Railway Accident Investigation Unit Ireland

INVESTIGATION REPORT

Wrongside Door Failure at Ashtown Station, 12th August 2018

RAIU Report No: 2019 – R001

Issued: 25th June 2019

Report publication

RAIU
2nd Floor, 2 Leeson Lane
Dublin 2
Ireland

email: info@raiu.ie
website: www.raiu.ie
telephone: + 353 1 604 1050

The original publication details are given below:

Title	Wrongside Door Failure at Ashtown Station, 12th August 2018
Document type	Investigation Report
Document number	2019-R001
Document issue date	25th June 2019

Where the report has been altered following its original publication, details on the changes are given below:

Revision number	Revision date	Summary of changes

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

On the 12th August 2018, the 19:43 hrs passenger service from Pearse to Maynooth was being operated by an eight-car 29000 Diesel Multiple Unit (DMU). At approximately 20:04 hrs while preparing to depart Ashtown Station the driver pressed the passenger doors close button on the driver's console when he saw that all passengers had disembarked and boarded the train. The driver noticed that the blue Door Interlock Light (DIL) on the driver's console (light used for confirmation that the passenger doors are closed and locked) illuminated immediately while the platform side passenger door directly behind the driving cab was still in the process of closing; this is classified as a wrongside failure i.e. the blue DILs should only illuminate when the passenger doors have closed and locked. The wrongside door failures re-occurred on the return journey from Maynooth to Pearse, with the train being taken out of service at Connolly Station.

The immediate cause of the wrongside door failure was as a result of unwanted contact of the Door Interlock Loop crimp with the battery positive spade, resulting in the Door Interlock Loop circuit completing, when a door was opened by a passenger on the front set and the doors of the rear set remained closed. Contributory factors (CF) associated with the incident were:

- CF-01 – The detachment of Crimps 38 and 39 from their associated spades;
- CF-02 – The lack of insulation beyond the crimp spade head.

Underlying cause (UC) associated with the incident was:

- UC-01 – Vehicle Maintenance Instruction (VMI) Z1C29A0001 did not require a thorough examination of all parts of the autocoupler after the collision on the 6th June 2018, despite the examination identifying damage to the exterior of the autocoupler;
- UC-02 – Scheduled maintenance did not detect that Crimps 38 and 39 had detached from their associated spades.

A root causes (RC) associated with the incident was:

- RC-01 – CME-SMS-006, Hazards & Risk Assessments, was not robust in identifying the risks associated with lack of insulation on the crimp and the risks of not carrying out a thorough examination of all parts of the autocoupler after an accident.

The following additional observations (AO) have been made by the RAIU:

- AO-01 – The Traffic Regulators' Manual does not include a procedure for dealing with wrongside rolling stock failures;
- AO-02 – The Traffic Regulators' Manual does not list the immediate or monthly bulk occurrences to be notified to the RAIU;
- AO-03 – Voice communications between Chief Mechanical Engineer (CME) Maintenance Department (Drogheda) and the Driver were not recorded as required in the Traffic Regulators' Manual.

As a result of the investigation, the RAIU have made the following safety recommendations:

- IÉ-RU CME should review VMI Z1C29A0001 'Examination of 29000 class vehicle after an incident / accident' to develop a more thorough and robust VMI that is commensurate with the safety risk of faults occurring after rolling stock has been involved in an incident or accident;
- IÉ-RU CME should review VMIs associated with the examination of rolling stock after an incident / accident, for all rolling stock fleets, to develop a more thorough and robust VMI that is commensurate with the safety risk of faults occurring after rolling stock has been involved in an incident or accident.
- IÉ-RU CME should review their scheduled maintenance examinations, for multiple-unit fleets, with a view to developing a means to check the connection is correct on the electrical head.
- IÉ-IM should re-brief Traffic Regulators on the importance of adhering to the Traffic Regulators' Manual in relation to the recording of all telephone conversations within the controlled environment.

CONTENTS

THE INCIDENT 1

Summary of the incident 1

General description of the railway 2

Infrastructure 2

Rolling Stock 3

Signalling and communications 4

Operations 4

Fatalities, injuries & material damage 4

Fatalities & injuries 4

Material damage 4

Parties & roles involved in this incident 5

Parties involved in the incident 5

Roles involved in the incident 5

External Circumstances 6

Weather 6

RAIU INVESTIGATION 7

RAIU decision to investigate 7

Scope of investigation 7

Investigation and evidence 7

EVIDENCE 8

Passenger doors 8

Passenger door operation 8

Maintenance of the passenger doors 10

Post incident examination of the passenger doors 10

Coupler 11

General description 11

Autocoupler design 11

Autocoupler maintenance *13*

Unscheduled examination of coupler *13*

Post incident inspection of the autocoupler *14*

Rolling Stock Safety 17

General description *17*

Responsibilities & accountabilities *17*

Management of Rolling Stock Safety *17*

Hazards & Risk Identification *18*

Rolling Stock Risk Register *18*

Train Fault Reporting 19

Driver Reporting of Train Faults *19*

Traffic Regulator Reporting of Train Faults *19*

Traffic Regulator's Actions on Reported Train Faults *20*

Train fault reporting on the day of the incident *20*

Events before, during & after the incident 21

Events before the incident *21*

Events during the incident *21*

Events after the incident *22*

Similar occurrences 23

General *23*

Wrongside Door Failure, 29000 DMU at Drogheda on the 27th April 2017 ..... *23*

Wrongside Door Failures, 8100 EMU, August 2010 and February 2012 ..... *23*

ANALYSIS 25

Passenger doors 25

Coupler 25

Rolling Stock Safety 26

Train Faults 26

Reporting Train Faults *26*

Traffic Regulators' Manual & Train Faults *27*

Additional observations *27*

CONCLUSION **28**

Summary of conclusions 28

Passenger doors *28*

Coupler *28*

Rolling Stock Safety *29*

Train Fault Reporting *29*

Immediate cause, contributory factors, underlying causes & root causes 30

Additional observations 30

RELEVANT ACTIONS TAKEN OR IN PROGRESS **31**

SAFETY RECOMMENDATIONS **32**

General description 32

Actions reported by IÉ 32

Safety recommendations 32

ADDITIONAL INFORMATION **34**

List of abbreviations 34

Glossary of terms 35

References 37

The incident

Summary of the incident

1 On the 12th August 2018, the 19:43 hrs passenger service (train identification number D910) from Pearse to Maynooth was being operated by an eight-car 29000 DMU (two four-car 29000 DMUs coupled together), with car 29414 leading.

2 At approximately 20:04 hrs while preparing to depart Ashtown Station the Driver pressed the passenger doors close button on the driver's console when he saw that all passengers had disembarked and boarded the train. The Driver noticed that the blue Door Interlock Light (DIL) on the driver's console (light used for confirmation that the passenger doors are closed) illuminated immediately while the platform side passenger door directly behind the driving cab was still in the process of closing; this is classified as a wrongside failure i.e. the blue DILs should only illuminate when the passenger doors have closed and locked.

3 The Driver re-enabled and closed the passenger doors and observed the blue DILs illuminated and the amber external lights extinguished, when the doors were closed, before departing Ashtown Station and continued on his journey.

4 En route to Maynooth, the train served Navan Road Parkway, Castleknock, Coolmine, Clonsilla Leixlip Confey and Leixlip Louisa Bridge without the wrongside failure reoccurring.

5 At Maynooth, while waiting to depart for the return journey to Pearse (train identification number P680), the Driver carried out a number of checks to try and recreate the wrongside failure. The failure could not be recreated with a door open command from the cab but could be recreated after a local passenger door button was pressed. The Driver concluded that the fault was confined to Door 4 on car 29414 (the door directly behind the driving cab) and contacted Suburban Regulator CTC before locking the door off so it could not be opened by passengers, who remained on the train.

6 On the approach to Ashtown Station, on the return journey, with car 29115 now leading, the Driver contacted the Suburban Regulator CTC to advise that the wrongside failure had reoccurred on additional doors. The Suburban Regulator CTC arranged for the train to terminate at Connolly Station.

7 The train was taken out of service and taken to Drogheda Train Care Depot for investigation.

General description of the railway

Infrastructure

8 The route from Pearse to Maynooth is a double line section of flat bottom *continuously welded rail* (CWR) track mounted on concrete sleepers in ballast.

9 Ashtown Station is a commuter railway station in Fingal (Dublin) on the Pearse to Maynooth and Docklands to M3 Parkway commuter services, see Figure 1.

10 The infrastructure was not found to be contributory to the incident.

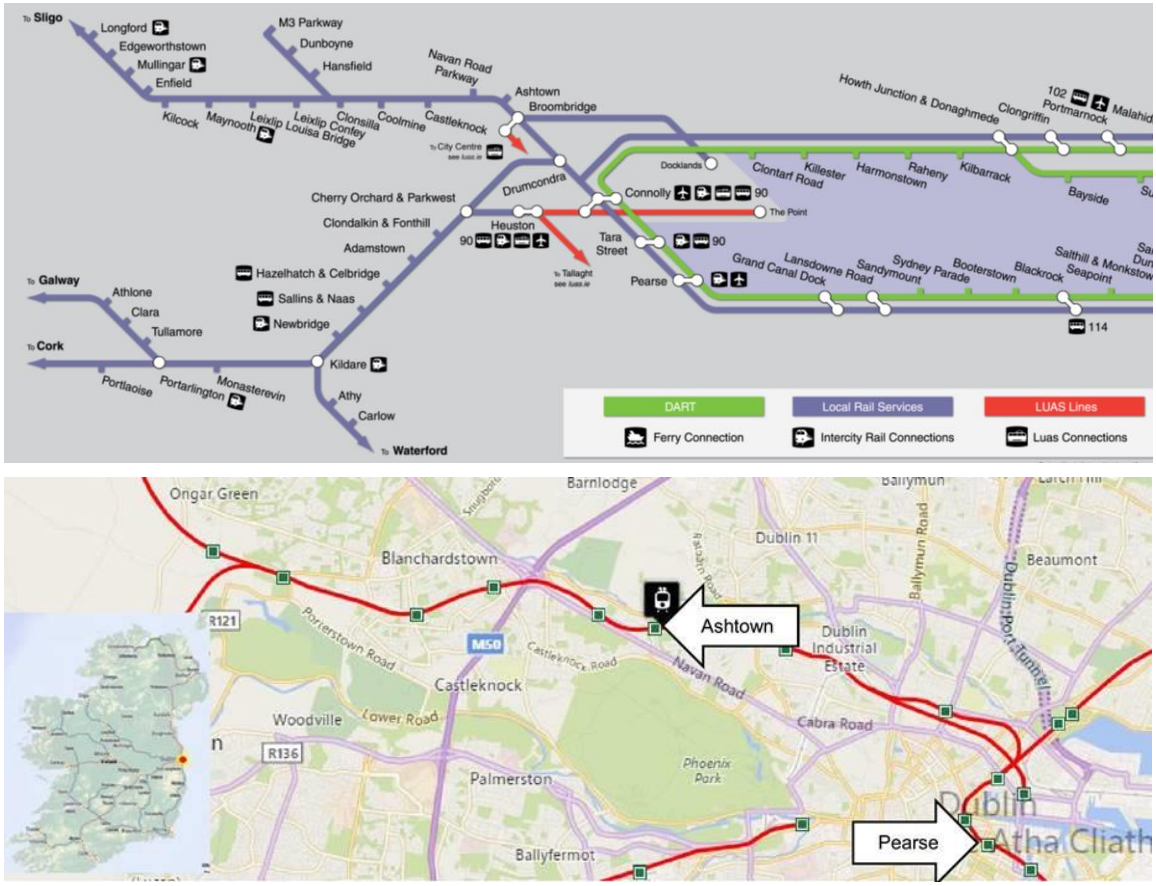

Figure 1 – Section of route map for IÉ suburban service from Pearse to Maynooth

Rolling Stock

11 The train involved in the incident was an eight-car 29000 DMU manufactured by Spanish company Construcciones y Auxiliar de Ferrocarriles (CAF). The 29000 class DMU comprises of four-car sets which can be operated in multiples up to a maximum of eight cars in passenger service.

12 On the day of the incident, two four-car DMUs (Unit 15 and Unit 14) was made up of cars 29115, 29215, 29315, 29415 (Unit 15) and 29114, 29214, 29314 and 29414 (Unit 14). Car 29414 was leading for the Pearse to Maynooth service, and car 29115 was leading from Maynooth to Pearse (the train terminated in Connolly due to the door fault), see Figure 2.

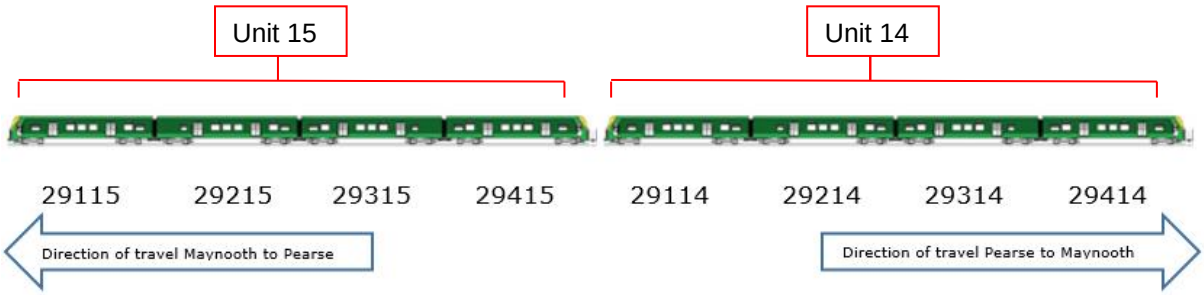

Figure 2 – Train consist with the directions of travel

13 An eight-car 29000 DMU train consist is 162.52 metres (m) in length with a combined weight of approximately 341 tonnes and can travel at a maximum speed of 70 miles per hour (mph) (110 kilometres per hour (km/h)).

14 The train is fitted with a Secheron, Teloc 2520 On Train Data Recorder (OTDR). The OTDR is and electronic measurement and recording system that can record safety critical signals, such as: car number; date and time; wheel diameter; speed; distance travelled; and brake application. The information can be viewed on the Nexala telemetry system or downloaded through a serial port or a USB storage device; plotted graphically and analysed.

15 Each car in a four-car set is joined together by a semi-permanent coupler. Two, four-car sets can be joined together via an automatic coupler that joins the two four-cars together; mechanically, pneumatically and electrically.

16 The operation of the doors is discussed in paragraphs 35 to 38 and the operation of the coupler is discussed in paragraphs 43 to 47.

Signalling and communications

17 The double track route from Dublin Pearse to Maynooth is signalled using three and four aspect colour light signals. This section of track from Pearse to Broombridge is controlled by the CTC Central Signaller based in CTC, Connolly; and the section of track from Broombridge to Maynooth is controlled by the Clonsilla Signaller. Track Circuit Block regulations apply to this route.

18 The means of communication between train drivers and the signalmen on these routes is via train radio. Lineside signal telephones are also available.

19 No factors in relation to the condition of the signalling and communications systems were found to have contributed to the incident.

Operations

20 The route is fitted with a Continuous Automatic Warning System (CAWS).

21 The train service identification numbers involved were the D910 (Pearse to Maynooth) and P680 (Maynooth to Pearse).

22 The competency of the Driver and the Suburban Regulator will be discussed in paragraphs 27 and 28.

Fatalities, injuries & material damage

Fatalities & injuries

23 There were no injuries or fatalities as a result of this incident.

Material damage

24 There was no material damage as a result of this incident. Damage to the coupler, resulting from a previous accident will be discussed in the Evidence Section of this report.

Parties & roles involved in this incident

Parties involved in the incident

25 Iarnród Éireann (IÉ) Railway Undertaking (RU) operates mainline and suburban railway services in Ireland. The RU departments associated with this incident are the:

- RU Operations – responsible for the operation of trains on the network. This includes the supervision of train drivers. The RU Operations also supply staff to the IM under special working arrangements for emergency operational duties;
- Chief Mechanical Engineer's (CME) Department – Responsible for the specification, purchasing, commissioning and maintenance of rolling stock, including management of the maintenance depots, associated personnel and procedures. Support on technical matters is provided through the CME's Fleet Technical Support (FTS) staff.

26 IÉ is also the Infrastructure Manager (IM), who owns and operates their railway infrastructure in Ireland. The IM departments involved in the accident are:

- The IM Operations (IMO) Department – responsible for the safe and efficient control of operations on the rail network for the IM team. The department is responsible for the management, control, supervision, delivery and recovery of train control operations activities on the IÉ Network. The activities of the department are allocated between the Train Control Manager and Manager CTC & Train Performance and can be categorised as follows; Central Traffic Control (CTC), Signalling Control, Level Crossing Control, Emergency Response (Degraded Working), IÉ Network Capacity Allocation and Train Performance Reporting;
- 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.

Roles involved in the incident

27 The Driver is an employee of IÉ RU who is trained and competent to drive locomotive and DMU trains. The Driver was assessed as competent to perform driving duties on the 6th February 2018 (with no restrictions); with his next assessment due two years later on the 6th February 2020.

28 Suburban Regulator CTC is an employee of IÉ IM who is based in CTC, and responsible for delivering a punctual train service in accordance with the timetable and to deal with any service recovery situations. The Suburban Regulator CTC was passed as competent to perform the role of Traffic Regulator in September 2010 and was last assessed in June 2018 as part of his two year assessment cycle.

External Circumstances

Weather

29 The weather on 12th August 2018 ranged between a minimum temperature of 15.9˚C and a maximum temperature of 20.5˚C with rainfall of 1.6 millimetres (mm) over the course of the day.

30 The weather was not found to be contributory to the incident.

RAIU Investigation

RAIU decision to investigate

31 In accordance with the Railway Safety Act 2005 and Statutory Instrument 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.

32 Under slightly different conditions, this incident may have led to a serious accident with the potential for fatalities and serious injuries due to the passenger doors being open while the train was able to take power. As the failure is classified as a wrongside failure (i.e. is not a failsafe system), a decision was made to investigate.

Scope of investigation

33 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 incident;
- Establish, where applicable, the immediate cause, contributory factors, underlying factors and root causes;
- Examine the relevant elements of the coupler and coupling mechanism;
- Examine the procedures associated with inspection of rolling stock after an incident;
- Examine the procedures in place for dealing with a rail vehicle wrongside failure;
- Review the SMS documentation in relation to risk and hazard identification;
- Previous coupler damage and maintenance.

Investigation and evidence

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

- Photographic record of damage to coupler;
- Witness evidence from parties involved in the incident;
- Recorded communication between the Driver and Suburban Regulator CTC;
- Other evidence from members of the RU with information pertaining to the incident;
- RU standards, procedures and other documentation;
- SMS documentation from the RU associated with recommendations from investigations;
- Maintenance regime for the couplers;
- Design specifications for the couplers.

Evidence

Passenger doors

Passenger door operation

35 Each individual 29000 Class DMU vehicle is fitted with four double leaf passenger entrance doors, two on each side. Doors are closed by the action of a pneumatic cylinder and locked by means of a mechanical lock. Micro-switches fitted to each door confirm the door is closed and locked. The passenger doors operate on the 'Driver Enable, Passenger Open' principle:

- Driver Enable – The train must be stopped; and the driver must press the red enable buttons (two pressed simultaneously) for the desired side, see Figure 3, Figure 4 and Figure 5 (note for the right doors, these can be enabled through the console (Figure 4) or in a panel adjacent to the non-driver side cab door (Figure 5);
- Passenger Open – The passenger must press the local "Open Door" button for the desired door to open (It is noted that the driver can also open and close all doors from the cab).

Figure 3 – Left Door Controls (Driver's Console)

Figure 4 – Right Door Controls (Driver's Console)

Figure 5 – Right Door Controls (Adjacent to *off-side* Cab Door)

36 When the doors are closed, by the pressing of the local door close button, or by the driver pressing the appropriate 'Door Close' button (green buttons in Figure 3 & Figure 5); the external amber lights should extinguish and the blue DILs on the driver's console (Figure 4) and the door panel (Figure 5) should illuminate. When the doors are enabled, the blue DILs should extinguish and the amber external indicator, positioned on the external of the train, should illuminate (see Figure 6).

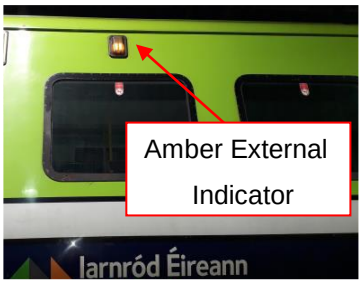

Figure 6 – External Indicator

37 When the passenger doors are closed on all the cars, the door interlock loop signal flows throughout the cars, completing the loop. This in turn illuminates the blue DILs in the driving cab (Figure 7) and extinguishes the external amber lights. This verification of the doors being closed energises the traction interlock relay, allowing the train driver to take power.

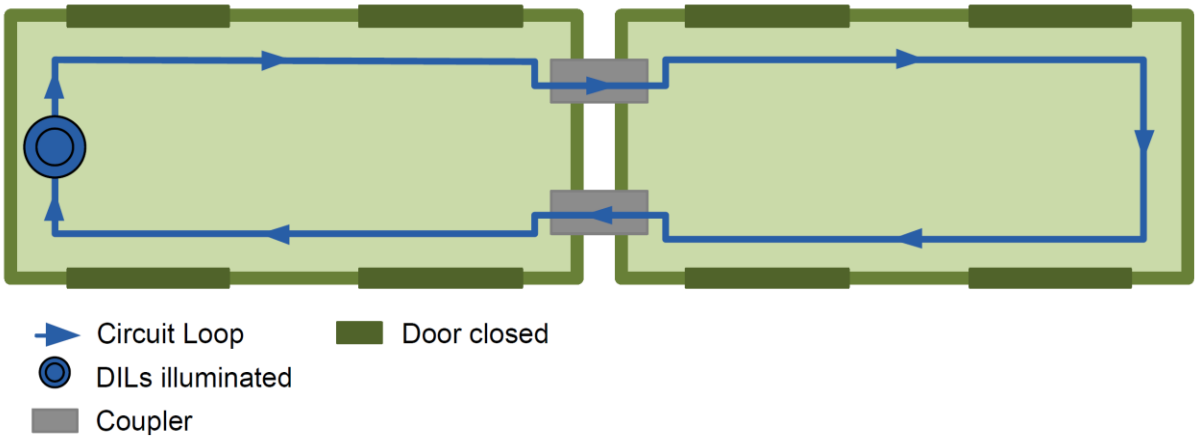

Figure 7 – Door Interlock Loop with illuminated DIL

38 Therefore, if a door remains open, the Door Interlock Circuit does not form a complete circuit, and the blue DILs remains extinguished in the driver's cab, see Figure 8.

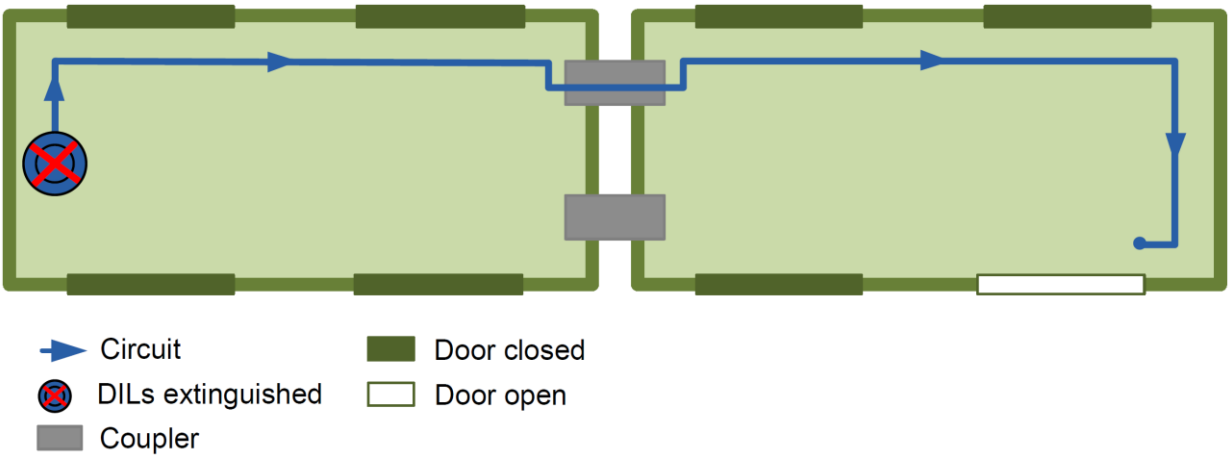

Figure 8 – Door Interlock Closed Circuit not returned with DILs remaining extinguished

Maintenance of the passenger doors

39 The maintenance and inspection of the passenger doors on IÉ rolling stock is carried out in accordance with periodic scheduled maintenance exams. "A Exams" (also referred to as Fuel Point Exams) are carried out every 48 hours. A more thorough suite of "B Exams", of which there are thirteen, must be carried out within every 130,000 km (i.e. one "B Exam will be carried out approximately every 10,000 km). Each of the thirteen B Exams examines different components of the train to balance the workload; each B Exam will examine the safety critical components and then, additionally, may focus another non-critical component, such as doors.

40 Specific tasks in the scheduled maintenance exams are called Vehicle Maintenance Instructions (VMI), and the last passenger door VMI that was carried out on Unit 15 as part of the "A Exam" was carried out on the 11th August 2018 (the day before the incident). No faults were found with the passenger doors.

Post incident examination of the passenger doors

41 As part of the investigation the passenger doors on Unit 14 and Unit 15 were examined, no damage or faults were identified with the passenger doors.

42 When car 29415 was uncoupled (from Unit 14) the fault could not be reproduced but when car 29415 was coupled to any other car the fault was present, meaning that the fault was most likely present on the coupler of 29415.

Coupler

General description

43 A 29000 DMU consists of four-car 29000 DMUs coupled together by a semi-permanent coupler. Both end cars are fitted with an automatic coupler (autocoupler) allowing the joining (mechanically, electrically and pneumatically) of an additional four-car 29000 DMU to form an eight-car DMU for operational services.

Autocoupler design

44 The autocoupler associated with the incident and fitted to the 29000 DMU fleet is manufactured by Scharfenberg. Coupling of two (four-car) units is achieved without manual assistance by driving one unit up to the second unit. Connection of the electrical lines and air pipes is automatically achieved as the couplers are mechanically coupled. See Figure 9 for an example of the autocoupler involved in the incident, with the mechanical, electrical and pneumatic mating parts.

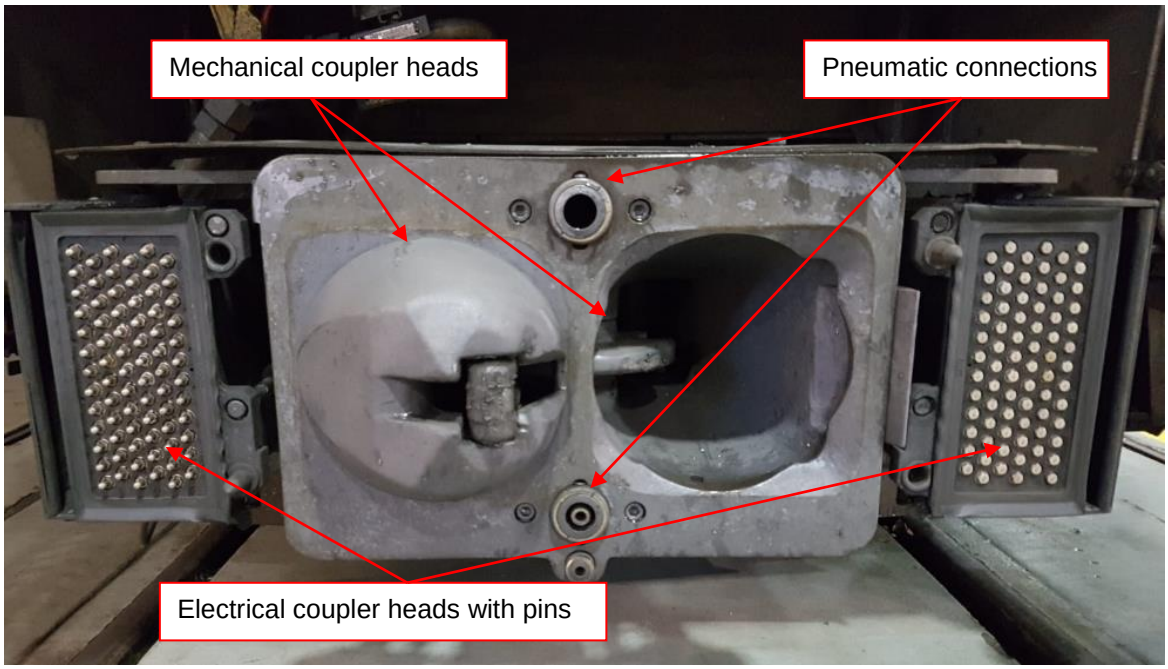

Figure 9 – Example of automatic coupler fitted to the 29000 DMU fleet

45 The electrical coupler heads operate in duplicate, i.e. there is a duplicate wire in the opposite coupler head for each pin. Figure 10 shows a front external view of the electrical coupler heads with the associated pins, Pin 38, Pin 39 (and an example of a duplicate pin, Pin 139).

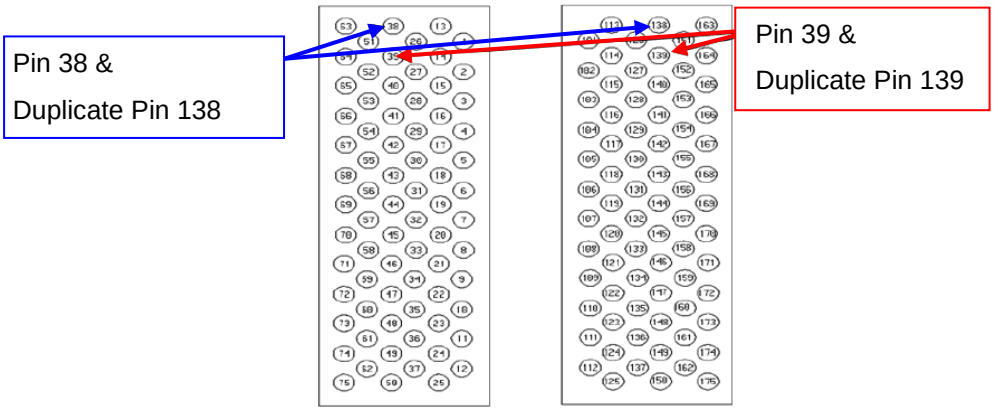

Figure 10 – Electrical Pin 38 & Pin 39 (and Pin 39 duplicate, Pin 139)

46 The joining of the electrical autocoupler heads, when coupled correctly, allows opposing pins to connect, which in turn opens the spring-loaded normally-closed contacts; allowing the current to flow through to the next carriage, see Figure 11; and throughout all the coupled cars.

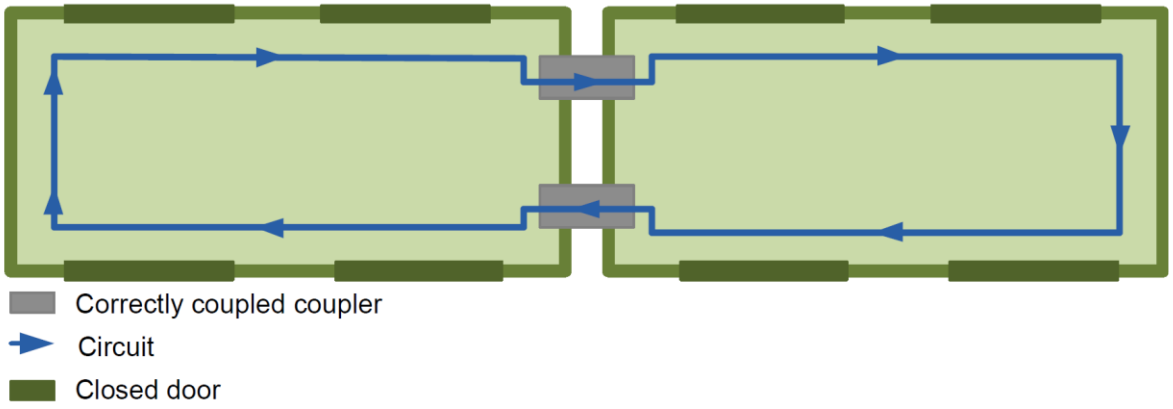

Figure 11 – Coupled units, with open contacts and Door Closed Indication Circuit

47 The rear of the electrical head contains male spades (to be referred to as spades for the remainder of the report) which allow the connection of female push-on crimps (to be referred to as crimps for the remainder of the report), see Figure 12. The crimps hold the cables, which feed the required circuits through the coupler.

Figure 12 – Example of push-on crimp spades usually used on the 29000 DMU fleet

Autocoupler maintenance

48 As mentioned previously, the last "A Exam" on Unit 15 was conducted on the 11th August 2018 (the day before the incident). No faults associated with the coupler were found as part of this examination, with no faults or work orders generated.

49 The last B Exam was a "B6 Exam" on Unit 15 was conducted on the 20th July 2018. Two safety critical tasks, under the Mechanical/All Crafts section, which "must be completed in full accordance with the task instructions" associated with the autocoupler are completed through the following VMIs:

- VMI UC029J5658 – Autocoupler: Functionality Check – To test the operation of the autocoupler equipment;
- VMI UC029J5662 – Automatic Coupler: Examine, Gauge and Test – To check electrical head projection, physical conditions and coupler entering device.

50 The VMIs are four and nine pages, respectively; and include a number of steps which must be completed before sign-off, with many illustrations for guidance on how to complete the steps in full. These VMIs are solely checking the mechanical properties of the autocoupler, and neither VMI has any requirements to check the rear of the electrical head of the autocoupler where the crimps and spade are located.

51 None of the "B Exams" include a comprehensive electrical check for the autocoupler.

Unscheduled examination of coupler

52 29000 DMU Unit 15 was involved in a fatal accident on 6th June 2018 with car 29415 leading. The collision impacted the coupler electrical head.

53 As a result of the collision, the steps of unscheduled examination document Z1C29A0001 (Issue 1, June 2012), titled "Examination of 29000 class vehicle after an incident / accident" (to be referred to as VMI Z1C29A0001 for the remainder of the report) were carried out.

54 VMI Z1C29A0001 is a three page document, with a fifteen step implementation instruction for the examination of a train after an accident. A number of the steps involve the checking of various systems with the final step, Step 15 stating: "Examine the consist for damage that may have been sustained in the incident. If in doubt if any damage sustained may compromise the safety of the unit in transit, contact FTS on call for further advice". There is no specific mention of the couplers in VMI Z1C29A0001, but is encompassed as part of Step 15, where necessary.

55 After the fatal accident on the 6th June 2018, the steps identified in VMI Z1C29A0001 were undertaken. CME generated an unplanned 'work order' to "check for coupler damage after fatality". After which the coupler was checked, repaired and tested, with the work order stating: "repaired door on electrical head" and "tested coupler ok now", see Figure 13.

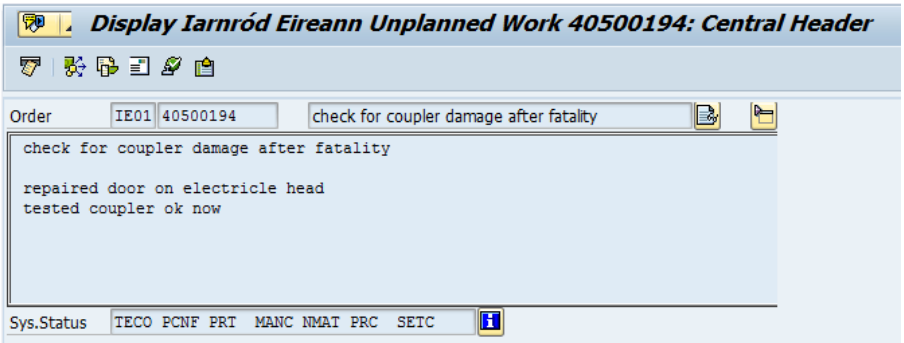

Figure 13 – CME Work Order generated for coupler on the 6th June 2018

Post incident inspection of the autocoupler

56 In terms of the incident on the 12th August 2018, after the wrongside door failure, the train was taken to Drogheda Train Care Depot for investigation and the fault was still present. When Unit 15 was uncoupled, the fault could not be reproduced; but when car 29415 was coupled to any other car the fault was present.

57 A further inspection of the rear of the coupler electrical head on car 29415 found that Crimp 38 (battery positive) and Crimp 39 (door interlock loop) were detached from Spade 38 and Spade 39, respectively; with Crimp 39 (door interlock loop) now touching Spade 38 (battery positive). See Figure 14 for an illustration of the contact and Figure 15 for a photograph taken after the incident (which shows the detachment, however, Crimp 39 is no longer touching Spade 38).

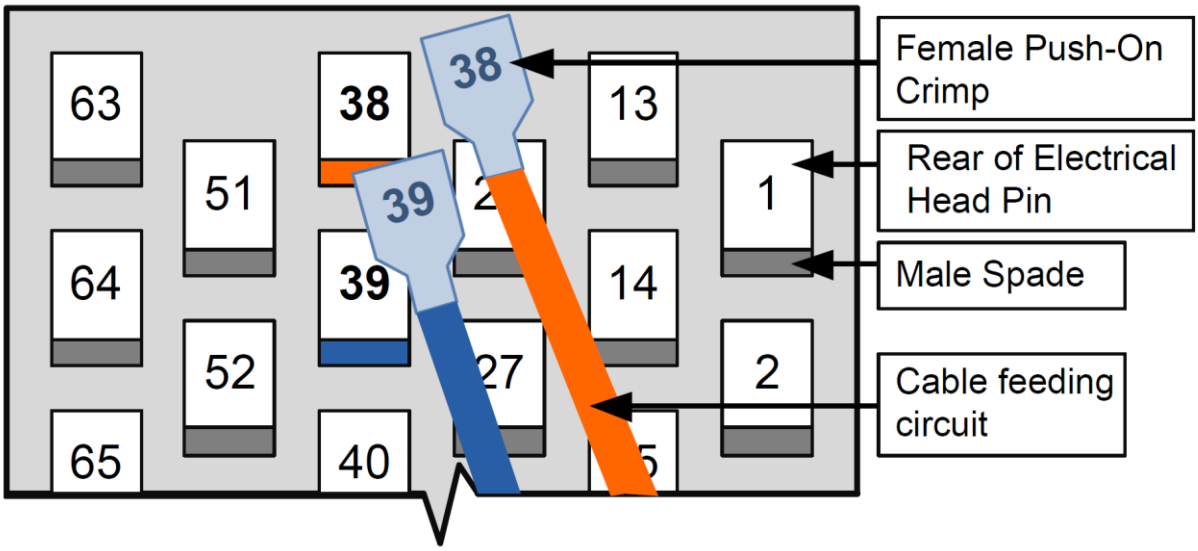

Figure 14 – Illustration of rear of coupler head

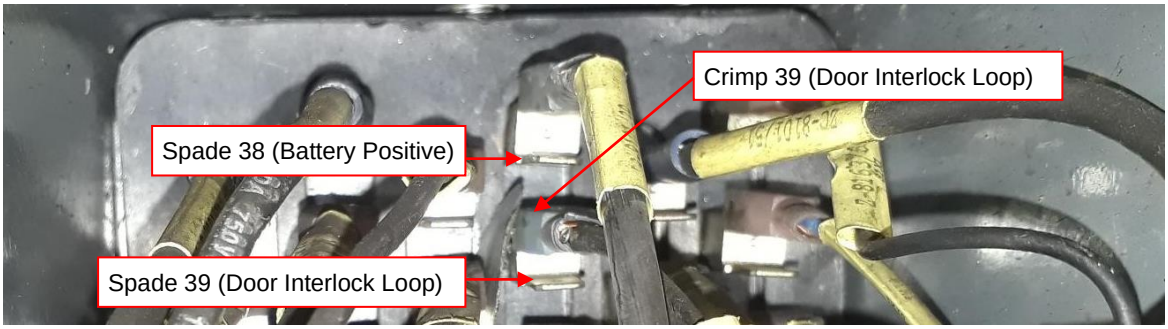

Figure 15 – Photograph taken after the incident (Crimp 39 is no longer touching Spade 38)

58 The contact resulted in the Door Interlock Loop (from Crimp 39) being supplied with a 24V Direct Current (DC) from the battery positive contact (from Spade 38), effectively meaning that the Door Interlock Loop circuit and the battery positive circuit became one combined circuit, see Figure 16. This resulted in the Door Interlock Loop circuit completing, when a door was opened by a passenger on the front set and the doors of the rear set remained closed.

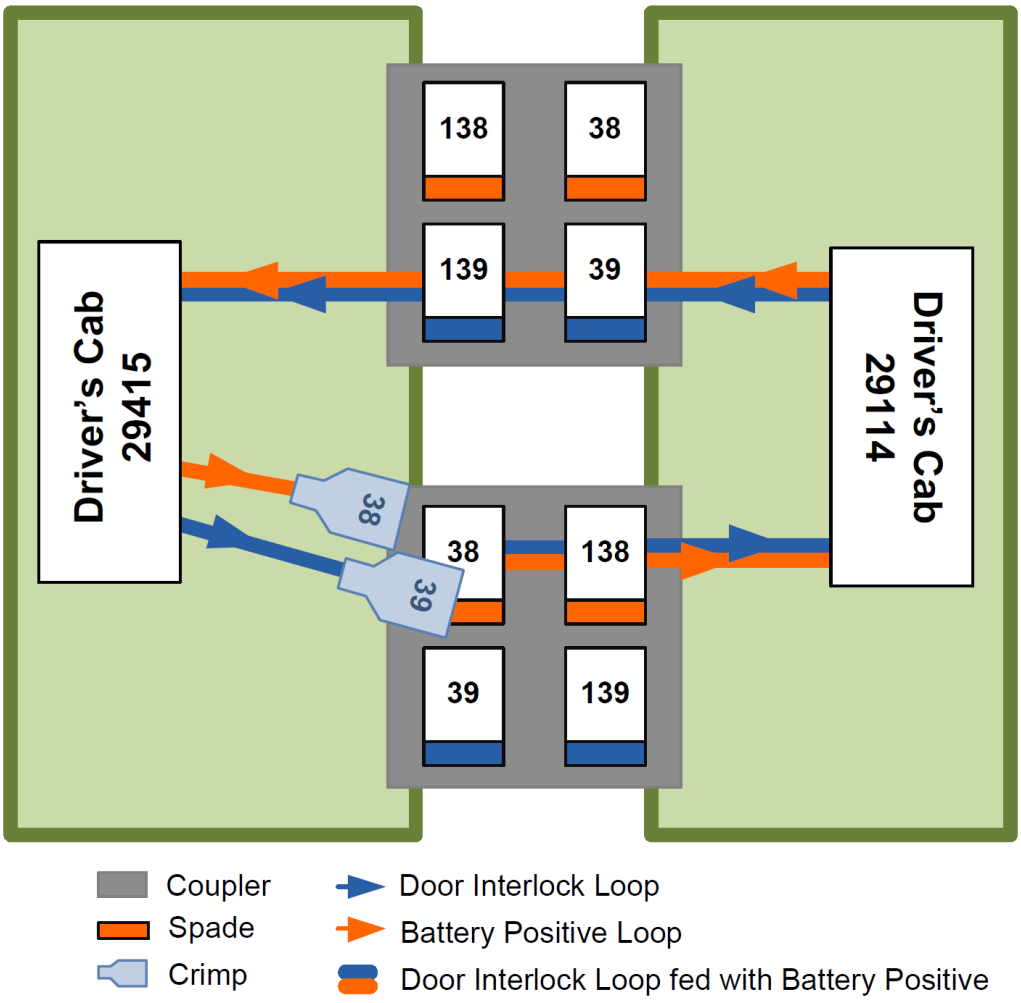

Figure 16 – Door Interlock Loop fed with Battery Positive

59 The physical condition of the crimps and spades showed no signs of wear. When they were reconnected to the correct terminals, both were found to be a tight fit and required force to make the connections. An inspection of the crimps found that the insulation sleeve did not protrude beyond the head of the crimp (see white insulation sleeve in Figure 17); this allowed the crimp to make direct contact with the spade. Figure 17 also illustrates a crimp with a protruding sleeve (see blue insulation sleeve covering the head of the crimp).

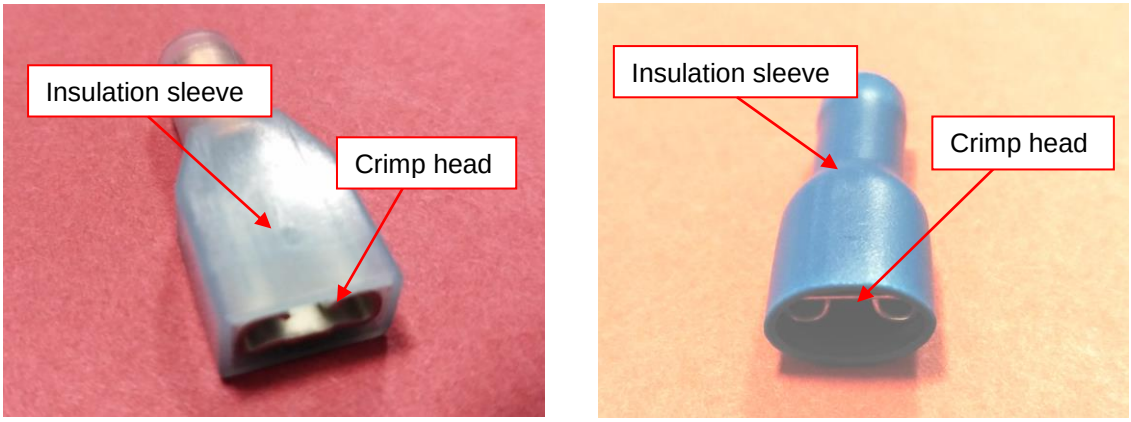

Figure 17 – Push-on Crimp Spades

60 An interrogation of Nexala telemetry data from the train identified the blue DILs were illuminating while the passenger doors were in the process of closing at Leixlip Confey, Castleknock and Navan Road Parkway stations, on the return journey.

61 A further interrogation of data extracted from Nexala telemetry system did not show the fault on any occasion apart from the day of the incident, despite the cab of 29415 being coupled to other 29000 DMU units in service on twelve occasions from 6th June 2018 to the day of the fault on 12th August 2018 with no faults displayed.

Rolling Stock Safety

General description

62 The CME's Safety Management Standards relevant to this investigation are:

- CME-SMS-001, CME Safety Management System, Issue 9, operative since the 19th December 2017 was in place at the time of the incident (to be referred to as CME-SMS-001);
- CME-SMS-006, Hazards & Risk Assessments, Issue 9, operative since the 19th December 2017 was in place at the time of the incident (to be referred to as CME-SMS-006).

63 It is noted that the above CME SMS documents included both rolling stock/bogie/wheelset safety and Occupational Health and Safety requirements; making the documents difficult to read.

Responsibilities & accountabilities

64 The CME is responsible for ensuring that all rolling stock fleets are at all times safe for the duty it is expected to achieve; specifically, the CME has full accountability for all rolling stock safety within the entire IÉ railway network. Accountability for rolling stock safety resides with the Technical Manager CME and the Manager FTS and, on a fleet by fleet basis, with the Senior FTS. Senior FTS staff monitors the rolling stock safety of the fleet for which they are accountable by utilising a programme of *Compliance Verification* checks.

65 Both documents clearly and comprehensively identify the responsibilities and accountabilities of CME staff.

Management of Rolling Stock Safety

66 According to CME-SMS-001, rolling stock safety is managed as follows:

- Rolling Stock Fleets – The responsibility of the CME department;
- Duties & responsibilities of employees – Every employee must act in accordance to CME documentation;
- Fleet Control & Production – Accountable line managers are responsible for ensuring that all maintenance activities are completed within the specified maintenance periodicities and according to the technical documentation and instructions;
- Standards of maintenance – The Technical Manager is accountable for developing comprehensive technical documentation of all maintenance activities to ensure the safe and reliable operation of rolling stock fleets;
- Quality of work & "Sign Off" – Accountable line managers will ensure that employees execute tasks correctly and "sign-off" for tasks completed;
- Rolling Stock Risk Registers – The Senior FTS will manage and control the risk register as well as all actions and programme to close out those risks.

Hazards & Risk Identification

67 One of the principles of CME-SMS-001 is that "hazards are identified and risks are assessed and precautionary/mitigation actions are implemented to limit the probability of accident/incidents occurring thereby reducing the overall risk".

68 According to CME-SMS-001 and CME-SMS-006 rolling stock hazards and risks are identified through:

- Investigating all rolling stock incidents on a daily basis (CME-SMS-006, 3.5.2.1);
- Compliance Verification across the fleet (CME-SMS-006, 3.5.2.2);
- Employee reporting of identified hazards to Rolling Stock Safety through the Hazard Reporting Process (CME-SMS-006, 4.1.3) or Hazard Report Book (CME-SMS-006, 4.6);
- The convening of a Risk Assessment Panel;
- The Annual Rolling Stock Risk Workshop (CME-SMS-001, 7.6.1.1).

69 The identified risks are inputting into a Rolling Stock Risk Register, managed by Senior FTS, which "record every known risk to… rolling stock safety of that fleet as well as all the actions and programmes to close-out those risks".

Rolling Stock Risk Register

70 The Rolling Stock Risk Register is managed through:

- The Technical Manager CME reviewing the register every period with all Senior FTS to ensure that acceptable progress is made with action plans to resolve the risks (3.2.2.1);
- The Manager FTS leading a monthly review of all the Rolling Stock Risk Registers and assisting programmes and actions to close and resolve outstanding risks (3.3.2.1);
- The Annual Rolling Stock Risk Workshop (CME-SMS-001, 7.6.1) to review the management of rolling stock risks.

71 CME-SMS-001 and CME-SMS-006 go into great detail in relation to actions to be taken in terms of the Rolling Stock Risk Register.

Train Fault Reporting

Driver Reporting of Train Faults

72 Reporting of train faults, by drivers, is covered in the IÉ's General Appendix and the IÉ / NIR Rule Book (to be referred to as the IÉ Rule Book for the remainder of the report), August 2011 revision. There are two sections relevant to this investigation:

- General Appendix, Section B, Part 1: Locking Off of Doors on Passenger Trains, 6.4.3, with regards to the driver reporting a door fault to the CTC Traffic Regulator, states that "Where it is necessary to lock off a door or doors during the course of the journey, the Guard (or Driver on Driver Only Trains) must report the matter to the CTC Traffic Regulator at the earliest opportunity and to the Maintenance Department on completion of the journey and make a suitable endorsement in the vehicle log book and in his journey / manifest".
- IÉ Rule Book, Section H, Part 3: Instruction to Drivers, paragraph 3.6.17: If a vehicle defect occurs, requires the driver to report serious defects to his supervisor, and to tell the Maintenance Staff "as soon as possible".

Traffic Regulator Reporting of Train Faults

73 The Traffic Regulator, IMO-SMS-043 Traffic Regulators' Manual, Issue 1.0, operative since November 2014 (to be referred to as the Traffic Regulators' Manual for the remainder of this report), contains work instructions and supporting guidance to assist Traffic Regulators in the performance of their duties.

74 Section 5: Communications – Methods and Protocol, of Traffic Regulators' Manual 5.1 Telephones / Train Radio 5.1.1 states that "All telephone conversations are recorded within the control environment; this is to enable safety messages that have been passed between regulators to be reviewed for competency and to review incidents for performance implication in the event of an incident". The recording of third party conversations (e.g. Driver and CME Maintenance Department) is done through the Traffic Regulator (e.g. Suburban Regulator CTC) "patching" through calls through his console.

75 The Traffic Regulators' Manual (Section 6.2) contains a schedule of "accidents that the IM/RU must report immediately to the RAIU"; however, the schedule does not contain one of the immediate notification requirements, i.e. "Wrongside failures of safety critical equipment that led to an unsafe condition requiring withdrawal from service". This incident would be immediately reportable. Although not formally documented, CTC were briefed on the requirements to notify the RAIU in January 2018.

Traffic Regulator's Actions on Reported Train Faults

76 The Suburban Regulator CTC took steps to remove the train from service, using his own experience to make the decision; at the time of the incident there was no documented process in IMO-SMS-043 dealing specifically with wrongside rail vehicle failures.

Train fault reporting on the day of the incident

The Driver

77 The actions of the Driver, on the day on the incident, are discussed in paragraphs 88 to 97. It should be noted that the Driver adhered to the requirements of the IÉ Rule Book by locking off the doors and reporting to Suburban Regulator CTC and requesting contact with CME Maintenance Department for assistance.

Suburban Regulator CTC

78 The actions of the Suburban Regulator CTC on the day of the incident are discussed in paragraphs 92 to 97. It should be noted that the Suburban Regulator CTC adhered to the requirements of the Traffic Regulators' Manual in that he reported the incidents to the CTC Duty Manager as well as advising him that he had arranged for the train to be terminated at Connolly.

79 The Suburban Regulator CTC also requested that CME Maintenance Department (Drogheda) contact the Driver; however, he did not "patch" the call, and, as such the phone conversations were not recorded as set out in paragraph 5.1.1 of the Traffic Regulators' Manual (paragraph 74).

Additional Reporting

80 The CTC Duty Manager issued a text alert to the relevant IÉ staff and also contacted the IÉ On-Call Accident Investigator, who in turn notified the CRR and the RAIU.

81 Although, the incident was reported to the RAIU, it was noted that this type of incident, which is immediately reportable to the RAIU, was not formally documented, although it was briefed to CTC (paragraph 75).

Events before, during & after the incident

Events before the incident

82 On the 6th June 2018, Unit 15, was involved in a fatal collision, impacting the coupler of leading car 29415. Unit 15 was taken to Drogheda Train Care Depot for an inspection in accordance to unscheduled VMI Z1C29A0001. Damage to the external coupler electrical head cover was identified and a replacement fitted; with the coupler tested after fitting.

83 The last "B6 Exam" was conducted on the 20th July 2018, which included an automatic coupler check and an examination of the gauge with associated testing. No faults or work orders were generated against the coupler.

84 Car 29415 was coupled to other 29000 DMU units in service on twelve occasions from 6th June 2018 to the day of the fault on 12th August 2018 with no faults reported between these dates.

85 The last CME maintenance intervention of Unit 15 was an "A Exam" on the 11th August 2018.

86 On the 12th August 2018 the train was an eight-car 29000 DMU, with Units 14 and 15 coupled.

87 The Pearse to Maynooth train was operating with car 29414 leading.

Events during the incident

88 At approximately 20:04 hrs, on the 12th August 2018, while preparing to depart Ashtown Station the Driver pressed the passenger doors close button when he saw that all passengers had disembarked and boarded.

89 The Driver noticed that the blue DIL on the driver's console illuminated immediately while the platform side passenger door directly behind the driving cab (Door 4) was still in the process of closing; this is classified as a wrongside failure i.e. the blue DILs should only illuminate when the passenger doors have closed and locked.

90 The Driver re-enabled and pressed the passenger "door close" button and observed the blue DILs illuminated and the amber external lights extinguished, when the doors were closed; the fault did not re-occur. The Driver then departed Ashtown Station and continued on his journey with the passengers.

91 En route to Maynooth, the train served Navan Road Parkway, Castleknock, Coolmine, Clonsilla Leixlip Confey and Leixlip Louisa Bridge without the wrongside failure re-occurring.

92 At Maynooth, while waiting to depart for the return journey to Pearse, the Driver carried out a number of checks to try and recreate the wrongside failure. The failure could not be recreated with a door open command from the cab but could be recreated after a local passenger door button was pressed. The Driver concluded that the failure was confined to Door 4 on car 29414 (the door directly behind the driving cab) and contacted Suburban Regulator CTC before locking the door off so it could not be opened by passengers. The Driver also requested contact with

CME Maintenance Department (Drogheda), this was arranged by the Suburban Regulator CTC, but the conversations were not recorded. The Suburban Regulator CTC also contacted the CTC Duty Manager.

93 At 20:46 hrs, the Driver departed Maynooth Station to travel to Pearse Station, with carriage 29115 now leading. The Driver continued to check the timing of the illumination of the blue DILs and the external amber lights. Nexala telemetry identified that the wrongside failures occurred again at Leixlip.

94 At Coolmine Station the Driver contacted the Suburban Regulator CTC to inform him that the blue DILs were illuminating while a number of the doors were closing and the external lights were illuminated.

95 The wrongside door failure reoccurred at Castleknock Station and the Driver tested the doors (while the Suburban Regulator CTC observed the rear two carriages from CCTV cameras at CTC). When the Driver pressed the door close button, the blue DILs illuminated immediately. The Driver saw that three doors at the front of the train were still open with the external amber lights illuminated, while the doors that were in view of the Suburban Regulator CTC were already closed as no member of the public had opened the doors and the external amber lights were extinguished.

96 The Driver performed a door test (opening all platform side doors from the cab) before closing the doors; the fault did not reoccur.

97 The Suburban Regulator CTC advised the Driver that he would terminate the service at Connolly Station and the Driver advised that he would be extra vigilant en route. The Suburban Regulator CTC advised the CTC Duty Manager of the incident and his decision to terminate at Connolly.

98 The Nexala telemetry identified that the fault re-occurred at Navan Road Parkway Station.

Events after the incident

99 The train was taken out of service at Connolly and transferred to CME Maintenance Department (Drogheda), with the findings identified in paragraphs 41, 42 and 56 to 61.

100 The CTC Duty Manager issued a text alert to the relevant IÉ staff and also contacted the IÉ On-Call Accident Investigator, who in turn notified the Commission for Railway Regulation (CRR) and the RAIU.

Similar occurrences

General

101 Although the fault at Ashtown Station is classified as a wrongside door failure, the post-incident inspection found that the fault was with the coupler. In terms of the 29000 DMU, there is one wrongside door failure recorded. In addition, a wrongside door failure on the 8100 EMU fleet is similar to the failure at Ashtown as it also involves the coupler; the RAIU investigated this incident.

Wrongside Door Failure, 29000 DMU at Drogheda on the 27th April 2017

102 At approximately 19:25 hrs on the 26th April 2017, the driver of Train P677 at Connolly Station, reported that when he had enabled the passenger doors the blue DIL did not extinguish. The driver contacted maintenance and was advised to power off the train and wait for Connolly platform maintenance staff to attend. When the train was re-started the fault had cleared. FTS issued instructions to the depot for checks to be completed as soon as possible. The following day (27th April 2017), at approximately 18:40 hrs the set was being shunted from Platform 3 in Drogheda into the yard when a member of staff observed the passenger doors were closing as the train was moving from the platform. The investigation identified that two relays on the same circuit failed in the energised position.

103 Although similar in train classification, this incident is not similar in terms of its failure mechanism, to the incident on the 12th August 2018.

Wrongside Door Failures, 8100 EMU, August 2010 and February 2012

104 The RAIU investigated the following incident, publishing report “DART Wrongside Door Failure, Salthill & Monkstown Station, 10th August 2013”, RAIU Report No: R2014 – 003, published on the 30th July 2014. The report findings are as set out below.

105 At approximately 08:50 hrs on Saturday 10th August 2013 the driver of the DART service from Howth to Greystones was stopped at Salthill & Monkstown Station, when he noticed that the blue DIL was illuminated while the rear passenger doors of the train were open. After a number of checks, the driver found that the coupler was damaged and the rear units of the train were incorrectly coupled. The driver contacted the CME Department and the train was taken out of service and sent to Fairview Depot for inspection.

106 A CME inspection of the train found that the door of the coupler electrical head had been damaged, which resulted in the train not being correctly coupled electrically; resulting in the display in the driving cab showing that the doors were closed; as the ‘doors closed’ signal did not pass through the incorrectly coupled carriages due to a design weakness in the coupler. This design weakness was first recorded on the 26th August 2010; in February 2012 after reports of two similar incidents, an investigation was carried out by the CME which resulted in a number of recommendations, including a recommendation in relation to a design modification to rectify the

design weakness and an interim mitigation measure of a 'Coupler Electrical Head Integrity Test' to be carried out by drivers after coupling to ensure correct coupling. These recommendations were not fully implemented at the time of the incident.

107 As a result of this investigation, the RAIU have made four safety recommendations related to the: design of the EMU autocoupler; correct coupling visual indicators on the driving console; updates to the EMU Drivers' Manual to include specific guidance on the requirement for the examination of couplers; and, a review and modification on the CME processes for closing recommendations. All recommendations have now been addressed by IÉ and closed by the CRR.

Analysis

Passenger doors

108 Paragraphs 35 to 38 outline the operation of the passenger doors, which operate on a 'Driver Enable, Passenger Open' principle. In order to drive the train, the door interlock loop (which flows through the contacts of the electrical heads on the couplers) must be satisfied all doors are closed and locked; micro-switches fitted to each door confirming the door is closed and locked, with the external amber lights extinguishing and the blue DILs in the driver's cab illuminating. When a passenger door is enabled, the blue DILs should extinguish and the amber external indicator should illuminate.

109 A review of the maintenance and inspection found that the last planned maintenance of Unit 15 took place on the 11th August 2018 and that no faults with the functionality of the passenger doors were found (paragraph 39).

110 In addition, a post-incident examination of the passenger doors found no fault with the passenger doors on the day of the incident (paragraphs 41 - 42).

Coupler

111 The Scharfenberg autocoupler allows the joining of four-car 29000 DMUs together (paragraphs 43 - 44). Connection of the electric and pneumatic lines is automatically achieved when the couplers are mechanically coupled. Correct joining of electrical heads allows the circuits to flow through to the next carriage; the door interlock loop is one of the circuits to travel through the coupled units (paragraph 46).

112 In terms of scheduled maintenance, the last A Exam on car 29415 (Unit 15) was carried out on the 11th August 2018, with no faults found (paragraph 48). The last B6 Exam was conducted on the 20th July 2018, which included a mechanical check of the autocoupler, which found no faults (paragraph 49).

113 In terms of the unscheduled maintenance, VMI Z1C29A0001 was carried out after the collision on the 6th June 2018. The collision which directly impacted the coupler of car 29415. VMI Z1C29A0001 does not directly request the inspection of the coupler, but does have an all-encompassing step for checking for damage sustained (paragraphs 52 - 54); as a result, the external parts of the coupler was checked, damage was found to the door of the electrical head which was repaired and tested (paragraph 55). There were no checks carried out to the internal parts of the electrical head.

114 The inspection of the coupler on car 29415 identified Crimp 38 (Battery Positive) and Crimp 39 (Door Interlock Loop) were detached from their relevant spades. This investigation could not determine when the detachment occurred. As the detachment alone would not register a fault due to the duplication of the circuit.

115 The fault did occur on the 12th August 2018 when Crimp 39 (door interlock loop) made contact with Spade 38 (battery positive), resulting in the Door Interlock Loop being supplied with a 24V Direct Current (DC) from the battery positive contact, effectively meaning that the Door Interlock Loop circuit and the battery positive circuit became one combined circuit. This resulted in the Door Interlock Loop completing the circuit, even when the doors were open (paragraphs 57 - 58) i.e. the detachments would not alone have caused the fault.

116 The lack of insulation protruding beyond the crimp head, allowed the door loop circuit to be completed, after Crimp 39 (Door Interlock Loop) touched Spade 38 (Battery Positive) (paragraph 59).

Rolling Stock Safety

117 The CME's Safety Management Standards, CME-SMS-001 and CME-SMS-006 included both rolling stock/bogie/wheelset safety and Occupational Health and Safety requirements; making the documents difficult to read; however, the responsibilities and accountabilities of CME staff are clearly and comprehensive stated (paragraph 63).

118 The management of Rolling Stock Safety (paragraph 66) is also thorough, as it the management of the Rolling Stock Risk Register (paragraph 70).

119 However, although identifying a number of ways of identifying hazards and risks, through investigating incident, compliance verification, employee reporting and workshops (paragraph 68); the risks associated with the coupler and the failure to do more thorough inspections after an accident, was the case in this investigation, were not identified.

Train Faults

Reporting Train Faults

120 The requirements of the IÉ Rule Book and General Appendix were complied with, in full, as the Driver reported to Suburban Regulator CTC and to CME Maintenance Department (Drogheda) that he was locking off the Door 4 (General Appendix, Section B, Part 1, 6.4.3); and, he suitably notified the appropriate staff on the vehicle defect (IÉ Rule Book, Section H, Part 3, 3.6.17), (paragraph 72).

121 The requirements of the Traffic Regulator's Manual were complied with in terms of the reporting of the incident to the CTC Duty Manager by the Suburban Regulator CTC; who sent a text alert to the relevant IÉ staff and informed the On-Call Accident Investigator; however it was not reported to the RAIU by the Suburban Regulator CTC as the Traffic Regulators' Manual does not require the reporting of "wrongside failures of safety critical equipment that led to an unsafe condition requiring withdrawal from service", despite it being a current RAIU requirement (paragraph 75).

Traffic Regulators' Manual & Train Faults

122 In addition, it is noted that there is a dearth of information, in the Traffic Regulators' Manual regarding steps to be taken in the event of a rail vehicle wrongside failure.

Additional observations

123 The Suburban Regulator CTC did not record the conversations between CME Maintenance Department (Drogheda) and the Driver, as required by the Traffic Regulators' Manual (paragraph 79).

Conclusion

Summary of conclusions

Passenger doors

124 A review of the operation, maintenance and inspection and post-incident inspection of the passenger doors identified that the doors operated as expected, were maintained appropriately and no faults were identified after the incident (paragraphs 108 - 110); meaning that the functionality of the passenger doors were not contributory to the wrongside door failure.

Coupler

125 From an analysis of the evidence, there was a fault with the autocoupler on car 29415 (Unit 15); the fault was as a result of Crimps 38 (Battery Positive) and 39 (Door Interlock Loop) becoming detached; with Crimp 39 (door interlock loop) making contact with Spade 38 (battery positive), resulting that the Door Interlock Loop circuit and the battery positive circuit effectively becoming one circuit. This ultimately resulted in the Door Interlock Loop circuit completing, when a door was opened by a passenger on the front set and the doors of the rear set remained closed (paragraph 115); leading to the blue DILs illuminating in the Driver's cab when the doors were still in the process of closing, causing a wrongside door failure. Contributory to the contact causing the circuit to complete was the fact that the crimps did not have protruding insulation which would have prevented the crimp contacting the spade (paragraph 116).

126 The investigation could not determine when and how the crimps became detached, but it is unlikely that they became detached due to in-service vibrations as force was required to re-attach the crimps to the spades.

127 Although it is not clear when the crimps became detached, had they become detached on the 6th June 2018 as a result of the collision, the detached crimps were not identified between the 6th June 2018 and the 12th August, despite there being unscheduled maintenance on the 6th June 2018 as a result of the collision (paragraph 113) and a number of A Exams (the last on the 11th August 2018) and a B6 Exam (20th July 2018) (paragraph 112). In terms of the scheduled maintenance, it is noted that, as a result of the duplicate pins on the electrical head, the functionality of the coupler would appear to be operating correctly; and given the intrusive nature of an examination to check the rear of the electrical head, it may not have been detected; however, the collision with the autocoupler should have led to a more thorough examination of all parts of the coupler, given the fact that there was direct impact with the coupler, and some damage to the external mechanism of the autocoupler evident from the completion of VMI Z1C29A0001.

Rolling Stock Safety

128 The CME's Safety Management Standards, CME-SMS-001 and CME-SMS-006 included both rolling stock/bogie/wheelset safety and Occupational Health and Safety requirements; making the documents difficult to read. However, the responsibilities and accountabilities of CME staff are clearly and comprehensive stated (paragraph 117) along with the management of Rolling Stock Safety and the Rolling Stock Risk Register (paragraph 118).

129 Although identifying a number of ways of identifying hazards and risks (paragraph 68); the risks associated with the coupler and the failure to do more thorough inspections after an accident, was the case in this investigation, were not identified (paragraph 119).

Train Fault Reporting

130 Reporting of the incident by the Driver and the Suburban Regulator CTC complied with the requirements of the IÉ Rule Book and Traffic Regulators' Manual, respectively (paragraphs 120 - 121).

131 The Traffic Regulators' Manual did not include the wrongside failures of safety critical equipment requiring withdrawal from service should be immediately reported to the RAIU (paragraph 121); although it is noted that the requirements were briefed to CTC.

132 An additional observation by the RAIU was that the phone calls between CME Maintenance Department (Drogheda) and the Driver were not recorded by the Suburban Regulator CTC as required by the Traffic Regulators' Manual (paragraph 123).

133 The Traffic Regulators' Manual contains section on how a Traffic Regulator deals with many incident procedures but does not contain a section on dealing with rail vehicle wrong sided faults.

Immediate cause, contributory factors, underlying causes & root causes

134 The immediate cause of the wrongside door failure was as a result of unwanted contact of the Door Interlock Loop crimp with the battery positive spade, resulting in the Door Interlock Loop circuit completing, when a door was opened by a passenger on the front set and the doors of the rear set remained closed (paragraph 115).

135 Contributory factors associated with the incident were:

- CF-01 – The detachment of Crimps 38 and 39 from their associated spades;
- CF-02 – The lack of insulation beyond the crimp spade head.

136 Underlying cause associated with the incident was:

- UC-01 – VMI Z1C29A0001 did not require a thorough examination of all parts of the autocoupler after the collision on the 6th June 2018, despite the examination identifying damage to the exterior of the autocoupler;
- UC-02 – Scheduled maintenance did not detect that Crimps 38 and 39 had detached from their associated spades.

137 A root causes associated with the incident was:

- RC-01 – CME-SMS-006, Hazards & Risk Assessments, was not robust in identifying the risks associated with lack of insulation on the crimp and the risks of not carrying out a thorough examination of all parts of the autocoupler after an accident.

Additional observations

138 The following additional observations have been made by the RAIU:

- AO-01 – The Traffic Regulators' Manual does not include a procedure for dealing with wrongside rolling stock failures;
- AO-02 – The Traffic Regulators' Manual does not list the immediate or monthly bulk occurrences to be notified to the RAIU;
- AO-03 – Voice communications between CME Maintenance Department (Drogheda) and the Driver were not recorded as required in the Traffic Regulators' Manual.

Relevant actions taken or in progress

139 As of the publication of this RAIU report, IÉ have notified the RAIU of the following completed actions:

- Crimps 38 and 39 have been re-connected to the relevant spades and a functionality test of the autocoupler was carried out successfully before Unit 15 re-entered service;
- IÉ-IM issued operational manual, CTC Operations Control Room Manual, IMO-SMS-052, on the 12th November 2018 which supersedes the Traffic Regulators' Manual. This new manual gives clear guidance on the procedures to be carried out for wrongside rolling stock failures and the correct list of occurrences that must be reported immediately to the RAIU;
- A new VMI, VMIOZ26J0002, Door Interlock Circuit Check, has been added to the A Exam, conducted every 48 hours;
- The 29000 DMU maintenance schedule has been updated to include a note on the use of enhanced insulation of crimps;
- Since March 2018 a full review and revision of safety standards relating to risk has been undertaken by IÉ-RU in conjunction with IÉ-IM colleagues to best align the standards across the company. This review included CME-SMS-006 taking on-board views and opinions from within CME, the findings of previous audits (CRR) and with advice from external experts. This revision and redraft has been the largest undertaken since it was first introduced in 2007. Fleet Risk and Occupational/Operational Risk are addressed in separate sections of the standard. Section 7 of the revised CME-SMS-006 outlines the Fleet Hazard Identification and Risk Assessment Process. Section 7.2 outlines the risk control measures and identifies the Reactive Fleet Risk Assessment (current fleet risk register) and the Proactive Fleet Risk Assessment to better align with Conformance Assessment Criteria. The revised CME-SMS-006 was published on 02/04/2019 after comments from IÉ-RU, CRR and external experts. The Proactive Fleet Risk Register process has commenced and is expected to complete for all fleets by December 2019.

Safety recommendations

General description

140 In accordance with the Railway Safety Act 2005 (Government of Ireland, 2005a) and 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.

Actions reported by IÉ

141 Actions reported that address factors which otherwise would have resulted in an RAIU safety recommendation:

- The issuing of CTC Operations Control Room Manual (IMO-SMS-052), superseding the Traffic Regulators' Manual gives clear guidance on the procedures to be carried out for wrongside rolling stock failures and the correct list of occurrences that must be reported immediately to the RAIU. This action addresses additional observations, AO-01 and AO-02;
- The update to 29000 DMU maintenance schedule requesting the use of enhanced insulation of crimps addresses CF-02;
- The extensive updating of CME-SMS-006, Hazards & Risk Assessments (paragraph 139), ensures that there is a comprehensive means of identifying the risks associated with rolling stock (RC-01).

Safety recommendations

142 VMI Z1C29A0001 did not require a thorough examination of the coupler after the collision on the 6th June 2018, despite the examination identifying damage to the exterior of the coupler; a more thorough examination would have identified the detached crimps (IC, CF-01, UC-01), as a result the RAIU make the following safety recommendation:

Recommendation 2019001-01

IÉ-RU CME should review VMI Z1C29A0001 'Examination of 29000 class vehicle after an incident / accident' to develop a more thorough and robust VMI that is commensurate with the safety risk of faults occurring after rolling stock has been involved in an incident or accident.

143 Associated with the above safety recommendation, the RAIU consider that a review of similar VMIs (associated with examinations of rolling stock after incidents/ accidents) for all fleets should be conducted to identify any deficiencies in these VMIs to ensure that rolling stock re-entering service is fit-for-purpose; as a result, the RAIU make the following safety recommendation:

Recommendation 2019001-02

IÉ-RU CME should review VMIs associated with the examination of rolling stock after an incident / accident, for all rolling stock fleets, to develop a more thorough and robust VMI that is commensurate with the safety risk of faults occurring after rolling stock has been involved in an incident or accident.

144 Scheduled maintenance (A Exams and a B6 Exam) did not and would not detect latent faults on autocouplers (IC, CF-01, UC-01); given there is a concern in relation to all fleets, the RAIU make the following safety recommendation:

Recommendation 2019001-03

IÉ-RU CME should review their scheduled maintenance examinations, for multiple-unit fleets, with a view to developing a means to check the connection is correct on the electrical head.

145 Voice communications between CME Maintenance Department (Drogheda) and the Driver were not recorded as required by the Traffic Regulators' Manual (AO-03); as such the RAIU make the following safety recommendation:

Recommendation 2019001-04

IÉ-IM should re-brief Traffic Regulators on the importance of adhering to the Traffic Regulators' Manual in relation to the recording of all telephone conversations within the controlled environment.

Additional information

List of abbreviations

AO	Additional Observations
CAF	Construcciones y Auxiliar de Ferrocarriles
CCTV	Closed Circuit Television
CF	Contributory Factors
CME	Chief Mechanical Engineers
CRR	Commission for Railway Regulation
CTC	Centralised Traffic Control
CWR	Continuously Welded Rail
DART	Dublin Area Rapid Transport
dc	Direct Current
DMU	Diesel Multiple Unit
DTTAS	Department of Transport, Tourism and Sport
EMU	Electrical Multiple Unit
FTS	Fleet Technical Support
IÉ	Iarnród Éireann
IM	Infrastructure Manager
m	Metre
NIR	Northern Ireland Railways
No.	Number
OTDR	On Train Data Recorder
RAIU	Railway Accident Investigation Unit
RC	Root Cause
RU	Railway Undertaking
SMS	Safety Management System
SI Units	International System of Units
UC	Underlying Causes
USB	Universal Serial Bus
V	Volts
VMI	Vehicle Maintenance Instruction

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.
Automatic coupler (autocoupler)	A device which simultaneously connects together two Rail Vehicles with a minimum of operator input, mechanically, electrically and pneumatically.
Colour Light Signal	Signals which convey movement authorities to drivers by means of coloured lights.
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).
Compliance Verification	Defined by IÉ as a process of safety verification checks whereby the Senior FTS identifies rolling stock hazards in order to reduce the Rolling Stock Safety Risk on the fleet.
Continuously Welded Rail	Rails are welded together to form one continuous rail that may be several kilometres long.
Contributory Factor	Factors relating to actions taken by persons involved or the condition of rolling stock or technical installations.
Crimp	The female part of an electrical connector that allows for easy attachment and removal of connections.
Door Enable	By pressing the Door Enable buttons on the Drivers console control of the doors is passed from the Driver to the Passenger, allowing passengers to open or close a door.
Door Interlock Light	A light on the Driver's console the advised the Driver that the passenger doors on the train are closed and locked.
Door Interlock Loop	An electrical circuit that travels through the train, verifying the status of the passenger doors on the train i.e. whether they are open or closed and locked.
Door Lock Off	A Door Locked Off is no longer accessible by passengers as the door is mechanically locked and electrically isolated.
Double Track	A route with two tracks.
Extensive damage	Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
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	Organisation that is responsible for the establishment and maintenance of railway infrastructure, including the management of infrastructure control and safety systems.
Interlock	An interlock is a feature that makes the state of two system or functions mutually dependent. It may be used to prevent undesired states
Nexala	Nexala is an automated communications process by which train system data are collected from the train and transmitted to receiving equipment for monitoring and analysing.
Off-side	The non-driver's side of the train.
On Train Data Recorder	An On Train Data Recorder logs safety critical data from the train for monitoring often referred to as the Black Box.
Railway Undertaking	Organisation that operates trains.
Root cause	Causes related to framework conditions and application of the SMS.
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.
Spade	The male part of an electrical connector that allows for easy attachment and removal of connections.
Standard	A document that mandates technical, operational or managerial requirements.
Traffic Regulator	Traffic Regulators proactively monitor real-time train operations against the daily train plan intervening and directing as required to minimise the effect of disruption and return services to right time running.
Underlying cause	Causes related to skills, procedures and maintenance.
Vehicle Maintenance Instructions	A set of detailed steps that must be carried out as part of a planned maintenance schedule of a rail vehicle.
Wrongside Failure	A failure condition in a piece of railway equipment that results in an unsafe state.

References

Iarnród Éireann (2018), 29000 A Exam 11/08/2018.

Iarnród Éireann (2018), 29000 B6 Exam 20/07/2018.

Iarnród Éireann (2017), CME Safety Management System, CME-SMS-001, Issue 9.

Iarnród Éireann (2018), CTC Operations Control Room Manual, IMO-SMS-052.

Iarnród Éireann (2011), General Appendix.

Iarnród Éireann (2017), Hazards & Risk Assessments, CME-SMS-006, Issue 9.

Iarnród Éireann (2011), IÉ Rule Book, Section B, Part 1.

Iarnród Éireann (2017), Investigation Report Wrongside door failure (29114) at Drogheda 26th and 27th April 2017.

Iarnród Éireann (2016), VMI UC029J5658 – Autocoupler: Functionality Check, Issue 2.

Iarnród Éireann (2016), VMI UC029J5662 – Automatic Coupler: Examine, Gauge and Test, Issue 2.

Iarnród Éireann (2012), VMI Z1C29A0001 – Examination of 29000 class vehicle after an incident / accident.

RAIU (2014), Investigation Report DART Wrongside Door Failure, Salthill and Monkstown Station 10th August 2013.