Railway Accident Investigation Unit

Ireland

INVESTIGATION REPORT

Collision of an ICR with a buffer stop at Laois Train Care Depot, 17th July 2018

RAIU Report No: 2019-R002

Issued: 25th June 2019

Report publication

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The original publication details are given below:

Title	Collision of an InterCity Railcar with a buffer stop at Laois Train Care Depot on the 17th July 2018
Document type	Investigation Report.
Document number	2019-R002
Document issue date	26th 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 (Iarnród Éireann (IÉ)), 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 17th July 2018 an Iarnród Éireann (IÉ) InterCity Railcar (ICR) set 16 (ICR 16) was required to be shunted from Road 6B to Road 8 in Laois Train Care Depot (LTCD) to allow maintenance repairs to be carried out on the set following a collision with cattle at Tullamore on 28th June 2018.

The Chief Mechanical Engineer (CME) Driver and *Limited Shunter* checked the "Handover Notes" and the "Set Stopped – Reason" on the "Daily Production Board" in the *Duty Manager's* office in LTCD; there were no restrictions found against ICR 16.

The Limited Shunter approached ICR 16 and removed the *"Not To Be Moved" Board* as there was no *identification tag* fitted. Initially the Limited Shunter made arrangement for ICR 16 to be *hauled* into the depot but when the air pressure built up sufficiently the Limited Shunter informed the CME Driver who agreed to drive the unit into the depot.

The CME Driver checked the *Man Machine Interface* (MMI) screen and could see the brakes were isolated on both *B-cars* (intermediate cars); there was no indication of brake *isolation* on the two remaining *A-cars* (cars with driving cabs), and the CME Driver assumed it was safe to drive the train.

The CME Driver carried out a Static Brake Test and a Brake Functionality Test utilising the cab brake gauges, while the Limited Shunter carried out an external inspection of the train set. The Limited Shunter found a wheel *chock* stuck under a wheel and asked the CME Driver to move ICR 16 to allow the chock to be removed. The CME Driver moved ICR 16 and applied the brake, bringing ICR 16 to a stop.

The Limited Shunter entered the cab and advised the CME Driver that he would have to pull Points Number 6 (Points 6) in the yard, enroute to Road 15. The CME Driver applied power to ICR 16 and on approach to Points 6 he applied the brake and could feel no retardation i.e. ICR 16 did not slow down.

Both the CME Driver and the Limited Shunter made a number of attempts to slow down ICR 16 without success and ICR 16 struck the *buffer stop* on Road 14 at approximately 14 kilometres per hour (km/h). The CME Driver reported the accident immediately and the relevant parties were informed.

The immediate cause of ICR 16 colliding with the buffer stop at LTCD was as a result of ICR 16 been driven with no operational brake on the train.

Contributory factors (CF) associated with the accident are:

- Circuit breaker General Warning Circuit Breaker (GWCB) was in the tripped position on both A-cars resulting in no notification of the brake isolation being shown on the cab MMI;
- The brakes on all four cars of ICR 16 were isolated (leaving ICR 16 unbraked) with no adequate process in place to communication this to staff at LTCD;
- The ICR Hauling Assisting Instructions were not complied with for the previous movement of the vehicle resulting in ICR 16 being stabled with the brakes isolated;

- The ICR cab brake cylinder gauge is upstream of the brake isolating cocks allowing for a positive brake cylinder reading even when the brakes are isolated;
- It is possible to achieve all the correct readings when the Brake Functionality Test and Static Brake Test are completed and still have no brake on an ICR train set.

The underlying cause (UC) associated with this accident:

- The formal and informal processes in place for: the use of Not To Be Moved Boards; the labelling of defective vehicles; and the communication of train statuses, was not sufficient in notifying the staff at LTCD of the issues with ICR 16;
- The suite of LTCD documentation does not refer to the ICR Hauling Assisting Instructions which would have ensured that ICR 16 was sufficiently braked while stabled.

As a result of the accident, the RAIU made four safety recommendations:

- IÉ-Railway Undertaking (RU) CME should review their Portlaoise Train Depot Safe System of Work & Operating Instructions (SSOW & OI) and associated documents related to the identification, communication and prevention of movement of defective vehicles to ensure relevant staff are made aware of identified defects and that the defective vehicles are adequately labelled and tagged; and these processes and staff responsibilities are fully understood by all CME staff working on trains.
- IÉ-RU CME should review the suite of LTCD documents that relate to the management of moving trains within LTCD to ensure they are consistent and adequately reference any existing supporting documentation (e.g. ICR Hauling Assisting Instructions);
- IÉ-RU CME should review its training and competency of CME Drivers and Limited Shunters ensuring the stabling and movement of vehicles (defective or otherwise) are adequately addressed;
- IÉ-RU CME should expand the requirements of preparation instructions for rail vehicles to ensure that on completion of these tests the brake status of a train can be fully established; this should include checking the status of circuit breakers and brake isolations.

In addition, the RAIU made three safety recommendations based on additional observations (AOs).

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The Accident

Summary of the accident

1 On the 17th July 2018 ICR 16 was required to be shunted from Road 6B to Road 8 in LTCD to allow maintenance repairs to be carried. The LTCD Duty Manager appointed the Limited Shunter and the CME Driver (to act as the driver of ICR 16) to carry out these movements.

2 The Limited Shunter and the CME Driver checked the Day and Night Production Boards in the Duty Managers Office; noting that there were no restrictions against ICR 16. With this information, the Limited Shunter went out to ICR 16 and removed the "Not to be Moved" Board (Figure 1), which had remained on ICR 16 since it was last worked on, as there were no personal identification tags attached (Figure 2). It should be noted there was no restriction on the Limited Shunter from removing the board.

Figure 1 – "Not to be moved board"

Figure 2 – Identification tags

3 The Limited Shunter started up the engines on ICR 16 and only one (of four) engines started, it was therefore arranged for ICR 16 to be hauled into LTCD maintenance shed. However, after completing a number of other tasks the Limited Shunter returned to ICR 16 and realised that the brake pressure had built-up sufficiently to allow ICR 16 to be driven under its own power into the LTCD Maintenance Shed.

4 The CME Driver arrived onto ICR 16 and the Limited Shunter advised him that air pressure had built-up. The CME Driver viewed the MMI screen in the cab and could see that the brakes on both B-cars were isolated; there was no indication of brake isolation on the two remaining A-cars. The CME Driver assumed that the brakes were operational on the A-cars, as the cab brake cylinder pressure gauge in the cab had a positive reading and there would be sufficient brake to stop the train as the shunt was a low speed movement. The CME Driver advised the Limited Shunter that he would drive ICR 16.

5 The Limited Shunter carried out a physical check of the outside of ICR 16 and as he walked around the set noticed a wheel chock under a wheel that was stuck. The Limited Shunter requested the CME Driver to move ICR 16 to allow for the removal of the wheel chock. The CME Driver moved ICR 16, the Limited Shunter removed the wheel chock and the CME Driver applied the brake and ICR 16 came to a stop due to the slow movement of the train.

6 The Limited Shunter entered the cab and advised the CME Driver that he would have to pull Points 6 in the yard, enroute to Road 15 (which entailed two shunting movements, shunt from Road 6B to Road 15 and Road 15 to Road 8). The CME Driver applied power to ICR 16 and began travelling towards Road 15. Enroute, the Limited Shunter alighted from the cab to pull Points 6. The CME Driver applied the brakes and realised that there he could feel no retardation i.e. ICR 16 did not slow down.

7 The CME Driver and Limited Shunter made a number of attempts to stop ICR 16, but all attempts failed and ICR 16 struck the buffer stop on Road 14 at approximately 14 km/h.

8 The CME Driver reported the accident to the Duty Manager and all relevant parties were informed.

Parties directly involved in the incidents

Iarnród Éireann

9 IÉ is the *railway undertaking* (RU) who owns and operates mainline and suburban railway services in Ireland and operates under a *safety certificate* issued by the Commission for Railway Regulation (CRR). The RU Safety Certificate is issued in conformity with European Directive 2004/49/EC and S.I. 249 of 2015; the Safety Certificate was renewed on 23rd March 2018 for a period of five years.

10 IÉ is also the *infrastructure manager* (IM), who owns and operates the railway infrastructure in Ireland and operates under a safety certificate issued by the CRR. The IM Safety Authorisation is issued in conformity with European Directive 2004/49/EC, the Safety Authorisation was renewed on 23rd March 2018 for a period of four years.

Roles involved in the accident

11 The RU IÉ staff directly involved in the accident were the:

- CME Day Duty Managers (DDM1, DDM2, DDM3) – Responsible for planning and allocating work to staff under his/her control; organising access arrangements for all site contractors and monitoring train operations within the LTCD during the day;
- CME Night Duty Manager (NDM) – Responsible for planning and allocating work to staff under his/her control; organising access arrangements for all site contractors and monitoring train operations within the LTCD during the night;
- CME Driver – CME staff member qualified and authorised to move a traction unit within the confined areas of a CME maintenance depot. His competency record shows he was last assessed on 24th April 2017 and deemed competent until 24th April 2019. He was also the Team Leader on the day;
- Limited Shunter – CME staff member qualified to co-ordinate the safe movement of trains within a maintenance depot; this includes setting routes, checking points and operating the depot protection system. His competency records show he was last assessed on the 10th January 2018 and deemed competent until 10th January 2020;
- CME Driver 2 – Travelling in the rear of ICR 16 on the day of the accident; CME Driver 2 was present to allow for a quick turn-around when they got to Road 15. His competency records show he was assessed and passed competent on the 17th October 2017 and last monitored on the 8th March 2018.

Roles not directly involved in the accident

12 The IÉ RU roles not directly involved in this accident, but responsible in some aspects of the CME Drivers and Limited Shunters role are as follows as set out by SMS documentation:

- Depot Safety Officer – Responsible for preparation, drafting and briefing safety notices and standards;
- CME Driver and Limited Shunter Trainer – Responsible for drafting and delivering training for CME Persons Authorised to Move and Shunt Traction Units / Vehicles.
- Competency Assessor – Responsible for carrying out the requirements of CME-SMS-011 Training and Competence Assessment of Persons Authorised to Move or Shunt Traction Units.

General description of the railway

Infrastructure

13 LTCD is located in Clonminam Business Park, Portlaoise, County Laois (see Figure 3). It has been operational since July 2008 and is part of the CME Department.

14 The depot is adjacent to the Dublin to Cork mainline near the 52-mile post (mile posts are measured from Heuston Station, Dublin) and approximately one mile south of Portlaoise Station. The depot is connected to the mainline by a loop (the 'Down Loop') which is joined to the Down line.

15 LTCD is the primary servicing, maintenance and storage facility for the 22000 ICR fleet.

Figure 3 – Location of LTCD, Portlaoise, Co. Laois

16 The LTCD consists of servicing slabs, a train wash, wheel lathe and a maintenance workshop. Rail lines and sidings facilitate the movement of trains throughout LTCD and are often used of storage of trains, see Figure 4.

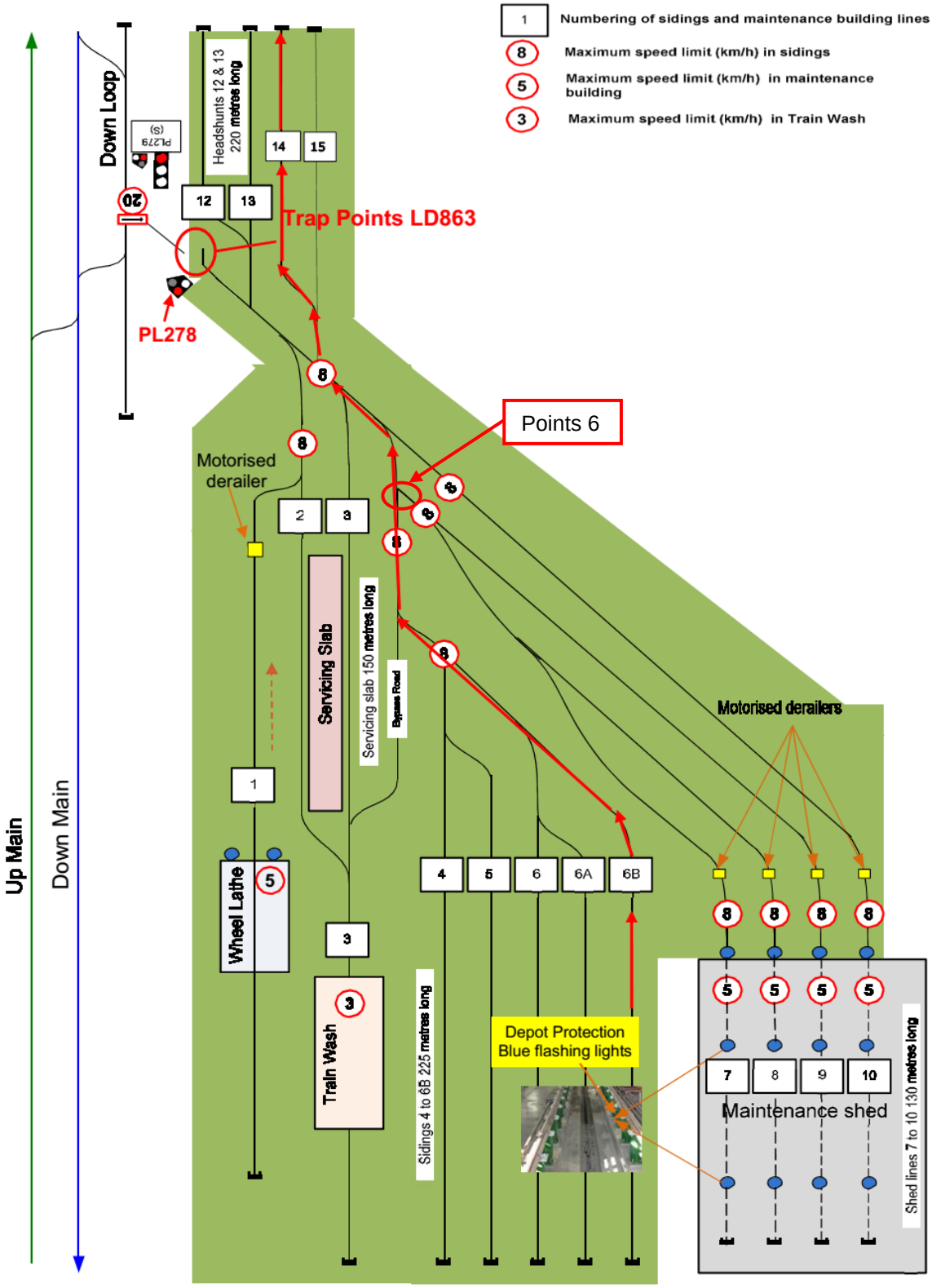

Figure 4 – Simplified illustration of LTCD (not to scale). The route from Road 6B to Road 14 is shown in red.

Rolling stock

17 The train involved in the accident was an empty 22000 class ICR (Set 16) consisting of four cars, 22216, 22816, 22416 and 22316; car 22316 was leading at the time of the accident (see Figure 5). ICR cars with a driving cab are known as A-cars and the intermediate cars are known as B-cars.

22216	22816	22416	22316
A-Car	B-Car	B-Car	A-Car

Figure 5 – Illustration of ICR, displaying the configuration on the day of the accident

18 A four car ICR unit is 95 meters long and has a mass of 189 tonnes. A train of this type has a maximum permitted speed of 100 miles per hour (mph) (160 kilometres per hour (km/h)).

19 ICR 16 was involved in a collision with cattle at Tullamore on 28th June 2018 and sustained a large amount of damage. *SAP System* records show that CME maintenance staff worked on ICR 16 five times on four different dates after the collision at Tullamore up to the day of the accident. On these dates, ICR 16 often required shunting into and out of LTCD Maintenance Shed to carry out the work.

Operations

20 Trains are scheduled into LTCD as per the working timetable, weekly circular or running notices, as required.

21 Train movements within LTCD (up to Signal PL279) are managed by CME staff, these are certified as 'Limited Shunter' and 'CME Driver'. Train movements outside LTCD are managed by IÉ-RU operation staff.

22 The maximum speed in LTCD is 5 mph (8 km/h).

Fatalities, injuries and material damage

Fatalities and injuries

23 There were no fatalities, major or minor injuries as a result of this accident.

Material damage

24 There was damage to the headlights of ICR 16 and the buffer stop retarder blocks at Road 14 had to be repositioned and retorqued as a result of this accident.

External circumstances

25 The weather data taken from the nearest Met Éireann weather station (Oak Park, Carlow (20 km South / East of Portlaoise)) around the time of the accident recorded that there was no rain, a maximum temperature of 21.3˚C, a minimum temperature of 12˚ C and mean wind speed of 5.8 knots.

26 The weather or any other external factors were not thought to be contributory to the accident.

RAIU Investigation

RAIU decision to investigate

27 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.

28 Give that under slightly different circumstances, this accident may have led to a serious accident with potential for fatalities and serious injuries; the RAIU made the decision to conduct a full investigation.

Scope of investigation

29 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 accident;
- Establish, where applicable, the immediate cause, contributory factors, underlying factors and *root causes*;
- Examine the relevant elements of the SMS;
- Examine the competency management system in place for CME Drivers and Limited Shunters;
- Examine the Standards and Safe Systems of Work (SSOW) relevant to driving and limited shunting roles in LTCD;
- Review the 'Portlaoise Traincare Depot[1] Safe System of Work and Operating Instructions';
- Review the IÉ Rule Book[2];
- Review the training documents for the CME Driver and CME Limited Shunter;
- Examine the CME-SMS-011 Training and Competency Assessment of Persons Authorised to Move or Shunt Traction Units (22nd December 2016);
- Examine the actions of the CME Limited Shunter and CME Driver on the day;
- Review the brake schematics and the functionality of the brake cylinder gauge in the cab of an ICR vehicle (Rotem MAP01151);
- Review the on-train data recorder (OTDR) and close circuit television (CCTV) data.

[1] LTCD is sometimes known as Portlaoise Traincare Depot

[2] IÉ/Northern Ireland Railways (NIR) Rule Book but will be referred as the IÉ Rule Book.

Investigation & evidence

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

- Formal interview and witness testimonies from the relevant IÉ personnel;
- OTDR download and analysis (7th August 2018);
- CCTV footage of the accident;
- CME-SMS-0011 Training and Competency Assessment of Persons Authorised to Move or Shunt Traction Units (22nd December 2016);
- Competency and monitoring records of the CME Driver and Limited Shunter.
- Portlaoise Traincare Depot Safe System of Work and Operating Instruction;
- Use of Not To Be Moved Boards On Stationary Vehicles Safe System of Work and Work Instruction LTCD (15th January 2014);
- Professional Handbook CME Persons Authorised to Move and Shunt Traction Units / Vehicles (March 2012);
- CME Training Course for CME Driver and Limited Shunter;
- Rotem Diagram of Brake System MAP01151;
- IÉ report of investigation into the collision of DMU 2713 with the buffer stop on platform 4 Limerick Station 26th February 2012 (23rd August 2012);
- CME investigation report of 'Over-inflation of the trailer bogie secondary suspension at Connolly Depot 7th May 2010' (published the 2nd June 2010);
- IÉ Rule Book (2007).

Evidence

22000 ICR braking system & isolation mechanism

ICR braking system

31 The 22000 ICR fleet are fitted with a Knorr-Bremse dual braking system which comprises of a direct electro-pneumatic (EP) and an indirect pneumatic brake system. The brakes on the 22000 ICR fleet are controlled by a Brake Electronic Control Unit / Electro Pneumatic Compact (BECU / EP) module. The main functions offered by the system are:

- Service brake;
- Emergency brake;
- Brake pressure limitation based on train load;
- Pre-defined pilot pressure for relays valve in case of failure of load pressure input.

32 In an air brake system, compressed air is produced by a compressor and stored in a reservoir. The air travels to the brake cylinders situated at the brake discs. The pressure applied to the discs is determined by either a train line brake pipe or an electrical signal from the train.

33 In the event of a brake component failure on a particular car or bogie it is possible to isolate the brake containing the failed component. The isolation allows the train to complete its *link* as the remaining brakes are still functional. A train set with isolated brakes may be required to operate at a predetermined reduced speed depending on the number of isolations.

ICR brake isolation mechanism

34 Each individual car in an ICR set has a brake isolating box mounted on the underframe, which allows for the isolation of brakes, on a single or both bogies, on that particular car.

35 Isolation of the brakes on the ICR fleet is achieved by turning the *brake cylinder* (BC) *isolating cocks* BC Left and BC Right mounted on the underframe of the vehicle to the horizontal position (see Figure 6 for one isolation box). When the brakes are isolated on a vehicle a notification of the isolation is displayed on the MMI screen in the cab with the message “Brake isolated front bogie / Brake isolated rear bogie” (see Figure 7).

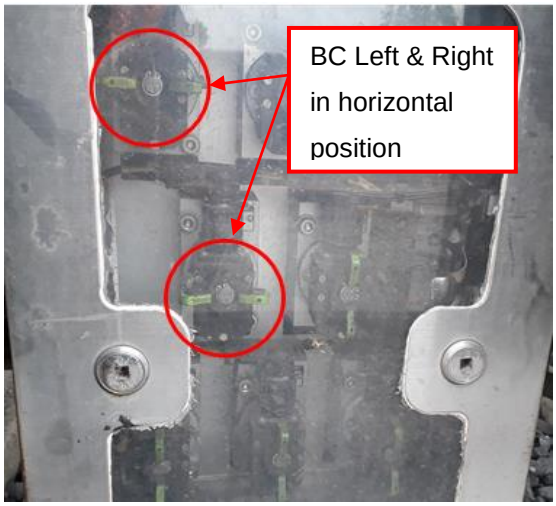

Figure 6 – BC Left & BC Right in the horizontal isolated position

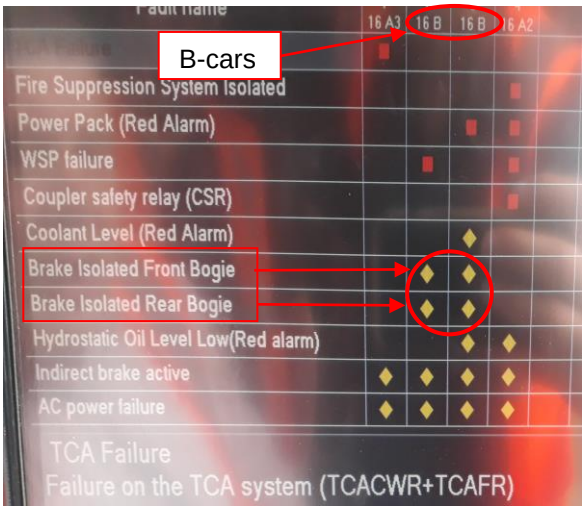

Figure 7 – MMI showing brake isolated front & rear bogies for both B-cars

36 The *cab brake cylinder gauge* (which under normal circumstances displays the amount of air pressure available in the brake cylinder on a gauge in the cab). The ICR cab brake cylinder gauge indicates brake cylinder pressure, the signal is taken from a position upstream of the brake cylinder isolating cocks allowing for a positive brake cylinder pressure reading in the cab even when the brake cylinders are isolated, see Figure 8 (the figure is for illustrative purposes only, and illustrates the position of the brake cylinder gauge in relation to the brake isolation cock) i.e. the cab brake cylinder gauge can show a positive pressure reading even when all the brakes have been isolated.

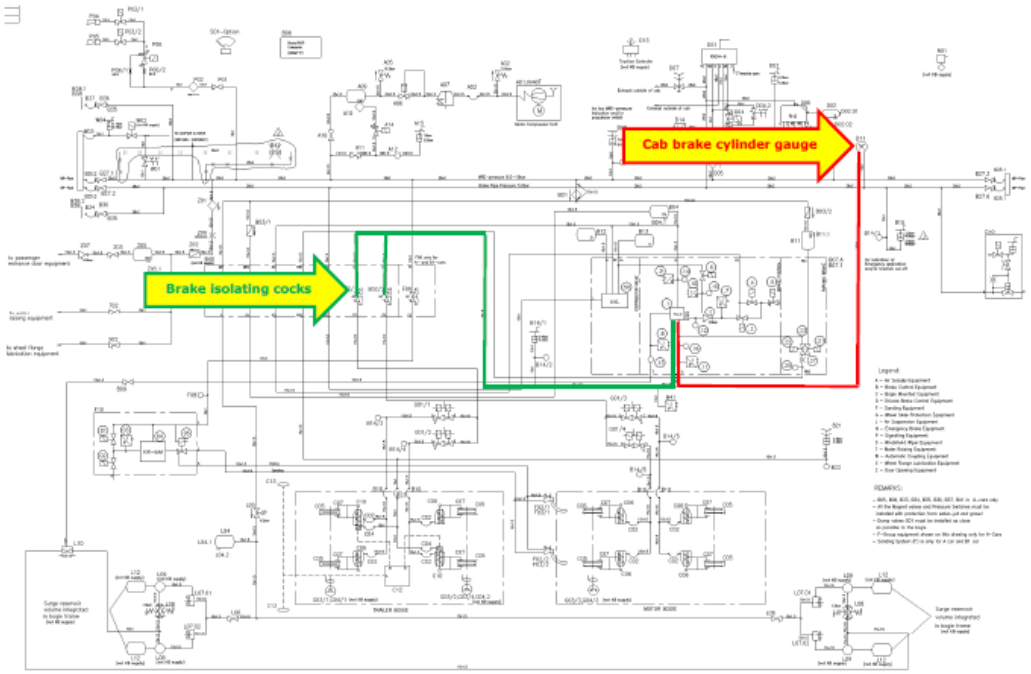

Figure 8 – ICR 22000 Brake system diagram illustrating "Brake isolation cocks (Green Line)" and the "Cab brake cylinder gauge (Red Line)"

37 The ICR braking system is different to other IÉ fleets. On the ICR fleet, isolation of the brake cylinder cock does not isolate both the cab gauge and the brake cylinder, it only isolates the brake cylinder; this was to allow for the brake pressure to be visible in the active cab when the brakes were isolated on the same unit.

38 The RAIU became aware of the presence of cab brake cylinder reading on the ICR fleet even when all the brakes are isolated; the RAIU issued an Urgent Safety Advice Notice on the 17th August 2018 recommending that "IÉ should advise all relevant staff that a positive brake cylinder gauge reading in the cab of an ICR is not an indication that a brake is present".

Post-accident examination of ICR 16

39 ICR 16 was physically examined after the accident, and the following was found:

- All four brake isolating boxes of ICR 16 were found to have the brake isolating cocks BC Left and BC Right in the horizontal isolated position (Figure 6 shows one isolation box, there are a total of four) resulting in no brake being present on the entire set;
- The cab brake cylinder gauge was found to have a positive brake cylinder reading;
- The MMI screen showed the message "Brake isolated front bogie" / "Brake isolated rear bogie" for both B-cars (illustrated previously in Figure 7);
- The cab circuit breaker panel (which allows for the isolation of electrical circuits) on the two A-cars had General Warning Circuit Breaker (GWCB) was in the tripped position (see Figure 9); the RAIU cannot ascertain why this was the case. The tripping of cab circuit breaker GWCB results in no feed to the BC Right and BC Left on the MMI i.e. the isolation of the brakes on the A-car would not be displayed on the cab MMI.

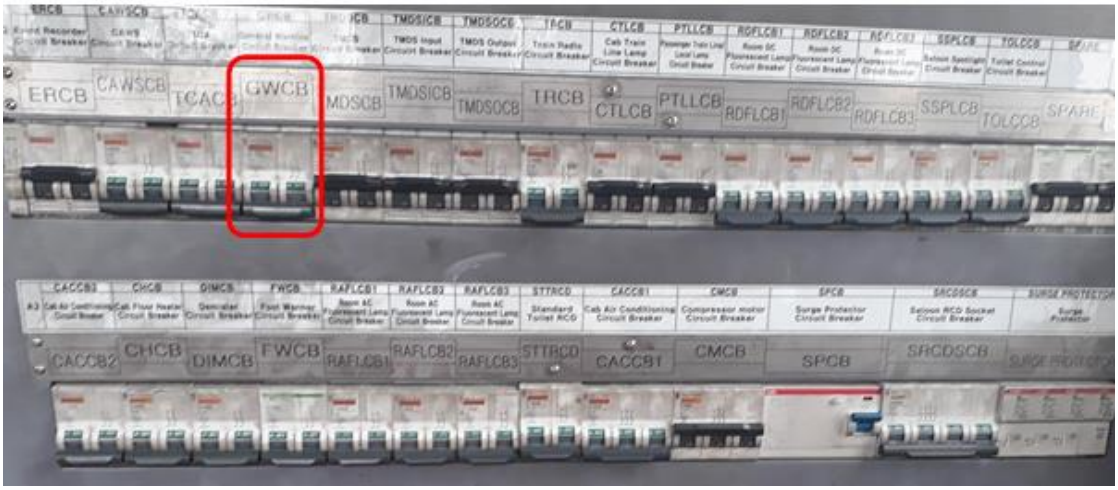

Figure 9 – Tripped GWCB on the cab circuit breaker panel

40 The wheel diameter inputted to the OTDR was found to be 821 millimetres (mm) whereas the actual wheel diameter of the set was 809 mm (where wheel diameters are different, this would give an incorrect speed reading on the OTDR); however, this was as a result of the unit not receiving its post-lathe examination which would include the inputting of the correct wheel diameter.

Identification of defective passenger rail vehicles

General description

41 When a rail vehicle is defective, it must be labelled as such. At high-level this is managed through the IÉ Rule Book, Mechanical Engineering Standard for Management of Fleet Safety Risk and Railway Safety Standards. Locally, in LTCD, this is managed as set out below (paragraphs 43 - 48).

42 From the evidence provided by IÉ, to the RAIU, the practice of labelling defective passenger rail vehicles set out in the IÉ Rule Book has been superseded to the inputting of defects into the SAP system to generate work orders and the use of wipe boards in the Duty Managers Office of LTCD. The process change does not appear to have been assessed for the introduction of risks. As a result, ICR 16 was not labelled.

Recording of defective rail vehicles – Locally at LTCD

43 Defective rail vehicles components and systems at LTCD are recorded on the "Day Production Board" (see Figure 10) and the "Night Production Board" (see Figure 11), located in the LTCD Duty Manager's office. This board contains information on:

- Shed and yard position;
- Sets O/H (overhaul) – Exam Status;
- Sets stopped – Reason;
- Resource planning;
- In service defects;
- Arrivals;
- Departures;
- Handover notes.

44 The requirement to update the "Handover Notes" section of the Day and Night Production Board in not covered in any of the local documentation for LTCD.

45 A photograph taken by the RAIU on the 17th July 2018, show that in relation to ICR 16, the Day Production Board states: "Sets Stopped – Reason: Impact damage/ Parts/ Exam" and "Handover Notes: Moves – 16 to Rd". The Night Production Board states "Sets Stopped – Reason: Impact damage/ Parts/ Exam".

46 There is no record of any isolation of other degraded braking systems recorded on either of the production boards in the Handover Note section (see red boxes in Figure 10 and Figure 11).

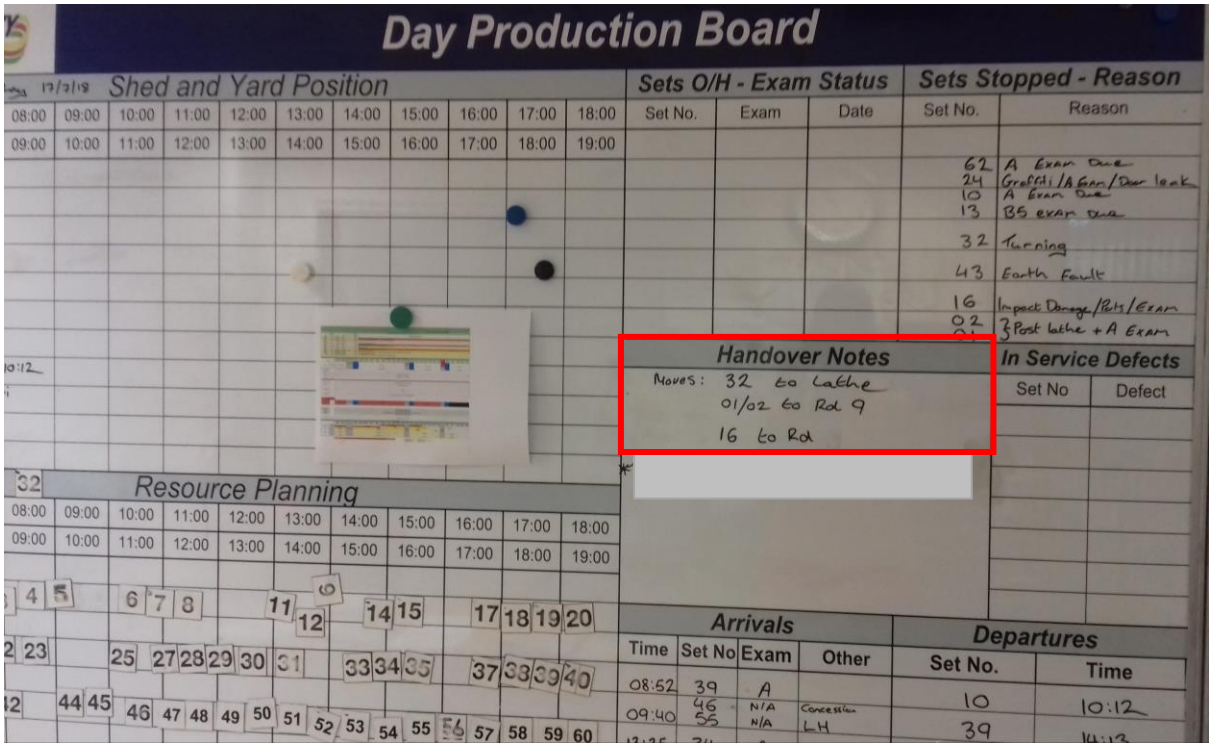

Figure 10 – Day Production Board (photograph taken on the 17th July 2018)

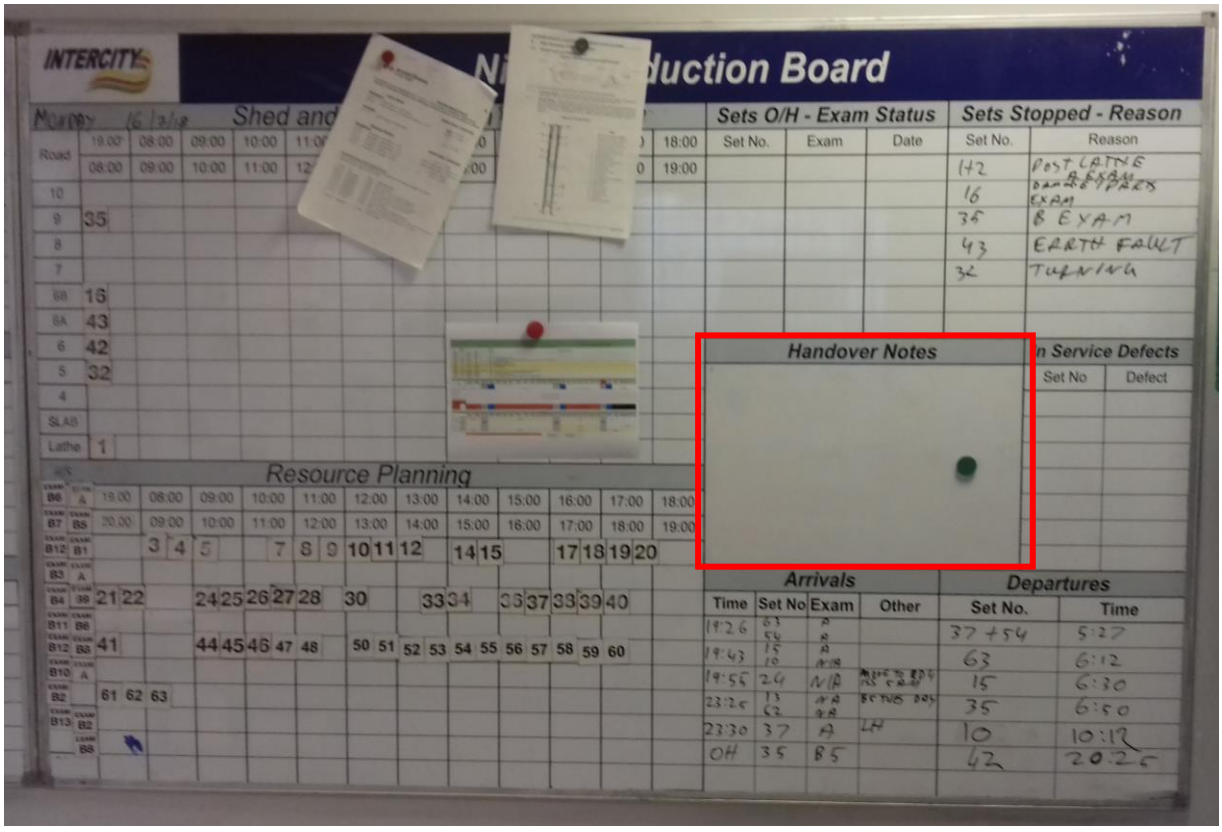

Figure 11 – Night Production Board (photograph taken on the 17th July 2018)

Generation of work orders for defective vehicles

47 A CME technical report into a defective rail vehicle at Connolly depot in May 2010, titled "Over-inflation of the trailer bogie secondary suspension at Connolly depot on 7th May 2010" made the following recommendation: "The SAP system must be used to create work orders for all maintenance tasks; all open work orders on any vehicle should be reviewed and accessed as to the effect on the safety of the vehicle before the unit is returned to service". The relevance of the recommendation was to ensure that a full list of work to be carried out a unit is documented and tested before entering service.

48 The list of work orders for ICR 16, as required by the above recommendation, is demonstrated in Figure 12. It is noted from the list of works that a scheduled examination was conducted on the 23rd June (five days before the accident with the cattle); and all previous maintenance back to the 12th September 2014 is outlined in the list of works (Figure 12).

Change PM Orders: List of Orders

Order Operations

S	Func. Loc.	Order	Description	System status	Bas. start date	MAT	Type	RefDate
	22316	40371501	REP Fuel Tank	REL PRT NMAT PRC SETC	12.09.2014	L	IE01	12.09.2014
	22216	60292548	Levelling valve change out 22000 HM	CRTD CSER MANC PRC	31.08.2015	A0G	IE12	31.08.2015
	22316	60292546	Levelling valve change out 22000 HM	REL PRT CSER MSPT PRC SETC	31.08.2015	A0G	IE12	31.08.2015
	22416	60292547	Levelling valve change out 22000 HM	CRTD CSER MANC PRC	31.08.2015	A0G	IE12	31.08.2015
	22816	60292726	Levelling valve change out 22000 HM	CRTD CSER MANC PRC	31.08.2015	A0G	IE12	31.08.2015
	22216	60319705	Exhaust mounting modification HM 22000	CRTD MANC NMAT PRC	01.09.2016	A0G	IE12	01.09.2016
	22316	60319706	Exhaust mounting modification HM 22000	CRTD MANC NMAT PRC	01.09.2016	A0G	IE12	01.09.2016
	22416	60319707	Exhaust mounting modification HM 22000	CRTD MANC NMAT PRC	01.09.2016	A0G	IE12	01.09.2016
	22816	60319456	Air bag thermal shield mod HM 22000	REL GMPS NMAT PRC SETC	01.09.2016	A0G	IE12	01.09.2016
	22816	60319708	Exhaust mounting modification HM 22000	CRTD MANC NMAT PRC	01.09.2016	A0G	IE12	01.09.2016
	22216	60327633	Drive shaft change HM 22000	REL PCNF PRT GMPS MANC MSPT PRC SETC	06.12.2016	A0G	IE12	06.12.2016
	22216	60327632	Wheel Change HM 22000	REL PCNF GMPS MANC PPRT PRC SETC	06.12.2016	A0G	IE12	06.12.2016
	22416	40457723	door a secondry latch lock broken	REL PRT NMAT PRC SETC	18.02.2017	A12	IE01	18.02.2017
	22216	40474416	Side skirt at EP compact missing	REL PRT GMPS NMAT PRC SETC	13.08.2017	A10	IE01	13.08.2017
	22416	40437320	Call: Intermittent fire suppression faul	REL PRT GMPS MANC NMAT PRC SETC	16.08.2017	A11	IE01	16.08.2017
	22816	40485934	Fuel tank inlet valve handle missing	REL PRT NMAT PRC SETC	28.12.2017	L	IE01	28.12.2017
	22016	40489708	HVAC smoke heads faulty 316 / 416 / 816	REL PRT GMPS NMAT PRC SETC	14.02.2018	A11	IE01	14.02.2018
	22016	40493568	caliper hanger check results	REL PRT GMPS NMAT PRC SETC	28.03.2018	A40	IE01	28.03.2018
	22316	40494015	CALL: Report of CAWS downgrade at 1 1/2	REL PRT NMAT PRC SETC	04.04.2018	A03	IE01	04.04.2018
	22816	60373623	Drive shaft change HM 2200	REL PCNF PRT GMPS MSPT PRC SETC	30.04.2018	A0G	IE12	30.04.2018
	22016	40499090	calipers not sitting central	CRTD MANC NMAT PRC	22.05.2018	A33	IE01	22.05.2018
	22016	40499091	all axels have paint damage	REL PRT NMAT PRC SETC	22.05.2018	A33	IE01	22.05.2018
	22016	40499089	22016 anti roll bars worn on all cars	CRTD MANC NMAT PRC	22.05.2018	A30	IE01	22.05.2018
	22416	40499094	lock brokne on cock box lid	REL PRT NMAT PRC SETC	22.05.2018	A20	IE01	22.05.2018
	22816	40499093	wheel 7 multiple small flats	REL PRT NMAT PRC SETC	22.05.2018	A33	IE01	22.05.2018
	22216	60376142	22216 Wheels - Re-profiling	REL PRT NMAT PRC SETC	14.06.2018	E9W	IE02	14.06.2018
	22016	60377895	22016 B6 Exam (KM Based)	CRTD MANC NMAT PRC	23.06.2018	E9B	IE02	23.06.2018
	22016	40502171	set 16 hit 8 cows and has suffered serio	REL PCNF PRT NMAT PRC SETC	28.06.2018	D10	IE01	28.06.2018
	22016	60378861	22016- Fuel Point Exam	CRTD MANC NMAT PRC	30.06.2018	E9F	IE02	30.06.2018
	22016	60378696	22016- A Exam	CRTD MANC NMAT PRC	30.06.2018	E9A	IE02	30.06.2018
	22216	40502376	Impact Damage ICR vs Cattle on line	REL GMPS NMAT PRC SETC	03.07.2018	DER	IE05	03.07.2018
	22016	40502419	Parts robbed :	REL PRT NMAT PRC SETC	04.07.2018	A12	IE01	04.07.2018
	22416	40503015	G/eng sump quick drain missing	REL CNF GMPS NMAT PRC SETC	10.07.2018	Y	IE01	10.07.2018
	22016	60376884	22016 - AS022J0071 Sanding System Check	CRTD MANC NMAT PRC	20.07.2018	E9S	IE02	20.07.2018
	22216	60379163	HA022J0004 Cab HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22216	60379289	HA022J0004 Saloon HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22316	60379226	HA022J0004 Cab HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22316	60379468	HA022J0004 Saloon HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22416	60379415	HA022J0004 Saloon HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22816	60379352	HA022J0004 Saloon HVAC Winter check	CRTD MANC NMAT PRC	01.08.2018	E9S	IE02	01.08.2018
	22816	60379765	22816 Wheels - Re-profiling	REL PRT NMAT PRC SETC	04.10.2018	E9W	IE02	04.10.2018
	22216	60328500	Remove axle for bearing change	CRTD CSER MANC NMAT PRC	18.01.2020	E9X	IE02	18.01.2020

Figure 12 – SAP System open work order for ICR 16

Prevention of the movement of vehicles

IÉ Rule Book

49 The following outlines the requirements form the IÉ Rule Book (Issue 11/07) in terms of preventing of the movement of vehicles:

- Section B, Part One, 2.5: "What you must do when required to work on rail vehicles" states that these instructions apply when working: on the outside, underneath or inside a vehicle (using steps or ladders);
- Section B, Part One, 2.5.1: "What you must understand about arrangement to prevent the movement of vehicles" requires that:
    - Arrangements must be made to prevent the movement of the vehicle(s) concerned on which work is being done, before work starts;
    - These arrangements must be made by the Designated Person Responsible for Protection, who is identified in local instructions in each depot.

50 In terms of the Designated Person Responsible for Protection, identified above, LTCD have not nominated a person to fulfil this role at LTCD.

Local Instructions at LTCD

Use Of Not To Be Moved Boards On Stationary Vehicles Safe System Of Work

51 The "Use Of Not To Be Moved Boards On Stationary Vehicles Safe System of Work" (to be referred to as the "Not To Be Moved Board SSOW" for the remainder of this report) issued on the 15th January 2014 is a safe system of work for LTCD; drafted by the local safety officer and approved by the LTCD Depot Manager. The document outlines the steps to be taken for the storage, fitting, and removal on "Not To Be Moved Boards" on stationary vehicles in LTCD.

52 Statements from Not To Be Moved Board SSOW relevant to this investigation, include:

- All staff involved with the use of 'Not To Be Moved Boards' on stationary units in LTCD must familiarise themselves with this SSOW, Section B of the IÉ Rule Book and all the necessary rules and local instructions (Section "All Staff" in "Safe Operation");
- The Duty Manager /Team Leader must inspect the unit to ensure it is safe to be moved before he releases to traffic (Step 15 of Preparation for Work on Stationary Vehicles in LTCD).

53 At the time of the accident, LTCD had adopted an informal undocumented "hand over" system (known locally as the Blue Tag system). The main function of the Blue Tag system was to allow for work to be carried from one shift to another. The Duty Manager issues the Blue Tag and notes the reason the tag was issued and to what train. A train cannot be moved until the "Blue Tag" is removed. The issue of these tags is also marked on the White Board. The "Blue Tag" was not placed ICR 16 as there was not any specific work task that had not been completed at the end of a shift. The introduction of this process does not appear to have been assessed for the introduction of risks.

Movement of vehicles in LTCD

General description

54 The general procedures for the movement of vehicles are included in:

- IÉ Rule Book;
- Professional Handbook CME Persons Authorised to Move and Shunt Traction Units/Vehicles (issued in March 2012), to be referred to as the CME Professional Handbook for the remainder of this report;
- DMU Assistance, Assisting 22000 Class, Book D (issued on the 19th April 2018).

55 The instructions specifically related to LTCD are the "Portlaoise Train Depot Safe System of Work & Operating Instructions" (Version 2.0 published on the 26th October 2016), to be referred to as LTCD SSOW & OI for the remainder of this report.

56 The training and competence management of persons authorised to move or shunt traction units within CME Maintenance Depots is standardised in an RU Safety Department document, document number, CME-SMS-011: "Training and Competence Assessment of Persons Authorised to Move or Shunt Traction Units" (to be referred to as CME-SMS-011 for remainder of report).

CME Professional Handbook

General description

57 The CME Professional Handbook applies to CME personnel and aims to provide staff with the highest standards of professionalism and safety for the movement of traction units. The techniques outlined in the book are based on good practice developed over many years by many railway companies.

Avoiding operating incidents, collisions and derailments

58 In the section of "General tips to avoiding operating incidents, collisions and derailments" the following statements from the relevant sections are pertinent to this investigation:

- "Failing to prepare the traction unit / vehicle correctly before any movement" is identified as an "Errors leading to operating incidents, collision and derailments";
- In "Planning and preparation for the movement" the following is stated: "Establish the type of vehicles to be moved and any degraded mode of working involved for example – unbraked vehicles or a propelling movement is listed;
- The "Static and running brake tests" (to be referred to as the Static Brake Test for the remainder of this report) section states "the purpose of the brake and safety control equipment is to check that the train brakes are operating effectively"; the procedure for Static Brake Test is listed is Figure 13.

	Checks	Action and Verify
1	Check the parking brake is applied	*The forward / reverse handle must be in neutral*
2	Check sufficient main reservoir pressure	*Must be between 6.6 BAR (6.5 on 26/2800) and 7.7 BAR.*
3	Charge the brakes	*Placing the brake handle into the 'run' position, operate the SCE pedal, acknowledge the CAWS button and then press and hold the "emergency brake reset" button until the emergency brake is released.*
4	Check full service	*Make a full service brake application and verify that the brake pipe pressure drops to 3.4 bar +/- 0.2 bar and that the brake cylinder rises to between 2.6 and 3.5 bar*
5	Check emergency	*Make an emergency brake application checking that the brake pipe pressure drops to zero*
6	Check the SCE	*Recharge the brake, test the SCE by releasing the pedal making sure the brake applies and the buzzer sounds.*
7	Check power cannot be taken	*With brakes applied, place the controller in notch 1 and make sure power cannot be taken.*
	Reset the brakes and observe that readings return to normal.	

Figure 13 – Procedure for Static Brake Test

DMU Assistance, Assisting 22000 Class, Book D

General description

59 The DMU Assisting 22000 Class, Book D document (to be referred to as the ICR Hauling Assisting Instructions) contains instructions for all the movements that are permitted to assist a failed IÉ 22000 class DMU where electrical coupling is not possible. In the case of LTCD where the maintenance of 22000 Class trains occurs, 'Table D4: Assistance from 22000 Class', is relevant.

60 The ICR Hauling Assisting Instructions provide information on preparation, coupling and further preparations of the failed ICR and the assisting ICR. Some of the relevant instructions are as follows:

- Preparation of failed ICR for coupling – This should be carried out as soon as possible after declaring a failure while main reservoir pressure is still available, and requires the: operation of the Haul Drive Switch (HDS); extension of the coupler; isolation of the sealed deadman solenoid valve (D10) in all cabs of failed 22000 class;
- Preparation of the assisting ICR – Which requires: stopping one metre short of failed 22000 Class; applying the brakes (emergency and braking); operating the HDS; and, extending the coupler;

- Coupling of assisting ICR to failed ICR – Which requires aligning and coupling to the failed 22000 class; applying the brakes (emergency and parking); confirming coupling integrity; and, turning the brake pipe override air cock handle (marked by red star in Figure 14) through 90° on both couplers;

Figure 14 – Brake pipe override air cock handle

- Further preparation of failed ICR – Which requires isolating air cock Main Reservoir (MR)(R1) and Parking Brake (PB) by turning handle (marked by red star in Figure 15) to the horizontal position on all cars of the failed 22000 Class;
- Further preparation of assisting ICR – Which requires isolating air cock MR(R1) by turning handle to the horizontal position on all cars of the assisting 22000 Class;
- Final preparation of failed ICR – Which requires the releasing of the parking brake; mounting of portable tail lights; and conducting a brake continuity test.

Figure 15 – MR(R1) & PB

61 By carrying out these procedures correctly; when the vehicles are divided, the brakes will apply on all vehicles.

LTCD SSOW & OI

62 LTCD SSOW & OI outlines the roles and responsibilities of the relevant staff within LTCD; as well as the requirements for the movement of trains up to Signal PL279 and within the confines of the LTCD.

63 In terms of roles and responsibilities, the following are relevant to this investigation:

- Driver[3] – Responsible for the safe movement of trains into, out and within LTCD (Section 2.3);
- Limited Shunter – Responsible for arranging the safe movement of trains within LTCD (Section 2.4)[4];
- Duty Manager – Responsible for appointing a Limited Shunter at the start of each shift who will be responsible for all movements into, out of and within the LTCD (Section 4.1.2).

[3] The Driver in this case is the role referred to as the CME Driver by the RAIU.

[4] Sections 2.3 and 2.4 appear to be conflicting in terms of overall responsibility for the movement of trains between the CME Driver and Limited Shunter.

64 In terms of hauling trains, there is one reference in the document, paragraph 4.4.7 states "When hauling a unit in the confines of CME Location Portlaoise ensure the couplers are mechanically latched by checking the position of the central pivot". There is no reference to the requirements set out in the ICR Hauling Assisting Instructions.

Training & Competence Assessment of Persons Authorised to Move or Shunt Traction Units

General description

65 CME-SMS-011, "Training and Competence Assessment of Persons Authorised to Move or Shunt Traction Units" describes how the RU Safety Department manages the training and competence of all CME staff authorised to move, control or shunt traction units / vehicles within the CME Maintenance Depots.

Training & assessment

66 Staff at LTCD required to carry out CME Driver and/or Limited Shunter duties attend the CME Training Course, which entails five days of training and assessment before being deemed competent to carry out CME Driver and/or Limited Shunter duties. The training consists of a twenty-session course with a mix of morning class room theory and evening hands-on training (see Figure 16).

67 Training Session 3 & 4 cover "basic look around the train" and Sessions 11 & 12 and 15 & 16 cover train preparation ("train prep"). It is noted that there is no requirement to formally log any of these inspections or preparations.

Time	Monday	Tuesday	Wednesday	Thursday	Friday
09.30	Session 1 • Course Introduction • Communications. • Introduction to CME Driver Handbook. • Lifestyle	Session 5 • The train and cab equipment. • Preparing to move trains. • In-cab system checks Train radio, DSD, CAWS. • Brake functionality Test.	Session 9 • Shunting • handsignals • Instructions to shunters	Session 13 • Action to be taken in emergencies. (derailment, collision, SPAD)	Session 17 Theory Assessment Complete successfully A written examination On rules & regs
11.00	Tea/Coffee Break	Tea/Coffee Break	Tea/Coffee Break	Tea/Coffee Break	Tea/Coffee Break
11.15	Session 2 • Personal safety on the depot • Yard knowledge • Running lines. • Operation of points (trailing, facing, gaping, and fouling) • Signals. • Depot protection systems.	Session 6 • Professional Driving. • Low speed driving. • Use of horn – warning persons on the ground. • Coupling/Uncoupling. • Low adhesion.	Session 10 • Changing ends, Disposal, securing. • Defective cab controls • T4 possessions in yards.	Session 14 • TCOD Demo. • simulated emergencies	Session 18 Practical Assessment Demonstrate all in cab checks Performing various movements controlled by handsignals
12.30	Lunch Break	Lunch Break	Lunch Break	Lunch Break	Lunch Break
13.30	Session 3 & 4 Yard Visit: – Signals – Stop Boards – Power Operated Points – Lineside Indications – Signal Post Telephone, Handpoints	Session 7 & 8 Sim session/practical to cover: – starting trains – cab prep – communications – low speed movements – coupling and uncoupling	Session 11&12 Practical: – cab prep – train prep – Shunting/moving trains – low speed movements – coupling and uncoupling – handpoints	Session 15 &16 Practical: – cab prep – train prep – Shunting/moving trains – low speed movements – coupling and uncoupling – handpoints	Session 19 Practical assessment continued
14.30	– Basic look round train				Tea/Coffee Break
14.50	– Cab equipment				Session 20 Feedback
16.00	Review, question and answer session	Review, question and answer session	Review, question and answer session	Review, question and answer session	

Figure 16 – CME Driver / Limited Shunter Training Plan (from May 2012)

68 Session 5 covers Brake Functionality Test, Train Radio and Safety Control Equipment. Slide 29 in Session 5 details the steps that are required to carry out a functionality brake test (Figure 17).

Brake functionality test - Railcar

	Checks	Action and Verify
1	Check the parking brake is applied	*The forward / reverse handle must be in neutral*
2	Check sufficient main reservoir pressure	*Must be between 6.6 BAR (6.5 on 26/2800) and 7.7 BAR (10 BAR on a 22000).*
3	Charge the brakes	*Placing the brake handle into the 'run' position, operate the SCE pedal, acknowledge the CAWS button and then press and hold the "emergency brake reset" button until the emergency brake is released.*
4	Check full service	*Make a full service brake application and verify that the brake pipe pressure drops to 3.4 bar +/- 0.2 bar and that the brake cylinder rises to between 2.6 and 3.5 bar*
5	Check emergency	*Make an emergency brake application checking that the brake pipe pressure drops to zero*
6	Check the SCE	*Recharge the brake, test the SCE by releasing the pedal making sure the brake applies and the buzzer sounds.*
7	Check power cannot be taken	*With brakes applied, place the controller in notch 1 and make sure power cannot be taken.*
	Reset the brakes and observe that readings return to normal.	

Figure 17 – Brake Functionality Test - Railcar

69 In terms of accessing and egressing from a vehicle, Session 6 'Movement of Traction Units in Shed Yards and Sidings' states that "Do not (or allow anybody) to get into or out of a moving vehicle; and, Session 9 "Personal Safety of Shunters" states that "Shunters must not get off any moving vehicle" i.e. staff should not access or egress a moving vehicle.

Competency assessment & monitoring

70 In line with CME-SMS-011, CME Drivers and Limited Shunters on successful completion of the five-day training, undergo three and four ongoing assessments/monitoring in the first year, respectively. Successful staff then progress to the competence assessment process which entails the CME Driver and Limited Shunter to receive two and four continuous assessments every two years, respectively.

71 The monitoring does not specifically include the monitoring of infrequent activities; as a result, specific monitoring of hauling of units within the depot is not covered under the monitoring schedule.

Note

72 A CME Driver may be passed competent as a CME Limited Shunter and a CME Limited Shunter may also be passed competent as a CME Driver but for a train movement to take place within LTCD both a CME Driver and CME Limited Shunter must be present.

Events before, during and after the accident

Events before the accident

73 On the 28th June 2018 ICR 16, operating a passenger service from Dublin to Galway, was involved in a collision with cattle at Tullamore, where the train sustained a large amount of damage. ICR 16 was hauled (by another ICR, driven by an operations driver) to Inchicore and then driven under its own power to LTCD (the brakes were operable on the train on arrival at LTCD) where it began undergoing repairs.

74 On the 6th July, ICR 16 was placed on the Wheel Lathe Road for *wheel turning,* the works were completed by the 8th July.

75 On the afternoon of the 8th July ICR 16 was to be moved from the Wheel Lathe Road. On powering up ICR 16 there was difficulty building air pressure and a decision was made to isolate the brakes and haul ICR 16 to a Head Shunt Road. DDM1 then emailed NDM1 advising that the brakes were isolated on ICR 16.

76 On the night of the 8th July ICR 16 was hauled into LTCD Maintenance Shed and the brakes are restored. NDM1 then emails DDM2 advising that the brakes are restored on ICR 16.

77 On the 11th July DDM1 does not realise that the brakes on ICR 16 have been restored and DDM1 isolates the brakes on ICR 16 and arranges for ICR 16 to be hauled from LTCD Maintenance Shed to a Head Shunt Road.

78 On the 12th July the CME staff under the direction of DDM4 made a number of shunting manoeuvres leading to ICR 16 being hauled to Road 6B. The ICR Hauling Assisting Instructions were not complied with, as the units were coupled without any of the set procedures followed. As a result, ICR 16 was left scotched, with the brakes isolated (i.e. unbraked) without the hauling set attached, on Road 6B until the 16th July.

79 During the day of the 16th July, while still in an unbraked condition, work is conducted on ICR 16 and a “Not to be Moved” board is placed on the train set; all workers leave the train set but the “Not to be Moved” board remains in place without any personal identification tags in place.

80 On the 17th July 2018 the DDM1 advised the Limited Shunter and the CME Driver, that ICR 16 was required to be shunted from Road 6B to Road 8 in LTCD to allow maintenance repairs to be carried out that morning; this movement entailed two shunting movements, a shunt from Road 6B to Road 15 and Road 15 to Road 8. The condition of the brakes, which were isolated, were not discussed; and at this stage the circuit breaker GWCB was tripped on both A-cars.

81 The Limited Shunter and the CME Driver checked the “Handover Notes” and the “Set Stopped – Reason” of the Day and Night Production Boards in the Duty Manager’s office in LTCD. There were no endorsements against ICR 16.

82 The Limited Shunter went out to ICR 16 on Road 6B and removed a “Not to be moved board” as there was no restriction recorded against ICR 16 on the day and night production boards.

83 The Limited Shunter started up the engines on ICR 16 and only one engine started. As the Limited Shunter felt that there would be a long delay in building up air pressure to enable the brakes to operate, the Limited Shunter put in place arrangements for ICR 16 to be hauled onto Road 8 by ICR 62.

84 After completing a number of other tasks, the Limited Shunter returned to ICR 16, still located on Road 6B and saw that the air pressure had built up. The CME Driver arrived onto ICR 16 and the Limited Shunter advised him that air pressure had built up.

85 The CME Driver viewed the MMI screen in the cab and could see that the brakes on both B-cars were isolated. The CME Driver assumed that the brakes were operational on the remaining two A-cars and as the cab brake cylinder pressure gauge had a positive reading, thought there would be sufficient brake to stop the train as the shunt was a low speed movement.

86 The CME Driver advised the Limited Shunter that he would drive ICR 16 (from cab 22316), from Road 6B to Road 15 and CME Driver 2 would travel in the rear cab (cab 22216) and on completion of the first part of the shunt the second CME Driver would drive ICR 16 onto Road 8.

87 The CME Driver successfully carried out a Brake Functionality Test and Static Brake Test on ICR 16 in accordance with the CME Training Course and CME Professional Handbook, respectively.

88 The Limited Shunter carried out a physical check of the outside of ICR 16 and as he walked around. The external examination did not identify that the brakes were isolated as checking the Brake Isolation Box was not part of the examination process.

89 The Limited Shunter also noticed a wheel chock under a wheel that was stuck; and requested the CME Driver to move ICR 16 to allow for the removal of the wheel chock. The CME Driver moved ICR 16 and applied the brake and ICR 16 came to a stop. It is probable the train stopped due to this being a low speed movement and activation of the parking brake, which further strengthened to the CME Driver that the brakes were functioning. The Limited Shunter removed the wheel chock and entered the cab of ICR 22316.

90 The Limited Shunter advised the CME Driver that Points 6 were not in the correct position and he would have to change the direction of the points enroute. The CME commenced the movement of ICR 16. On approach to the Points 6 the Limited Shunter alighted from ICR 16 and walked forward to change the direction of the points.

Events during the incident

91 The CME Driver applied the brakes on ICR 16 and felt no retardation. At first the CME Driver thought that the slow operation of the brakes was the result of the brakes being isolated on the two B-cars, but he soon realised that the brakes were not working on the complete set.

92 The CME Driver first phoned the CME Driver 2 travelling in the rear cab to apply the brakes in that cab, however, ICR 16 continued to move.

93 The CME Driver checked for a wheel chock in the cab and found that no wheel chocks were present on ICR 16. The CME Driver told the Limited Shunter that ICR 16 had no brakes and CME Driver alighted from the cab; and ran to ICR 32 (located across the yard of LTCD) and got the wheel chocks from the unit.

94 At the same time the Limited Shunter re-entered the cab of ICR 22316 (after leaving Points 6) and attempted to apply the brake.

95 The CME Driver then pulled Points 16 to divert ICR 16 on to Road 14 as there was a curve on the track and he hoped the curve on the track would help to slow down ICR 16. The CME Driver attempted to place the wheel chocks on the rail in an attempt to slow down and stop ICR 16, however this did not slow ICR 16.

96 Despite the efforts of the CME Driver, Limited Shunter and CME Driver 2, ICR 16 struck the Rawie friction buffer stop at Road 14 at 14 km/h. The force moved the buffer stop, and the buffer stop continued to move until all additional six buffer stop retarder blocks were compressed together (a distance of approximately five metres); it should be noted that the buffer stop functioned correctly; see Figure 18 for photograph of the buffer after the accident.

Figure 18 – Rawie buffer stop after the accident

Events after the accident

97 The CME Driver notified the LTCD Duty Manager who notified the relevant parties.

98 The CME Driver and the Limited Shunter were tested for drugs and alcohol in line with IÉ policy and procedures; both results returned negative.

Similar occurrences

99 IÉ historical reports show one previous accident of a train being driven with no brakes and striking a buffer stop, namely "Report of Investigation into the collision of DMU 2713 with the buffer stop on Platform 4, Limerick, 26th February 2012". In this case, the driver did not fully charge the brake system or carry out a brake test prior to driving the set and subsequently, the train collided with a buffer stop.

100 Another IÉ investigation related to this investigation, previously mentioned in paragraph 47, namely, the "Over-inflation of the trailer bogie secondary suspension at Connolly Depot, 7th May 2010". In this case, the suspension levelling valves were taken off a 29000 DMU in Drogheda Depot by team member fault-finding a suspension fault on another 29000 DMU vehicle. On fitting the levelling valves to the faulty vehicle, the fault remained, and the team member refitted the levelling valves to its original vehicle but unknowingly in the wrong configuration. The IÉ investigation report made the following recommendations:

- When a component is replaced / repaired on a vehicle, the operation of the component or affected system must be fully tested /commissioned before the vehicle is returned to service. In cases where it is not possible to complete the tests or commissioning checks immediately after the repair is completed the existing SAP system must be used to record and track the deferred work;
- The SAP system must be used to create work orders for all maintenance tasks; all open work orders on any vehicle should be reviewed and accessed as to the effect on the safety of the vehicle before the unit is returned to service.

101 Although, not directly similar, another accident occurred at LTCD during the RAIU's investigation into the buffer stop collision. The derailment occurred on the 14th June 2019 whereby a four-car ICR was exiting Road 10 in LTCD travelling towards the Head Shunt. Three of the four cars had passed the derailer without incident, when the limited shunter raised the derailers in error while the fourth car was travelling over the derailer. The derailers fully deployed before the rear bogie had reached them causing the rear bogie to derail.

Analysis

22000 ICR braking system & isolation mechanism

102 The *cab brake cylinder gauge* is on upstream to the brake isolating cocks; as a result, the cab brake cylinder gauge can show a positive pressure reading even when the brakes have been isolated on all cars of the set i.e. when the driver looks at the cab brake cylinder gauge, the driver sees that they have brake cylinder pressure, however, this is not the case (paragraphs 36 - 38).

103 On the 17th July, all four brake isolation boxes had the brake isolation cocks in the horizontal position (paragraph 39). The CME Driver saw a positive reading on the cab brake cylinder pressure gauge (paragraph 39) and the MMI screen showing the brakes isolated on both B-cars assumed that the brakes were present on the remaining two A-cars and there would be sufficient brake to stop the train travelling at a low speed movement.

104 The RAIU became aware of the anomaly i.e. the positive cab braking cylinder reading with all brakes and on the 17th August the RAIU issued an Urgent Safety Advice Notice recommending that "IÉ should advise all relevant staff that a positive brake cylinder gauge reading in the cab of an ICR is not an indication that a brake is present" (paragraph 37).

105 In addition, the cab circuit breaker panel (which allows for the isolation of electrical circuits) on the two A-cars had GWCB tripped resulting in the isolation of the brakes on the A-car not being displayed on the cab MMI (paragraph 39).

Identification of defective passenger rail vehicles

106 The IÉ Rule Book requires maintenance staff to place appropriate labels on vehicles needing repairs; and, identifies the type of label and restriction for use. There were no labels present on ICR 16 (paragraph 42) as staff at LTCD no longer place repair labels on defective vehicles. Instead, there appears to be the generation of work orders on the SAP system; this is likely as a result of a previous safety recommendation relation to another CME incident (paragraph 47). The RAIU have not been presented with evidence that this change was validated and assessed for any risks due to the change.

107 The recording of defective rail vehicles using the Day and Night Production Boards is not documented in the LTCD SSOW & OI (paragraphs 43 - 46).

Prevention of the movement of vehicles

IÉ Rule Book

108 The IÉ Rule Book outlines what CME staff must do when required to work on rail vehicles and what CME staff must understand about arrangements to prevent the movement of vehicles, stating that these arrangements must be made by the Designated Person Responsible for Protection (paragraph 49). Staff at LTCD have not identified who the Designated Person Responsible for Protection is (paragraph 50).

Not To Be Moved Boards SSOW

109 Step 15 states "The Duty Manager / Team Leader must inspect the unit to ensure it is safe to be moved before he releases to traffic." There is no requirement for the Duty Manager / Team Leader to inspect the vehicles to ensure it is safe to be moved if the work is suspended and there is a need to move the vehicle prior to entering service.

"Blue Tag" System

110 LTCD had adopted an informal "Blue Tag" system for the prevention of movement of trains which required work to be continued into the next shift; this process does not appear to have been assessed for the introduction of risks. Although, it is noted that its requirement would not have been used in the case of ICR 16, as the works had been completed (paragraph 53).

Movement of vehicles in LTCD

LTCD SSOW & OI

111 The LTCD SSOW & OI make no reference to the requirements set out in the ICR Hauling Assisting Instructions; with only one small referenced to mechanical checks after coupling (paragraph 64).

CME Professional Handbook

112 The CME Professional Handbook applies to CME personnel working in LTCD. The handbook identifies that failing to prepare the unit correctly before any movement; and, establishing and any degraded mode of working involved e.g. unbraked vehicles, as a potential for causing collisions and derailments but there are no supporting documents specifying how to prepare the traction unit correctly or what to do if the vehicle is found to be in a degraded mode (paragraph 58).

113 In the Static Brake Test the purpose of the brake and safety control equipment test is listed as to check that the train brakes are operating effectively, but if all the checks that are prescribed in the CME Professional Handbook are carried out correctly it is still possible to drive an unbraked train if the brakes have been isolated on the complete ICR train set (paragraph 58).

DMU Assistance, Assisting 22000 Class, Book D (ICR Hauling Assisting Instructions)

114 Section D4, of the ICR Hauling Assisting Instructions sets out a full list of procedures (paragraph 60) for the hauling of Class 22000 by other Class 22000, including preparations to be made to both the failed 22000 and assisting 22000. These instructions include:

- Turning the brake pipe override air cock handle through 90° on both couplers;
- Isolating air cock MR(R1) and PB by turning handle to the horizontal position on all cars of the failed 22000 Class.

115 By carrying out these procedures correctly; when the vehicles are divided, the brakes will apply on all vehicles (paragraph 61). As a result, had these procedures been followed, in full, the brakes would not have been isolated on ICR 16 when stabled on Road 6B.

Training and Competence Assessment of Persons Authorised to Move or Shunt Traction Units

116 Both the CME Driver and Limited Shunter were certified competent for their roles at the time of the accident (paragraph 11).

117 The CME Driver Training consists of both presentation and practical elements on how to conduct items such as train inspections and preparation; although, it is noted that there is no requirement to formally log any of these inspections or preparation (paragraph 67).

118 As with the Static Brake Test set out in the CME Professional Handbook (paragraph 113), it is possible to carry out all the prescribed steps in the Brake Functionality Test (paragraph 68) in the CME Training Course and still have no brake on the train.

Actions of the IÉ Staff

Actions Taken Before the Day of the Accident

119 ICR 16 carried out a number of shunting manoeuvres (conducted by CME Drivers and Limited Shunters) around the LTCD compound between the 8th July and the 12th July 2018 (paragraphs 75 - 78), with ICR 16 being eventually stabled on Road 6B. The ICR Hauling Assisting Instructions were not used for these hauling movements, with just the limited mechanical coupling occurring, resulting in ICR being stabled, unbraked, on Road 6B between the 12th and the 17th July 2018.

Driver & Limited Shunter

120 Both the CME Driver and Limited Shunter reviewed the Day and Night Production Board in relation to restrictions on ICR 16.

121 The Limited Shunter removed a Not To Be Moved Board from ICR 16.

122 The CME Driver carried out a Static Brake Test (CME Professional Handbook) and a Brake Functionality Test (CME Training Course).

123 The Limited Shunter alighted from the moving ICR 16 in order to change the points (paragraph 90) prior to the incident. During the incident it is noted that the Limited Shunter alighted back onto moving ICR 16 (paragraph 94) and the CME Driver alighted from moving ICR 16 in order to locate a chock (paragraph 93), however, this was in an emergency situation.

124 The CME Driver attempted to slow down and stop ICR 16 by placing wheel chocks in front the moving train. When this action failed the CME Driver then pulled Points 16 to divert ICR 16 on to Road 14 as there was a curve on the track and he hoped the curve on the track would help to slow down ICR 16.

Conclusions

Summary of conclusions

22000 ICR braking system & isolation mechanism

125 An unusual feature to the 22000 ICR braking system is that the cab brake cylinder gauge is upstream of the brake isolating cocks; meaning the cab brake cylinder gauge can show a positive pressure reading even when the brakes have been isolated on all cars of the set (paragraph 102). On the 17th July, all four brake isolation boxes had the brake isolation cocks in the horizontal position, with the CME Driver seeing a positive reading on the cab brake cylinder pressure gauge (paragraph 103). The RAIU became aware of the anomaly and issued an Urgent Safety Advice Notice recommending that "IÉ should advise all relevant staff that a positive brake cylinder gauge reading in the cab of an ICR is not an indication that a brake is present" (paragraph 104).

126 In addition, the cab circuit breaker panel (which allows for the isolation of electrical circuits) on the two A-cars had the GWCB in the tripped position resulting in the isolation of the brakes on the A-cars not being displayed on the cab MMI (paragraph 39).

Identification of defective passenger rail vehicles

127 The IÉ Rule Book requires CME maintenance staff to place appropriate labels on vehicles needing repair; and, identifies the type of label and restriction for use; however, LTCD do not adhere to this labelling requirement which has been replaced with the generation of work orders on the SAP system (paragraph 106). In addition, the recording of defective rail vehicles using the Day and Night Production Boards is not required under the LTCD SSOW & OI (paragraph 107). The absence of correct labelling or information on ICR 16 led to the CME Driver and Limited Shunter not having a full understanding of the status of the braking on ICR 16.

Prevention of the movement of vehicles

128 There are a number of areas of concern in terms of the prevention of the movement of vehicles at LTCD, including:

- LTCD documentation did not identified who the Designated Person Responsible for Protection (whose role includes arrangements to prevent the movement of vehicles which require work) as required by the IÉ Rule Book (paragraph 108);
- LTCD had adopted an informal "Blue Tag" system for the prevention of movement of trains which required work to be continued into the next shift (paragraph 110).

129 The formal and informal processes in place at LTCD for prevention of movement of vehicles meant that ICR 16 could be moved when left stabled in a degraded condition.

Movement of vehicles in LTCD

130 There are a number of areas of concern in terms of the movement of vehicles at LTCD, including:

- Although the CME Professional Handbook identifies the risks associated with failing to establish degraded conditions and preparing the unit correctly before any movement; there are no supporting documents specifying how to prepare the traction unit correctly or what to do if the vehicle is found to be in a degraded mode (paragraph 112). In addition, it is possible to carry out all the steps in the Brake Functionality Test prescribed in the CME Professional Handbook and still have no brake on an ICR vehicle (paragraph 113);
- There is no reference to the ICR Hauling Assisting Instructions in any of the relevant suite of documents associated with movement of vehicles in LTCD (paragraph 111); had they been fully implemented, ICR 16 would not have been stabled with the brakes isolated.

131 If the ICR Hauling Assisting Instructions had been complied with in full, the brakes would not have been isolated on ICR 16 when stabled on Road 6B (paragraphs 114 - 115). In addition, had there been a formal procedure to be carried out prior to the movement of ICR 16 (paragraph 117), which included checking Brake Isolation Box and tripping of Circuit Breakers.

Training and Competence Assessment of Persons Authorised to Move or Shunt Traction Units

132 The CME Driver Training consists of both presentation and practical elements on how to conduct items such as train inspections and preparation. If there was a correct understanding of the braking status after the “Brake Functionality Test” the CME Driver would have been aware that there may be no brakes on ICR 16.

Immediate cause, contributory factors, underlying causes, root causes and additional observations

133 The immediate cause of ICR 16 colliding with the buffer stop at LTCD was as a result of ICR 16 being driven with no operational brake on the train.

134 Contributory factors associated with the accident are:

- CF-01 – Circuit breaker GWCB was in the tripped position on both A-cars resulting in no notification of the brake isolation being shown on the cab MMI (paragraph 125);
- CF-02 – The brakes on all four cars of ICR 16 were isolated (leaving ICR 16 unbraked) with no adequate process in place to communication this to staff at LTCD (paragraphs 127 - 128);
- CF-03 – The ICR Hauling Assisting Instructions were not complied with for the previous movement of the vehicle resulting in ICR 16 being stabled with the brakes isolated (paragraph 130);
- CF-04 – The ICR cab brake cylinder gauge is upstream of the brake isolating cocks allowing for a positive brake cylinder reading even when the brakes are isolated (paragraph 125);
- CF-05 – It is possible to achieve all the correct readings when the Brake Functionality Test and Static Brake Test are completed and still have no brake on an ICR train set (paragraphs 130 - 132).

135 The underlying cause associated with this accident:

- UC-01 – The formal and informal processes in place for: the use of Not To Be Moved Boards; the labelling of defective vehicles; and the communication of train statuses, was not sufficient in notifying the staff at LTCD of the issues with ICR 16 (paragraphs 127 - 130);
- UC-02 – The suite of LTCD documentation does not refer to the ICR Hauling Assisting Instructions which would have ensured that ICR 16 was sufficiently braked while stabled (paragraph 130).

136 The RAIU made a number of additional observations during the investigation, namely:

- AO-01 – The Limited Shunter alighted out of a moving train to pull Points 6 (paragraph 90);
- AO-02 – There is no requirement to formally log any of train inspections or preparations prior to the movement of a train (paragraph 132);
- AO-03 – SSOW & OI does not clearly identify (CME Driver or Limited Shunter) who has overall responsibility for the movement of trains within the confines of LTCD (paragraph 63).

Relevant actions taken or in progress

Actions taken by IÉ

137 IÉ have advised the RAIU, as of the date of publication of this report, that the following actions have taken in relation to this accident:

- An email was sent to all relevant staff to check the isolations and MCBs prior to train being moved;
- All relevant CME staff, in all locations, were briefed on the operation of the brake gauges on the ICR fleet;
- The LTCD SSOW & OI were updated to include that prior to any movements the brake isolations and MCBs to be checked and any that are in the non-standard position are reported to the Duty Manager. Included in this document, is the following statement: "Prior to movement of a set that is fully shut down, that all accessible isolations, circuit breakers and bypass switches are checked and the Duty Manager is consulted if any are in the non-standard position";
- The LTCD SSOW & OI were updated to include the requirement for the ICR Hauling Assisting Instructions for 22000 Class ICR trains to be complied with when hauling trains within LTCD;
- The "Blue Tag" system is in full operation within LTCD;
- A process has commenced to institute a new procedure for Not to be Moved Boards and tagging of trains including those left in a degraded condition.
- A Safety Accident / Incident Notification Alert (CME-ANA-18-01) outlining the accident and the key learning points was issued to all CME Staff, which included:
    - The importance of ensuring relevant personnel are advised when safety critical systems or components have been isolated or by-passed;
    - The importance of checking that all isolation cocks and by-pass switches are in the correct position before moving a traction unit;
    - The importance of having special instructions in place before moving traction units that are in a degraded state;
    - That relevant Not to be Moved signage is in place.
- CME Technical Briefing CME-Te.Br-022-015 Function and Purpose of the ICR Brake cylinder gauge:
    - The purpose of the briefing is to make CME Personnel authorised to move vehicles aware that gauges and indications including the MMI screen in the driving cab of ta traction unit may not reflect actual functional operation of the unit if the unit is in degraded state or condition i.e. if isolation cocks, circuit breakers or by-pass switches are in a not-standard position.

138 In addition, following an internal investigation, IÉ made a number of safety recommendations:

- The CME to finalise the new procedure for tagging and placing of "Not to be Moved" boards on trains and introduce the procedure across all CME Locations;
- The Fleet Manager LTCD to introduce a formalised procedure to report the status of trains between shifts to be completed;
- The CME to introduce a system for the management of trains not fit for service in all CME locations;
- The CME to put a system in place for increased monitoring of infrequent activities in relation to train movements.

Actions taken by the CRR

139 The CRR carried out a Post Incident Inspection (PII) that was finalised and sent to IÉ-RU on the 4th February 2019. The CRR Inspector directed that IÉ-RU complete an Improvement Plan under Section 76 of the Railway Safety Act (RSA) Act 2005 to address the following outcome: 107/18-PII-AR-01: Review all communication processes and procedures for CME persons required to move and shunt vehicles; directing that:

IÉ-RU CME department should review all means of communication at LTCD depot i.e. meetings, information boards, SSOW processes and procedures, used to communicate with CME persons required to move and shunt vehicles. Any documents amended should be finalised. This review should be extended to all CME depot/yard locations, to reduce the risk of a similar incident occurring, and should include consultation with staff i.e. the CME persons required to move and shunt vehicles.

140 The planned completion date was three months. IÉ made a submission in relation to this direction on the 14th June 2019 and is currently undergoing review by the CRR.

Safety recommendations

General description

141 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 Commission for Railway Regulation (CRR). The recommendation is directed to the party identified in each recommendation.

Actions already taken by the RAIU

142 RAIU issued an immediate Urgent Safety Advice Notice recommending that "IÉ should advise all relevant staff that a positive brake cylinder gauge reading in the cab of an ICR is not an indication that a brake is present" as a result, there is no further safety recommendation warranted relating to CF-04.

Safety recommendation associated with the accident

143 The brakes on all four cars of ICR 16 were isolated; however, there were no appropriate measures in place at LTCD to identify, communicate or prevent the movement of a defective vehicles. The RAIU consider this risk to be relevant to all fleets and as such the recommendation is issued for the whole IÉ network (CF-01). The safety recommendation is as follows:

Recommendation 2019002-01

IÉ-RU CME should review their SSOW & OI and associated documents related to the identification, communication and prevention of movement of defective vehicles to ensure relevant staff are made aware of identified defects and that the defective vehicles are adequately labelled and tagged; and these processes and staff responsibilities are fully understood by all CME staff working on trains.

144 The ICR Hauling Assisting Instructions were not complied with for the previous movement of the vehicle on the 12th July resulting in ICR 16 being stabled with the brakes isolated for five days prior to the day of the accident (CF-02); as a result, the RAIU make the following safety recommendations:

Recommendation 2019002-02

IÉ-RU CME should review the suite of LTCD documents that relate to the management of moving trains within LTCD to ensure they are consistent and adequately reference any existing supporting documentation (e.g. ICR Hauling Assisting Instructions).

145 As above, the ICR Hauling Assisting Instructions were not complied with by the CME Drivers and Limited Shunters (CF-02); and, as a as a result of the derailment on the 14th June 2019 (paragraph 101), the RAIU make the following safety recommendations:

Recommendation 2019002-03

IÉ-RU CME should review its training and competency of CME Drivers and Limited Shunters ensuring the stabling and movement of vehicles (defective or otherwise) are adequately addressed.

146 The completion of the Brake Functionality Test and the Static Brake Test prescribed on the CME Training Course and in the CME Professional Handbook, respectively, does not guarantee the status of the brakes on the train. On the day of the accident the CME Driver conducted a Brake Functionality Test but remained unaware that there were no brakes on ICR 16 as there was no requirement to check the brake isolations. For these reasons the RAIU make the following safety recommendation (CF-03 and CF-05):

Recommendation 2019002-04

IÉ-RU CME should expand the requirements of preparation instructions for rail vehicles to ensure that on completion of these tests the brake status of a train can be fully established; this should include checking the status of circuit breakers and brake isolations.

Safety recommendations associated with additional observations

New safety recommendations associated with additional observations

147 The Limited Shunter alighted out of a moving train to pull Points 6 (AO-02). The RAIU consider that this should be re-briefed to all staff due to the potential severity of injury as a result of alighting from a moving train, as a result the RAIU make the following safety recommendation:

Recommendation 2019002-05

IÉ-RU CME should re-brief staff on the correct procedure for disembarking from a moving train.

148 There is no requirement to formal conduct any train inspections/ preparations prior to the movement of a train (AO-03), as a result the RAIU make the following safety recommendation:

Recommendation 2019002-06

IÉ-RU CME should develop a formal procedure for the examination of vehicles prior to moving a train which has been left unattended with no direct handover.

149 SSOW & OI does not clearly identify (CME Driver or Limited Shunter) who has overall responsibility for the movement of trains within the confines of LTCD (AO-04), as a result, the RAIU make the following safety recommendation:

Recommendation 2019002-07

IÉ-RU CME should determine who has overall responsibilities for the movement of trains within the confines of LTCD, including who is allocated the role of Designated Person Responsible for Protection, and, clearly brief these responsibilities in the CME Training Course and the SSOW & OI.

Additional information

List of abbreviations

AO	Additional Observations
CCTV	Closed Circuit Television
CF	Contributory Factors
CME	Chief Mechanical Engineers
CRR	Commission for Railway Regulation
DMU	Diesel Multiple Unit
DTTAS	Department of Transport, Tourism and Sport
GWCB	General Warning Circuit Breaker
ICR	InterCity Railcar
IÉ	Iarnród Éireann
IM	Infrastructure Manager
LTCD	Laois Traincare Depot
m	Metre
MMI	Man Machine Interface
MP	Mile Post
MR	Main Reservoir
NIR	Northern Ireland Railways
No.	Number
OTDR	On Train Data Recorder
PB	Parking Brake
RAIU	Railway Accident Investigation Unit
RU	Railway Undertaking
SMS	Safety Management System
SI Units	International System of Units
SSOW	Safe System of Work
UC	Underlying Cause
UF	Underlying factor

Glossary of terms

A-car (ICR)	ICR cars with a driving cab are known as A-cars.
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.
B-car (ICR)	ICR intermediated cars are known as B-cars (i.e. no driving cab).
Buffer Stop	A device used to stop the progress of rail vehicles at the end of sidings. Buffer stop at LTCD is described as a sliding buffer stop which are fixes to the rails by a clamp arrangement. When impact, this type of buffer stop moves dissipating the energy of the train over a period of time.
Chock	A wedge or block placed against a wheel or rounded object, to prevent it from moving.
CME Driver	CME person qualified and authorised to move a traction unit within the confined areas of a CME maintenance depot.
CME Limited Shunter	CME Limited Shunter – Person qualified to co-ordinate the safe movement of trains within a CME maintenance depot. This includes setting routes, checking points and operating the depot protection system. Competence does not include the full duties of a shunter such as coupling and uncoupling of trains.
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).
Competence Management System	IÉ IM Operations define a competence 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.
Control Room Process	Meeting that incorporates a visualisation room where the local supervisory/management team make prioritized decisions related to Maintenance production plans, progress reporting of different measures of performance, reviews of plans and revising actions to meet those plans, Occupational safety risks and asset safety risks and the appropriate risk mitigation actions, initiating practical problem solving for specific problems and controlling the extent of 5S workplace improvement action plans.
Duty Manager	CME manager responsible for all train movements into and out of the depot and

	all maintenance work on trains. Allocates work to staff.
Extensive damage	Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Hauled	Movement of non-functional locomotives or traction units by a shunting vehicle.
Identification tag	Tag with name and contact details of person who is working on the vehicle, that can be attached to the Not To Be Moved Board.
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.
Isolation	The formal procedure of de-energising a section of traction supply equipment,
Limited Shunter	CME staff member qualified to co-ordinate the safe movement of trains within a maintenance depot; this includes setting routes, checking points and operating the depot protection system.
Link	Scheduled service and travel to terminate point e.g. depot.
Mile Post	A post used to denote a location on a railway line using miles from a fixed point known as the 0 milepost.
National safety authority	The national body entrusted with the tasks regarding railway safety in accordance with European directive 2004/49/EC.
Not To Be Moved Boards	Illuminated board placed on a train to advise staff that it is not permitted to move the train. Staff can attach identification tags to the board to inform staff who are working on the train.
On Train Data Recorder	Often referred to as the “Black Box” is an electronic measurement and recording system fitted to the train and can record train speed distance travelled, brake and power application along with horn and headlight status.
Railway Undertaking	Organisation that operates trains.
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.

SAP System	Enterprise resource planning software developed by SAP SE SAP ERP in Germany and incorporates the key business functions of an organisation. Used by IÉ.
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.
Man Machine Interface	The Man Machine Interface provides a visual display in the cab for system status and faults on the train set.
Underlying cause	Causes related to skills, procedures and maintenance.
Wheel turning	The process of re-instating the correct flange profile on a rail wheel whilst the wheel is still attached to its parent vehicle.

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