES/PIC did not adhere to the requirements of the Rule Book in terms of travelling over a Level Crossing (paragraphs 217);
- Points run-through at Points 704 (Inchicore), 29th September 2015 – In this incident, the PICOP/ES/PIC did not check the position of the points or request the Signalman to reverse the points prior to instructing the RRV to travel over the points (paragraph 340);
- Points run-through at Points CL252 (Clonsilla), 6th October 2017 – The PIC did not check the position of the points prior to running through the points and derailing as the PIC was distracted making arrangements for further RRV movements. In addition, the Signalman did not set the points correctly when granting the T3 Possession (paragraph 394);
- Points run-through at Points 750 (Lisduff), 26th June 2018 – The RRVC did not check the position of the points before travelling over the points (paragraphs 410 - 411).

492 Section Q 2007 requires that a PIC "must be familiar with and present at the location where the vehicles is placed on and removed from the line and where it works"; and, Section Q 2018 requires that the RRVC must be present when an RRV is: about to go on or near the line; on-tracking; travelling; working; off-tracking. In the following occurrences, there was not adequate supervision in terms of the movements of the RRVs:

- RRV Collision with OHLE structure (CY22), Church Road Junction, 13th February 2016 – There was no PIC present at the worksite when the RRV struck the OHLE structure as he was at the on-tracking location with other RRVs (paragraphs 291 - 292);
- RRV collision with an OTM at Kildare Station, 28th June 2018 – Where the RRVC was not in a position to observe the RRV operating in close proximity to the OTM (paragraphs 315 - 326);
- Points run-through at Points 704 (Inchicore), 29th September 2015 – In this accident the PICOP did not remain with the RRV as it travelled to the worksite and as such the unsupervised Operator of the RRV travelled over the points in reverse position (paragraph 343);
- Points run-through at Points MN266 (Maynooth), 26th August 2016 – There was no PIC on the RRV Excavator when it was returning to the ballast pad to egress the railway and the Operation of the RRV Excavator continued past the ballast pad and through Points MN266; the Operator later denied he had run through the points despite evidence proving he had run through the points (paragraphs 364 - 366);
- Points run-through at Points BR116 (Bray), 22nd August 2017 – The Operator of the RRV Excavator, conducted an unauthorised movement instead of egressing from the railway line; at the time the PIC was not supervising his movements as he was removing other possession equipment from the line (paragraph 378);
- Points run-through at Points PN842 (Portarlington) on the 23rd November 2018 – The RRVC did not realise that the RRV had on-tracked on the wrong line and as a resulted travelled over the points and derailed (paragraph 423 - 425).

493 In terms of the instructions given to the Operators of the RRVs/RRVOs, there were some instances where incorrect instructions were given, such as the run through of points, where the PIC/RRVC should not have instructed RRVs to travel over points. In addition, the RRVC gave incorrect instructions when he incorrectly on-tracked an RRV on the wrong line in the following incident:

- Points run-through at Points PN842 (Portarlington) on the 23rd November 2018.

494 In addition, in terms of the RRVs operating in convoy, although there may have been a PIC/RRVC leading the convoy, in most cases there was no PIC/RRVC present on any other RRV on the convoy and as such was not able to instruct the Operators of RRVs/ RRVOs to give adequate instructions. This was the case for the following loss of accidents resulting in a collision with another RRV:

- Near Edermine LC (Wexford), 6th December 2017;
- Between Dublin & Cork, 22nd March 2018;
- Between Sallins & Newbridge, 10th April 2018;
- Between Skerries & Drogheda, 16th June 2018.

Part 19 – CRR Audits in relation to RRVs

Allocation of PIC/RRVCs

495 In 2014 the CRR carried out an audit in relation to the management of RRVs as part of their supervision activities. The audit was thorough and made a number of findings and recommendations, which were actioned by IÉ-IM. Of note to the RAIU was the recommendation related to the role of the PIC (now the RRVC) which required that the role should defined, documented and briefed in terms of locations of the PIC at worksite, sighting requirements (in terms of being able to see the RRVs) and the allocation of PICs per quantity of RRV (paragraphs 160 - 161).

496 In 2017, the CRR published another audit into the management of track and noted that the above recommendation had not been implemented In relation to the recommendation above the audit notes “To date, this role has not been implemented and follows by making the following recommendation, the “CRR should consider conducting supervision activities in the area of the RRVC at an appropriate time upon completion of this audit (circa 6 months) check whether this role has been put fully in place” (paragraph 162).

497 At the time of the publication of this RAIU report, the supervision activities in the area of the RRVC had not occurred and the recommendation remained open (and in progress) as of mid-2019, five years after the initial recommendation (paragraph 163).

Contractor Management

498 The RSC’s Vertical Slice Audit (15/14-A) carried out in May 2014 found there was a concern around the area of RRV management, making the following Audit Trail finding (15/14-A-AT1) “The CCE and/or the RSC should consider undertaking a review on the management and the performance of RRV contracted services” (paragraph 164). As part of the review, the CRR identified a minor non-compliance in relation to the dearth of procedures within the SMS to verify the competence of contractors (including subcontractors) and suppliers. This review of IÉ-IM contract management is ongoing (paragraph 165).

Possession Management

499 In terms of the management of possessions in Division 5 the RSC found “the possession management activity at this location was being carried out in a safe manner and that all persons involved appeared diligent and competent in carrying out their task on the night”. No further actions were required (paragraph 166).

SECTION E: ACTIONS TAKEN BY IÉ-IM & the CRR

PART 20 – Actions taken by IÉ-IM

500 It should be noted that IÉ-IM have stated that they are "currently going through a review of IÉ-IM Standard I-PLM-5001 which includes measuring and aligning, where appropriate, against EN 15746".

501 IÉ-IM have introduced corrective coaching of RRVOs post-occurrence, through the completion of IÉ-IM's "Road Rail Vehicle Operator (RRVO) Corrective Coaching Report".

502 IÉ-IM have commenced a process to obtain and trial *Global System for Mobile Communications – Railway* (GSMR) handheld radios to be utilised for the enhanced control and communications involved in RRV movements. The project has commenced, and a live trial will be established in 2020.

503 The IÉ-IM Safety Manager is arranging to document the CAN process. This is aimed at addressing issues raised by the RAIU around the CAN process.

504 IÉ-IM CCE have issued the following to all RRV contractors: "Following on from an incident involving any RRV, an inspection must be carried out by the RRVO to ensure that poor brake performance or nay other faulty safety system were not a cause of the incident. As a result, the relevant RRVO must carry out the inspection by using the Pre-Operational Checklist and present the completed document to the relevant CCE representative on site. The Pre-Operational Checklist must verify no brake (or any other machine) faults are present prior to the machine returning to service.

PART 21 – Actions taken by the CRR

505 The CRR audits undertaken in relation to RRVs have been discussed in Part 11 (paragraphs 159 - 166).

506 Since the commencement of the RAIU investigation report, the CRR:

- Continue to meet quarterly with IÉ-IM to review safety performance. This includes reviewing accident and incidents and active investigations the IÉ-IM are conducting. Incidents involving RRVs and plant in general are discussed to ascertain immediate and causal factors and actions being taken to prevent reoccurrence;
- Continue to recognise RRVs as an area of attention and in July 2019 the CRR initiated an Inspection (Ref: 112/19-I) of IÉ-IM's Management of RRVs. This involves the review of IÉ-IM standards and interviews with relevant personnel. As of the publication of this RAIU report, this activity is not yet concluded.

SECTION F: IMMEDIATE CAUSES, CONTRIBUTORY FACTORS, UNDERLYING CAUSES & ROOT CAUSES

PART 22 – Overview

507 As this investigation is a trend investigation, there are numerous causes and factors to the occurrences. As a result, the RAIU have separated the three types of investigation and identified common themes thorough the occurrences to determine some high-level causes and factors. Section G of this report makes final conclusion and recommendations based on these findings.

PART 23 – Loss of control of RRVs resulting in collision with other RRVs

508 In terms of the accidents involving the loss of control of the RRV resulting in collisions with other RRVs, the RAIU find that the immediate cause of these accidents was as a result of the RRVOs losing control over the operation of the RRVs; contributory to these accidents occurring, was as a result of:

- CF-01 – RRVOs not allowing adequate time (e.g. speeding) or maintaining sufficient distances (e.g. 100 m between RRVs) between RRVs when operating in convoy;
- CF-02 – RRVOs not controlling the movements of their RRVs in such a way to manage external conditions, such as weather conditions, rail contamination and track gradients;
- CF-03 – RRVOs not requesting or waiting for instructions from the RRVC;
- CF-04 – RRVOs not maintaining situational awareness in terms of the positioning and actions of the other RRVs e.g. not realising that other RRVs had stopped;
- CF-05 – RRVOs not being able to manage RRVs in an emergency situation;
- CF-06 – Lack of supervision from IÉ-IM (through RRVCs) in that there are not enough RRVCs on site where there are multiple RRVs operating in convoy;
- CF-07 – There is some doubt as to the suitably of the RRVs in their current state, in particular, in terms of braking performance.

509 Underlying causes are identified as:

- UC-01 – Inadequate training requirements of RRVOs/RRVCs, as set out in I-PLM-5001, in the operation of the RRVs;
- UC-02 – There is some doubt as to the requirements, inspection and maintenance of RRV plant, as set out in I-PLM-5001; in particular, the braking performance in an emergency situation.

510 Root cause are identified as:

- RC-01 – Section Q of the Rule Book is not robust in terms of the operation of RRVs in convoy, in particular in terms of the allocation of RRVCs per quantity of RRVs;
- RC-02 – I-PLM-5001 is not effective in terms of the requirement criteria, inspection, maintenance and management of plant on site; and it is ineffective at setting the requirements for training RRVOs/RRVCs.

PART 24 – RRV collisions with lineside equipment, OTMs & rolling stock

511 In relation to the RRV collisions with lineside equipment, the RAIU found that the immediate cause of these accidents was as a result of the RRVOs losing situation awareness of their surroundings (e.g. due to focusing on other work tasks), resulting in their RRV striking another object. Contributory factors to these accidents are:

- CF-08 – RRVOs not controlling the movements of their RRVs in such a way to manage external conditions, such as OHLE and other rail vehicles;
- CF-09 -RRVOs not requesting or waiting for instructions from the RRVC;
- CF-10 – RRVOs not maintaining situational awareness in terms of the positioning of other moving and fixed assets e.g. not appreciating the presence of OHLE or the confined spaces of railway working;
- CF-11 – Lack of supervision from IÉ-IM (through RRVCs) in that there was no RRVC present with the RRV at the time of the accident;
- CF-12 – The RRVC was not effective in providing instructions for the control of movements for the RRVs.

512 Underlying causes associated with the accidents were:

- UC-03 – Inadequate training of RRVOs in relation to infrastructure on the railway network (e.g. OHLE) and in relation to the operation of RRVs on the railway network (e.g. confined spaces);

513 Root cause are identified as:

- RC-03 – Section Q of the Rule Book is not robust in terms of the RRVCs being present with RRVs and provide adequate instructions for the control of RRV movements;
- RC-04 – I-PLM-5001 is not effective in terms of the requirement criteria for RRVs operating in confined/ restricted spaces (e.g. height limiters on RRVs).

PART 25 – Points run-throughs

514 The immediate cause of points run-throughs is as a result of RRVOs and RRVCs not checking the positioning of the points before travelling over them. Contributory factors to these accidents are:

- CF-13 – RRVOs do not have a clear understanding on the railway infrastructure i.e. they cannot differentiate the position of the points when either in normal or reverse positions;
- CF-14 – RRVOs did not operate to the instructions of the RRVCs (e.g. travelled beyond the worksite) as there was not RRVC present;
- CF-15 – Lack of supervision from IÉ-IM (through RRVCs) in that there was no RRVC present with the RRV at the time of some of the accidents;
- CF-16 – RRVCs have not requested the correct positioning of points, from the signalman, before requesting the RRVO to travel over the points;
- CF-17 – Signalmen did not set the points for the route requested in some instances.

515 Underlying factors associated with the accidents were:

- UC-04 – Inadequate training of RRVOs in relation to infrastructure on the railway network (e.g. OHLE) and in relation to the operation of RRVs on the railway network (e.g. confined spaces);

516 Root cause are identified as:

- RC-05 – Section Q of the Rule Book is not robust in terms of the RRVCs being present with RRVs and provide adequate instructions for the control of RRV movements;
- RC-06 – I-PLM-5001 is not effective in training the RRVOs.

SECTION G: CONCLUSIONS & SAFETY RECOMMENDATIONS

PART 26 – General Description Conclusions & Safety Recommendations

517 In accordance with the Railway Safety Act 2005 (Government of Ireland, 2005a) and Article 25 of the European Railway Safety Directive (European Union, 2004), recommendations are addressed to the national safety authority, the CRR. The recommendation is directed to the party identified in each recommendation.

PART 27 – Actions reported that address factors which otherwise would have resulted in a safety recommendation

518 Actions reported that address factors which otherwise would have resulted in an RAIU recommendation.

Rest Times for RRVOs

519 The RAIU found during the review of the "Loss of control of RRV resulting in collision with another RRV, between Sallins & Newbridge, 10th April 2018" accident that three RRVOs did not get the required eleven consecutive hours rest in any period of twenty-four hours rest times as set out by the Organisation of Working Time Act 1997. The RAIU cannot establish whether fatigue was an issue, but RRVOs should not be put in this position (paragraph 269). At the time of the accident, IÉ-IM reminded contractors of their obligations in relation to working times; and another reminder was issued on foot of the RAIU. As a result. the RAIU consider that no further action or safety recommendations are required.

PART 28 – RRV Plant Conclusions & Safety Recommendations

RRV Overview

520 RRVs are owned and operated by third party contractors which are hired by IÉ, with approximately one hundred in operation on a given night. Type 9B RRVs are the type used on the IÉ network, of which 70% are imported from the UK (where the use of Type 9Bs with no direct rail wheel braking are prohibited, due to the risks involved with not having direct rail wheel braking systems fitted); this prohibition is not in place on the IÉ network (paragraph 434). The RAIU consider that consideration should be given to the reason for the UK's prohibition, and as such, should be considered in the future specification of RRVs (see Safety Recommendation 2019004-01).

Are RRVs Rolling Stock?

521 In the opinion of the RAIU, RRVs are rolling stock; however, the RAIU recognise the opinions of the CRR and IÉ-IM, and therefore make the following recommendations in relation to the clarification on the classification of RRVs; and the requirements associated with RRVs where classified as rolling stock:

Recommendation 2019004-01

The DTTAS should review the Railway Safety Act 2005 and current amendments to make clear the classification of RRVs; consultation should be sought with the Commission for Railway Regulation (CRR); and, relevant stakeholders where appropriate

Recommendation 2019004-02

The CRR & IÉ-IM should review the requirements prescribed in the Railway Safety Act (and current amendments) to ensure they are satisfied that all the requirements of the Railway Safety Act (and current amendments) are met in terms of RRVs being classified as rolling stock.

Certification of RRVs

522 IÉ-IM certify RRVs through a third party (SNC Lavalin) who co-developed I-PLM-5001 (paragraph 436). I-PLM-5001 emphasis appears to be related to the complying with a European Directive associated with the common safety level of machinery in the EU to allow for the importing of RRVs from the UK (paragraph 437). IÉ-IM/ SNC Lavalin issues EACs based on technical criteria set out I-PLM-5501; however, I-PLM-5001 does not reference the additional requirements set out in EN 15746, although it is noted that despite Ireland being a CEN member EN 15746 is not mandatory (paragraph 436), such as considerations for: controls and indicators (such as speedometers (paragraph 81); visibility (such as an ACD (paragraph 80); warning systems and communications between work positions.

RRV Plant Requirements

523 The RAIU made some findings in relation to RRV Plant requirements, as follows:

- ACD – It is noted that while EN 15746 does not specifically mandate the use of ultrasonic devices or ACDs, the RAIU consider that had ACDs been installed on the RRVs involved in the RRVs in at least five accidents involving the collision of RRVs with other RRVs and other objects; these accidents may have been prevented where a device was fitted (paragraph 448);
- Speedometers – The RAIU found that not all RRVs are fitted with speedometers that operate in both directions in rail mode; the RAIU deem that speedometers are necessary to allow RRVs maintain the speeds outlined in the IÉ Rule Book (paragraphs 449 - 450);
- Brake Testing – In terms of the brake testing, requirements are set out in I-PLM-5001; and in terms of stopping distance requirements, the requirements of I-PLM-5001 are the same as EN 15746. All RRVs, with two exceptions, had the required EAC, meaning that they met the braking requirements at time of certification. However, no brake tests were carried out after any of the incidents, despite there being loss of control of RRV accidents, where the brakes would not stop the RRV before colliding with other RRVs. In addition, these RRVs were allowed back into service without any assurances that the RRVs were working correctly (paragraph 451 - 454);
- Braking Performance – The RAIU noted that WSP or sanders were not fitted to any of the RRVs involved in the occurrences reviewed by the RAIU which may have improved the braking performance of the RRVs in areas where there was low rail adhesion and/ or poor rail head conditions (paragraph 455);
- Warning Systems – The only warning systems available to RRVOs in the event of an emergency, such as the loss of control of an RRV, is through the use of flashing headlights and/or sounding the horn (paragraphs 456 - 458). Given that RRVs: are large plant; which work on noisy worksites (weather or work related noise); where it is normally dark (during night possessions); and there are personnel on-track (e.g. RRVCs) the RAIU consider that consideration should be given to appropriate warning systems in the event of an emergency to be able to warn staff to go to a place of safety or to provide safe with portable ACDs;
- Communications between work positions – There was no communication between Operators of RRVs/RRVOs and other Operators of RRVs/RRVOs or PICs/RRVOs through the use of intercoms, for example, in any other of the sixteen occurrences identified in this report. EN 15446 does require communication, through use of intercom, etc, between work positions (paragraphs 459). The RAIU consider that there should be a better means of communication between work positions, in particular, when travelling in convoy;
- Post-accident performance review of RRVs - It is noted from all the occurrences reviewed by the RAIU that data recorders are not fitted to the RRVs, as a result the braking capabilities, speeds and actions of the RRVOs cannot be reviewed post occurrence (paragraph 462).

524 It should be noted, that EN 15746 standards have been adopted by several other European countries, either directly or indirectly (paragraphs 69 and 95), meaning it has been deemed to be best practice in these countries; and, the NSAI transposed EN 15746-1 and EN 15746-2, into standards: I.S. EN 15746-1 and I.S. EN 15746-2 in July 2018. For these reasons and the reasons outlined in paragraphs 520 to 523 the RAIU make the following safety recommendations related to the introduction of improved CCE Plant and Machinery Standards (CF-07):

Recommendation 2019004-03

IÉ-IM should review and improve its current CCE Plant and Machinery Standards; attention should be given to best international practice in RRVs; and, as a minimum, the following should be considered for inclusion:

- **Applying the requirements set out in the EN 15746/ I.S. EN 15746 standards such as controls & indicators, visibility from the cab, warning systems & communications between work positions, etc. Where, due to a technical impossibility, the design specifications of EN 15746 cannot be met in full, control measures to address these deficiencies should be clearly identified, risks assessed, and suitable controls implemented;**
- **The installing of an appropriate emergency warning system, which, when activated in emergency, can produce a suitably loud audible alarm and/or visual alarm. In cases, where this is not possible, as a result of a technical impossibility, control measures to address this deficiency should be clearly identified, risk assessed, and suitable controls implemented;**
- **Installing WSP and/or sanders on RRVs;**
- **Installing of ACDs on RRVs for the prevention of collisions with other RRVs, rolling stock, infrastructure and staff (through the provision of portable ACDs fitted to staff) on the IÉ network. In cases, where this is not possible, as a result of a technical impossibility, control measures to address this deficiency should be clearly identified, risk assessed, and suitable controls implemented;**
- **Introducing an appropriate means of communication between work positions, whereby the RRVOs and RRVCs can communicate while on-tracking, travelling on the railway and at worksites;**
- **Installing of data recorders on RRVs;**
- **The suitability of the current braking system on Type 9B RRVs where an indirect rail wheel braking system is in place; consideration should be given for the requirement to have all RRVs fitted with direct rail wheel braking systems.**

525 In terms of IÉ-IM communicating with RRV contractors in relation to the implementation of Recommendation 2019004-03, the RAIU make the following safety recommendation:

Recommendation 2019004-04

IÉ-IM are to engage with the RRV contractors in relation to updated CCE Plant and Machinery Standards; and, give clear guidelines on when these new requirements come into full effect.

526 In terms of management of existing RRVs as Recommendation 2019004-03 is under review, the RAIU make the following safety recommendation:

Recommendation 2019004-05

In relation to existing RRVs, IÉ-IM should assess the operation of existing RRVs to satisfy itself, on the basis of a risk assessment, that there are adequate technical and operational controls to prevent loss of control of RRV occurrences in the future.

RRV Plant Management

In terms of post incident/ accident assessment of RRVs, it is noted that IÉ-IM or the contractors did not carry out any brake testing of RRVs or any other substantial checks, in particular, in the cases where RRVOs lost control of the RRVs and the RRVs were allowed back into service without verification that the RRV operated appropriately (paragraphs 453 - 454). This is particularly important given that Type 9B RRVs are without direct rail wheel braking, as a result, It has been noted that IÉ-IM have requested RRVOs to conduct inspections post incident to ensure that poor brake performance or any other faulty system were not a cause of the incident. IÉ-IM now need to document this in their own procedure, as such, the RAIU make the following safety recommendation (UC-02, RC-02):

Recommendation 2019004-06

IÉ-IM should include, in their post-occurrence procedures, a requirement to verify the performance of RRVs (including braking performance) involved in accident, incidents or dangerous occurrences (near misses) to ensure the requirements of the CCE Plant and Machinery Standards are met in full; this should involve the completion of a full post-occurrence examination of the RRV by the contractor. A requirement that RRVs involved in accidents, incidents or dangerous occurrences (near misses) are not permitted back onto the IÉ network until the post-occurrence procedures have been completed and the RRV is confirmed fit and safe for use.

527 In terms of RRV supplier information being provided to IÉ-IM, as part of the investigation into 'Collision between two RRVs near Edermine LC (Wexford) on the 6th December 2017' IÉ-IM requested information in relation to the modification to RRVs from the RRV supplier, which was not provided to IÉ-IM. It is also noted, that IÉ-IM did not apply any sanction on this supplier as a result, with the RRV supplier, continuing to supply RRVs for the use on the IÉ network (paragraphs 441 - 443).

Recommendation 2019004-07

IÉ-IM should update their Plant and Machinery Standards to include requirements for RRV contractors to provide RRV information: at the acceptance stage; and, at later dates where modifications are made to RRVs. Where this information is not provided, and the requirements of the updated Plant and Machinery are not met, the RRVs involved should not be allowed to operate on the IÉ network.

PART 29 – Operation of RRVs Conclusions and Recommendations

Training of RRVOs

528 According to I-PLM-5001, RRV Operators must have completed four courses: PTS; Safe Pass; CSCS (for their nominated piece of plant e.g. excavator); and IÉ-IM's RRVO Safety Training Course (paragraphs 463).

529 The PTS and IÉ-IM RRVO Safety Training Course are railway specific courses related to railway safety awareness and infrastructure knowledge, respectively. The Safe Pass course is a basic construction safety awareness course. The remaining course, for the CSCS Certification requires the person to attend a three-day course with a practical assessment followed by two-hundred logged supervised hours on the machinery, finished with a one-day assessment (paragraph 464).

530 The current method of training means that an RRVO can present for work on the IÉ network without ever having operated an RRV in rail mode (paragraph 465); there is also current no requirement for monitored competency; and, when an RRVO has been involved in an incident/accident there is no form of structure development or support for the RRVO (paragraph 467).

531 It should also be noted, that of the sixteen occurrences reviewed by the RAIU, eight involved RRVOs who had attended the RRVO Safety Training Course (paragraph 466).

532 As a result, the RAIU have found that RRVOs can be completely inexperienced in the operation of RRVs meaning that RRVOs find it difficult to on-track and operate RRVs; and require direct assistance from the RRVCs in carrying out their duties (paragraph 468).

533 As a result of the above (paragraphs 528 - 532) the RAIU make the following safety recommendation to improve RRVOs training and experience (CF-01 to CF-05, CF-08 to CF-10, CF-13 to CF-14; UC-01, UC-03, UC-04; RC-02, RC-04, RC-06):

Recommendation 2019004-08

IÉ-IM must develop a suitable RRVO training course which must incorporate both theory and practical elements for the operation of RRVs; there should be an assessment on completion of this initial training. When a person passes this initial training, they must complete and log supervised hours of RRV operation; and present for a final through assessment. This process should be risk assessed to determine the: number of days training; practical training requirements; number of supervised hours; and, final assessment requirements.

534 In addition, IÉ-IM need to develop a competency management system, which should incorporate re-training and supervision of RRVOs after an incident or accident. As a result, the RAIU make the following safety recommendation:

Recommendation 2019004-09

IÉ-IM should develop a competency management system for the management of RRVOs competencies; this system should also include instructions related to re-training and monitoring of RRVOs after they have been involved in an accident.

PART 30 – IÉ-IM and Contractor Safety and Plant & Machinery Documentation

IÉ-IM's SMS documentation

535 IÉ-IM's comprehensive suite of documents in relation to the CCE's SMS requirements, contractor's permit to access and safety tours and compliance are effective in identifying observed non-compliances and issuing CANs with corrective actions to address the issues identified (paragraph 473 - 474). And the long-term issuance of CANs for the same reasons has not been identified as a hazard by the Head of Engineering Safety at the Contractor's Safety Review Workshop to try and encourage contractors to operate and maintain their plant in a compliant way i.e. the contractors are satisfied to continue to accept CANs and only act on the corrective actions when forced (paragraph 475). In addition, it is noted that I-PLM-5110 is also not effective in the management of RRV plant on site (paragraph 478). As a result, the RAIU make the following safety recommendation (RC-02):

Recommendation 2019004-10

IÉ-IM should conduct a thorough review of their suite of SMS documentation and plant and machinery standards, related to RRV contractors, to identify deficiencies in terms of the management of contractors and their plant. Where deficiencies are identified, IÉ-IM should develop new systems for the management of plant on site, and, for their safety tour and compliance verification processes to ensure contractors regularly inspect and maintain their plant in good condition; rather than the continued issuance of corrective action notices.

536 This investigation identified a trend in terms of the non-reporting of RRV incidents and accidents, by both the contractors and IÉ-IM, this in turn lead to failures to complete the D&A screening in some instances (paragraphs 476 - 477); as a result, the RAIU make the following safety recommendation:

Recommendation 2019004-11

IÉ-IM should review the ways in which it promotes a positive safety culture that encourages contractors to report accidents, incidents and dangerous occurrences (near misses); this can be achieved through RRVO workshops and the absence of disciplinary procedures on the reporting of occurrences.

Recommendation 2019004-12

IÉ-IM should ensure appropriate procedures are in place for D&A screening for IÉ-IM and contractor staff post RRV occurrence.

537 I-PLM-5110 is a very high-level document, with little detail on how to address or brief (to RRVOs) site-specific hazards for RRVs, such as gradients of track and rail contamination; as well as consideration for the orientation of the RRVs when travelling in convoy (e.g. bin-to-bin) (paragraphs 478 - 480); and the spacing between RRVs, informally set at 100 m (paragraphs 246, 247 448, 508). As a result, the RAIU make the following safety recommendation (CF-06, CF-12):

Recommendation 2019004-13

IÉ-IM should update their CCE Plant and Machinery Standards to ensure that RRV contractors are either provided with, or required to identify, the hazards associated with track gradient, rail contamination (or other low adhesion conditions) and RRV orientation and position on track through:

- **Assessing documentation on the site-specific hazards associated with RRV and ensuring these are addressed in contractor's safety documentation;**
- **Setting requirements in relation to the spacing between RRVs when travelling in convoy (e.g. 100 m) and putting in place a regime to ensure these requirements are met;**
- **Training RRVCs/RRVOs on the risks associated with track gradient, rail contamination and RRV orientation and guidance on how to manage these risks in a braking emergency.**

538 In terms of contractor's Safety Statements, the RAIU found that hazards were not identified (paragraph 481) and there were errors in their systems of working (paragraph 482). In addition to improvements to contractor's high-level safety documents, this investigation found that method statements were not in place, or not briefed, for all the occurrences (paragraphs 128, 280, 286, 355 & 433). As a result, the RAIU make the following safety recommendation:

Recommendation 2019004-14

IÉ-IM should conduct an audit on RRV contractor's safety documents with a view to identifying deficiencies in terms of safety and ensuring the appropriate safety documentation is produced for the works; IÉ-IM should support and offer guidance to the RRV contractors in terms of the identification of hazards and methods of working on a railway network.

PART 31 – IÉ Rule Book Conclusions and Recommendations

Section Q, IÉ Rule Book

539 Two iterations of Section Q of the IÉ Rule Book were reviewed by the RAIU as part of this investigations Section Q 2007 and Section Q 2018 (paragraph 483). Although, Section Q 2018 does clarify when the RRVC should be present with the RRV (about to go on or near the line; on-tracking; travelling; working; off-tracking), paragraph 485, there are still deficiencies with the requirements of the IÉ Rule Book.

540 Section Q 2018, does make a number of other changes, related to protection arrangements, CCTV level crossings and speed limits, although it should be noted that I-PLM-5001 requires that the maximum speed over checkrails is 2 km/h (paragraph 486), which currently is not in Section Q 2108. In addition, one of the requirements of Section Q 2018 is currently not being implemented, in that IÉ-IM's RRVCs are not collecting the pre-operations checklist from the RRVOs (paragraph 487). As a result, the RAIU make the following safety recommendation:

Recommendation 2019004-15

IÉ-IM should make changes to the IÉ Rule Book to ensure that all relevant requirements set out in their Plant & Machinery Standards related to RRVs are incorporated into the IÉ Rule Book.

Recommendations 2019004-16

IÉ-IM should update their CCE Plant and Machinery Standards to include the requirements set out in Section Q 2018 of the IÉ Rule Book related to the collection of pre-operation checklists by the RRVCs from the RRVOs; and ensure these requirements are enforced through compliance verification activities.

Requirements of the RRVO, RRVC and other IÉ-IM staff

541 The RRVC can control more than one RRV under the certain conditions, however, there is no limit set for the number of RRVs which a RRVC can control at one time, meaning that, in theory the RRVC can control any number of RRVs at one time. The RAIU investigation has found that the RRVCs struggle with controlling large convoys and an informal system of having an RRVC in the front and last RRVs of the convoy (i.e. two RRVCs present) has been adopted by some areas (paragraph 488). In addition, the RAIU found that the lack of supervision of RRVs was contributory to a number of accidents, through either the lack of direct supervision (paragraph 492 and 494), breaking the rules of the IÉ Rule Book (paragraph 491). The issue with the number of RRVCs was identified as in problem in 2014, by both the CRR and IÉ-IM, with both parties making recommendations, however, they were never implemented (paragraph 488). As a result, the RAIU make the following safety recommendation (CF-11, CF-15, RC-01, RC-03, RC-05):

Recommendations 2019004-17

IÉ-IM should clearly define, document and explain the role and function of the RRVC in the management of RRVs in Section Q of the IÉ Rule Book and/or relevant CCE Plant and Machinery Standards. This should include:

- **Location of RRVC when on-tracking, during work, and off-tracking;**
- **The sighting requirements of RRVCs (i.e. an RRVC should be able to see RRVs in their control at all times);**
- **The allocation of RRVCs per quantity RRVs (i.e. how many RRVs per RRVs).**

542 The PICs/ RRVCs involved in the RRV accidents and incidents, made some mistakes in terms of not identifying the correct position of the points, not requesting points movements, on-tracking RRVs on wrong roads and not reporting accidents (paragraphs 491 - 492), as a result the RAIU make the following safety recommendation (CF-16):

Recommendations 2019004-18

IÉ-IM should review and update the training requirements of RRVCs with a view to incorporating:

- **Basic infrastructure training (e.g. points);**
- **Training in communications with relevant staff;**
- **Practical RRV training to ensure they have confidence in accepting pre-operations checklists from RRVOs as set out in the IÉ Rule Book.**

543 In addition, the signalmen made some errors in terms of), as such the RAIU make the following safety recommendation (CF-17):

Recommendations 2019004-19

IÉ-IM should brief Signalmen on RRVs operations during possessions (i.e. accessing and egressing worksites and well as travelling to worksites training in terms of RRVs operating in possessions) to ensure points are set correctly for the RRV movements. Training material for Signalmen on the roles of RRVs should be updated to reflect this.

Part 32 – CRR Audits in relation to RRVs

544 The CRR carried out in-depth audits in relation to the operation of RRVs, and in 2014 issued a recommendation in relation to the role of the PIC/RRVC (paragraph 495), however, in the five years until the publication of this report, this recommendation was not implemented (paragraph 497); an inaction that was identified by the CRR in 2017 (paragraph 496); and the RAIU have identified that the role of the PIC/RRVC was contributory in a number of RRV incident/accidents between 2015 – 2018 (after the time that the recommendation was made), (paragraph 541 - 542). In addition, Section Q of the Rule Book was re-issued in 2018, without any definitive changes to the allocation of the RRVC as a result the RAIU make the following safety recommendation:

Recommendations 2019004-20

The CRR and IÉ-IM should review their processes of closing out findings from CRR audits; with a view to identifying opportunities to close out findings, such as updates to the IÉ Rule Book.

SECTION H: ADDITIONAL INFORMATION

List of abbreviations

ACD	Anti-Collision Device
CCE	Chief Civil Engineer
CCTV	Closed Circuit Television
CRR	Commission for Railway Regulation
CTC	Centralised Traffic Control
CWR	Continuous Welded Rail
DTTAS	Department of Transport, Tourism and Sport
EAC	Engineering Acceptance Certificates
ES	Engineering Supervisor
GPS	Global Positioning System
GSMR	Global System for Mobile Communications - Railway
GVW	Gross Vehicle Weight
IÉ	Iarnród Éireann
IÉ-IM	Iarnród Éireann Infrastructure Manager
IÉ-RU	Iarnród Éireann Railway Undertaking
IM	Infrastructure Manager
LC	Level Crossing
m	Metre
MLCCC	Mallow Level Crossing Control Centre
NIR	Northern Ireland Railways
No.	Number

OHLE	Overhead Line Equipment
OTM	On-Track Machinery
PIC	Person In Charge
PICOP	Person In Charge Of Possession
RAIB	Rail Accident Investigation Branch (UK)
RAIU	Railway Accident Investigation Unit
RU	Railway Undertaking
RRV	Road-Rail Vehicle
RRVC	Road-Rail Vehicle Controller
RRVO	Road-Rail Vehicle Operator
RSSB	Rail Safety and Standards Board
SET	Signalling, Electrical and Telecommunications
SMS	Safety Management System
SI Units	International System of Units
TSC	Track Safety Co-ordinator
UC	Underlying cause
UK	United Kingdom
WC	Weekly Circular
WSP	Wheel Slip Prevention

Glossary of Terms

Accident	An unwanted or unintended sudden event or a specific chain of such events which have harmful consequences including collisions, derailments, level-crossing accidents, accidents to persons caused by rolling stock in motion, fires and others.
Action-Required	An area where potential exists for a non-compliance to occur unless remedial action is taken, or improvement is made, an isolated error that requires correction, or some other action arising from the audit.
Audit Trail	The CRR define an audit trail as an area that the auditor feels should have further attention, either by inclusion in the programme for future audits (but not necessarily an external audit item) or by some other means.
Ballast	Crushed stone used to support sleepers both vertically and laterally.
Ballast Cleaning	The action of excavating the ballast from under the track, discarding the dirt, undersize and oversize pieces and returning the good ballast to the track.
Ballast Consolidation	The process of compacting the ballast to reduce future settlement and increase the lateral stability of the track.
Ballast Regulation	The action of distributing ballast evenly along the track and to the correct profile.
Bi-directional	A track on which trains may be worked in either direction under normal signalling arrangements.
Cess	The part of the track outside the ballast shoulder that is deliberately maintained lower that the sleeper bottom to aid drainage.
Coloured light signals	Signals which convey movement authorities to drivers by means of coloured lights
Construction site	Any site at which construction work in relation to a project is carried out.
Constructions work	Construction work means the carrying out of any building, civil engineering or engineering construction work, other than drilling and extraction in the extractive industries as defined by the Safety, Health and Welfare at Work (Extractive Industries) Regulations 1997, and includes but is not limited to each of the following: (a) the doing of one or more of the following with respect to a structure: (i)

	construction; (ii) alteration; (iii) conversion; (iv) fitting out; (v) commissioning; (vi) renovation; (vii) repair; (viii) upkeep; (ix) redecoration or other maintenance, including cleaning involving the use of water or an abrasive at high pressure or the use of substances or mixtures classified as corrosive or toxic in accordance with Regulation (EC) No. 1272/20082 of the European Parliament and of the Council on the Classification, Labelling and Packaging of substances and mixtures or of the European Communities (Classification, Packaging and Labelling of Dangerous Preparations) Regulations 2004 (S.I. No. 62 of 2004); (x) de-commissioning, demolition or dismantling; (b) the preparation for an intended structure, including but not limited to site clearance, exploration, investigation (but not site survey) and excavation, and the laying or installing of the foundations of an intended structure; (c) the assembly of prefabricated elements to form a structure, or the disassembly of prefabricated elements which, immediately before such disassembly, formed a structure; (d) the removal of a structure or part of a structure or of any product or waste resulting from demolition or dismantling of a structure or disassembly of prefabricated elements which, immediately before such disassembly, formed a structure; (e) the installation, commissioning, maintenance, repair or removal of mechanical, electrical, gas, compressed air, hydraulic, telecommunication and computer systems, or similar services which are normally fixed within or to a structure.
Continuous welded rail	Sections of rail that are welded together.
Contributory Factor	Factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.
Controlling Signalman	The Signalman designated to control a specific section of track.
Competence	IÉ-IM Operations define competence as the ability to perform activities to the standard expected within employment, it includes practical and theoretical knowledge, experience and skill required to carry out duties to ensure the safety of any person who may be affected (by their duties).
Competency Management System	IÉ-IM Operations define a competency management system as a documented system by which an employer ensures, as far as reasonably practicable, that its employees consistently achieve the standards of competence required for their

	work.
Division	Made up of a number of regions and several CCE Locations.
Double line track	A route with two tracks
Down Line	Trains travelling from Dublin.
Engineering Acceptance Certificate	A certificate issued by IÉ-IM, or its representative (SNC-Lavalin), for an RRV when it: meets the technical criteria set out in I-PLM-5001; has the appropriate mandatory certification under Irish legislation, including: signed certificates from the manufacturer specifying the safe working load (SWL) of each RRV, taking account of different configurations of the RRV and any additional safety provisions; the 12-monthly Report of Thorough Inspection by an independent examiner (not the owner) for each RRV; the Weekly Inspection Report (GA2) by the operator/driver for each RRV.
Engineering train	A train used in connection with engineering works, e.g. carrying spoil.
Engineering Supervisor	The engineering supervisor in charge of a work site. This person authorises all movements entering the work site and those within the work site.
Extensive damage	Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Global System for Mobile Communications - Railway	Global System for Mobile Communications – Railway or GSM-Railway is an international wireless communications standard for railway communication and applications.
Good Practice	The CRR define a ‘good practice, as an area highlighted which, in the opinion of the Auditor, is good practice within the industry.
Immediate cause	Direct and immediate causes of the occurrence including contributory factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.
Incident	Any incident, other than an accident or serious accident, associated with the operation of trains and affecting the safety of operation.
Infrastructure Manager	Any body or undertaking that is responsible in particular for establishing and maintaining railway infrastructure. This may also include the management of infrastructure control and safety systems. The functions of the infrastructure

	manager on a network or part of a network may be allocated to different bodies or undertakings.
Interoperability Regulations	European Communities (Interoperability of the Rail System) Regulations 2011 (S.I. No. 419 of 2011) (as amended by the European Communities (Interoperability of the Rail System) Regulations 2011(Amendment) Regulations 2013 (S.I. No. 186 of 2013)).
Mile Post	A post used to denote a location on a railway line using miles from a fixed point known as the 0 milepost.
Major Non-Compliance	Identified by the CRR as an area of non-compliance with a railway organisation internal standard, an applicable external standard, or legislation that is evidence of a system failure.
Minor Non-Compliance	Identified by the CRR as an area of non-compliance with a railway organisation internal standard, an applicable external standard, or legislation that is evidence of a sporadic lapse in implementation of a system or deviation from a system.
National safety authority	The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC.
Off-tracking	Removing an RRV from the line.
On-tracking	Placing an RRV on the line.
On-track Machinery	Specialist plant which moves only on rails and in normally self-propelled e.g. tamper.
On-Train Data Recorder	Device that records data about the operation of train controls and performance.
Person In Charge Of Possession	The person in charge of a possession. This person authorises all movements within the possession, except those entering and within a worksite.
Plant	IÉ-IM define plant as mobile mechanical equipment used for construction activities. General categories of Plant include cranes, dumpers, excavators, hedgecutters, hoists and their associated attachments.
Possession	A period of time during which one or more tracks are blocked to trains, except engineering trains, to permit work to be safely carried out one or near the line.
Railway	Is (a) a metro, tramway or other light rail system; (b) a heritage, museum or

Organisation	tourist railway that operates on its own network, including workshop, vehicles and staff; (c) a heritage railway that runs on the railway system in the State; (d) a railway undertaking or an infrastructure manager; or € any other person who operates a railway.
Railway Undertaking	Any public or private undertaking, the principal business of which is to provide services for the transport of goods and/or passengers by rail with a requirement that the undertaking must ensure traction; this also includes undertakings which provide traction only.
Region	Sub-division Consisting of a number of CCE Locations
Road Rail Vehicle	EN 15746-1 defines an RRV as a self-propelled machine that can run on rails and ground (Note 1: It is normally a road vehicle adapted for running on rail also but can be a specially designed rail vehicle for running on the ground also. Note 2: It does not imply that the machine is suitable for use on the public road).
Road Rail Vehicle Controller	A person competent to control the use of one or more RRV within a possession.
Road Rail Vehicle Operator	A person competent to drive and operate an RRV within a possession.
Rolling stock	As set out in the Railway Safety Act 2005 means any train or any type of other vehicle with flanged wheels which is designed to operate on the railway.
Root cause	Causes related to framework conditions and application of the SMS.
Safety certificate	The purpose of the safety certificate is to provide evidence that the RU and IM: • Has established its Safety Management System (SMS) in accordance with Article Nine and Annex III of the Railway Safety Directive (RSD), and; • Can meet the requirements laid down in the Technical Specifications for Interoperability (TSI) and other relevant European Community legislation, and in National Safety Rules, in order to control risks and provide rail transport services safely on the network; • The CRR issue the RU and IM safety certificate. The RU Licence is issued in conformity with European Directive 2012/34/EU and S.I. 249 of 2015.
Sanders	A means of delivering small amounts of sand onto the rail head near the driving wheels of a traction unit in order to improve adhesion in areas of very poor rail head conditions. The system consists of a hopper of sand, a valve, a jet of

	compressed air and a pipe that delivers the sand as close as possible to the wheel.
Scope for Improvement	Identified by the CRR as an area highlighted where, in the opinion of the Auditor, system or business improvement can be achieved by the company. Typically, this is phrased as a recommendation, the merits and implementation of which should be decided by audited organisation.
Serious accident	Any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to 5 or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety, where extensive damage means damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Serious injury	Any injury requiring hospitalisation for over 24 hours.
Standard	A document that mandates technical, operational or managerial requirements.
Structure (as defined in the Safety Health and Welfare at Work (Construction) Regulations 2013)	Structure means (a) any building, railway line or siding, tramway line, dock, harbour, inland navigation systems, tunnel, bridge, viaduct, waterworks, reservoir, pipe-line (whatever it contains or is intended to contain), underground or over ground cables, aqueduct, sewer, sewage works, gasholder, road, airfield, sea defence works, river works, drainage works, earthworks, lagoon, dam, wall, caisson, mast, tower, pylon, underground tank, earth retaining element or assembly of elements, or element or assembly of elements designed to preserve or alter any natural feature, and any other structure similar to the foregoing, (b) any formwork, falsework, scaffold or other element or assembly of elements designed or used to provide support or means of access during construction work, or 14 [291] (c) any fixed plant in respect of work which is installation, commissioning, de-commissioning or dismantling.
Tamping	The operation of lifting the track and simultaneously compacting the ballast below the sleepers.
Track Circuit Block	A signalling system that uses track circuits to confirm the absence of trains in order to control the movement of trains.
Train	As set out in the Railway Safety Act 2005 means a vehicle with flanged wheels designed to operate on a railway for whatever purpose and includes carriages and rolling stock.

Underlying cause	Causes related to skills, procedures and maintenance.
Up Line	The line on which trains travel towards Dublin.
Weekly Circular	A document published on a weekly basis, providing information about engineering works, possessions requested, changes to services and speed restrictions.
Wheel Slip Prevention	A control system fitted to modern rolling stock that prevents the driving wheels spinning out of control or locking up during times of reduced adhesion.
Working	An RRV being used in rail mode for any purpose other than travelling.

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