Railway Accident Investigation Unit

Ireland

INVESTIGATION REPORT

Runaway locomotive at Portlaoise Loop

29th September 2011

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Reader guide

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

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

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

Report preface

The RAIU is an independent investigation unit within the Railway Safety Commission (RSC) which conducts investigations into accidents and incidents on the national railway network, the DART network, the LUAS, heritage and industrial railways in Ireland. Investigations are carried out in accordance with the Railway Safety Directive 2004/49/EC and the Railway Safety Act 2005.

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.

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

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 morning of the 29th September 2011 a Train Driver was rostered to drive a locomotive around Portlaoise Rail Depot to carry out preparatory works for a planned possession. He collected a locomotive from Limerick Junction and travelled to Portlaoise without incident. As part of his manoeuvre into Portlaoise Rail Depot he was required to change driving cab, disembark the locomotive and set the route, at a set of points, into Portlaoise Rail Depot. While setting the route the Train Driver saw the locomotive rolling away from him, down the gradient, towards Portlaoise Station.

The locomotive travelled approximately 306 metres from its stationary position, passing a signal at danger, running over a set of points and striking the buffer stop in the former Bay Platform road at Portlaoise Station, before continuing to travel another 9 m approximately until finally coming to a stop.

There were no passengers or other crew members on the locomotive and nobody was injured as a result of the occurrence. There was no damage to the to the locomotive or buffer stop as a result of the accident.

The immediate cause of the locomotive running away, whilst left unattended on a gradient, was the gradual release of the brakes. This was as a result of the following causal factors, which were necessary for the accident to occur:

- An air leak in part of the braking system;
- The train driver did not fully comply with the instructions for vacating and occupying locomotive cabs, set out in Iarnród Éireann's Drivers' Manual.

Contributory to the accident occurring are the following contributory factors:

- The overhaul in the braking system did not occur within the allocated time and therefore the locomotive was only subject to examination which did not include the brake leakage test which may have detected any faults in the braking system;
- The leak in the braking system was not detected during any pre-service checks carried out by the train drivers.

The underlying factors were:

- There was no quality control system in place for the updating of testing procedures which resulted in the omission of the brake leakage test from the newer procedures;
- IÉ's Drivers' Manual for 071 class locomotives had not been formally briefed to train drivers on its introduction in 2005, resulting in the train driver not fully appreciating the necessity of

the brake leakage test included in the pre-service checks, or the necessity to carry out the braking instructions, in full, in relation to vacating and occupying locomotive cabs;

- There was no system in place to ensure that train drivers are routinely assessed in relation to changing cab ends on locomotives.

The RAIU has made four new safety recommendations as a result of this investigation:

- IÉ should review their Vehicle Maintenance Instructions for locomotives to ensure that there are adequate braking tests at appropriate intervals;
- IÉ should adopt a quality control system, for the introduction of new maintenance procedures for locomotives;
- IÉ should review their system for introducing new train drivers' manuals, to ensure that train drivers are fully trained and assessed in all aspects of these manuals;
- IÉ should review their competency management system for train drivers to ensure that all driving tasks are routinely assessed.

Contents

The occurrence

Summary of the occurrence

1 On the morning of the 29th September 2011 a Train Driver was rostered to drive a locomotive around Portlaoise Rail Depot to carry out preparatory works for a planned possession. On arrival at Portlaoise Rail Depot there was no locomotive available, so he was required to travel to Limerick Junction to collect a locomotive. At approximately 10:45 the Train Driver approached Portlaoise Station from Limerick Junction with the locomotive, see Figure 1 – Location Map.

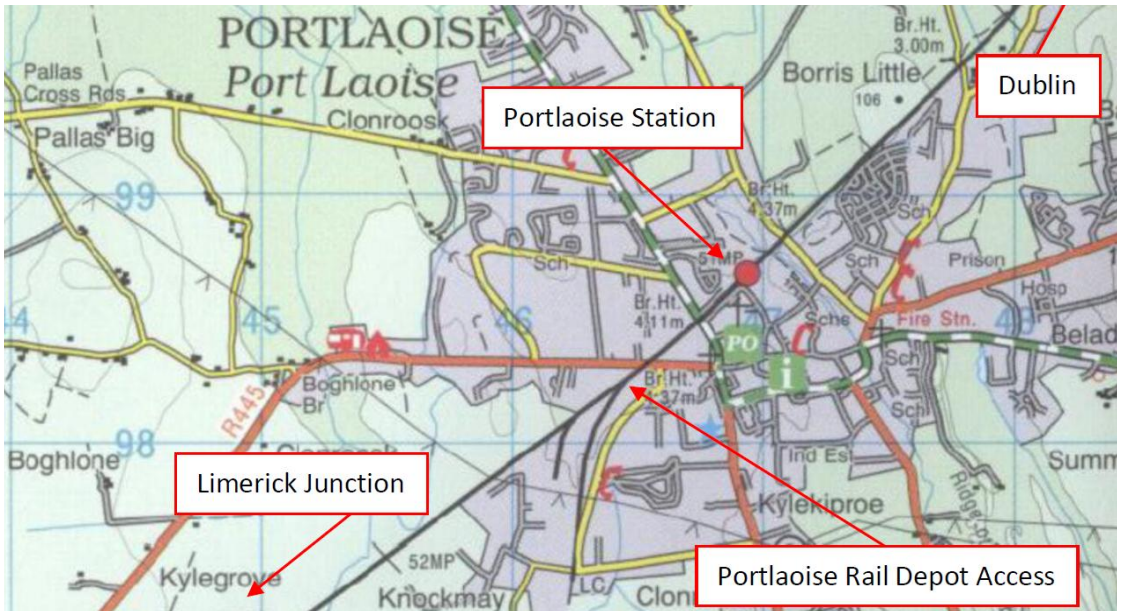

Figure 1 – Location Map (Ordnance Survey Ireland, 2003)

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2 Having travelled on the *Up Main* to Portlaoise, he stopped the locomotive outside Portlaoise Station in order to manoeuvre into Portlaoise Rail Depot. This manoeuvre required that he travel from the Up Main, across the *Down Main*, onto the Portlaoise *Loop* and into Portlaoise Rail Depot, see Figure 2.

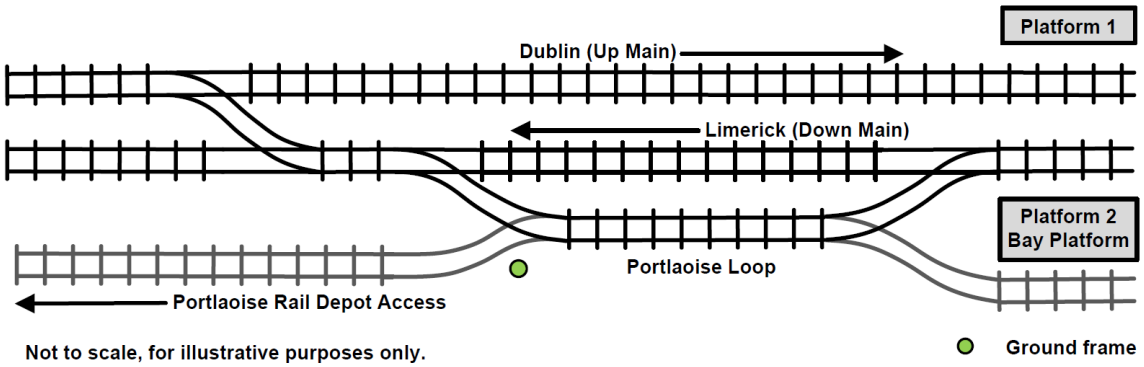

Figure 2 – Track layout for Portlaoise Station

3 While stopped on Portlaoise Loop (which has a gradient of 1 in 230, sloping down towards Dublin), the Train Driver disembarked the locomotive to set the *ground frame* (see Figure 2) for Portlaoise Rail Depot. While standing at the ground frame the Train Driver saw the locomotive travelling away from him, in the direction of Portlaoise Station.

4 The locomotive travelled approximately 306 metres (m) from its stationary position, passing a signal at danger and striking the *buffer stop* in the former Bay Platform road at Portlaoise Station. The locomotive then moved the buffer stop 9 m before finally coming to a stop (315 m from its original stationary position). See Figure 3 for photograph of accident.

Figure 3 – Locomotive at stopping position at buffer stop

5 The locomotive crossing over the points triggered the *Track Circuit Interrupter*, placing all signals protecting the entrance and exit from the Loop to danger.

6 The Train Driver then contacted the mainline signalman, through his supervisor, to inform him of the situation and stop all trains in the area.

7 There were no passengers or other crew members on the locomotive and nobody was injured as a result of the occurrence.

8 There was minor damage to the buffer stop. There was no damage to the locomotive.

Description of the railway

9 The railway line through Portlaoise is the double track route from Dublin to Cork (via Limerick Junction) and is signalled using two and three aspect *colour light signals* by the main line signalman based in CTC, Connolly Station. Running signal CY105 is an Up Mainline signal and running signals CY108 and CY107 are positioned on Portlaoise Loop (Figure 4).

10 When points 628 are in the normal position, the route is set for a train movement from Portlaoise Loop towards the Bay Platform road. The Bay Platform has been decommissioned and a buffer stop has been placed on the residual stub of the Bay Platform road just short of the platform ramp. This residual stub of track acts as *flank protection* for the Down Main when points 628 are in the normal position. When points 628 are in the reverse position, and CY107 indicates a proceed aspect, the route is set for a train movement onto the Down Main. Points 628 are fitted with a Track Circuit Interrupter, therefore trains passing these points towards the buffer stop, activate the track circuits and thus all protecting signals will either return to danger or remain at danger until the Track Circuit Interrupter has been reset. On the day of the accident, points 628 were set in the normal position.

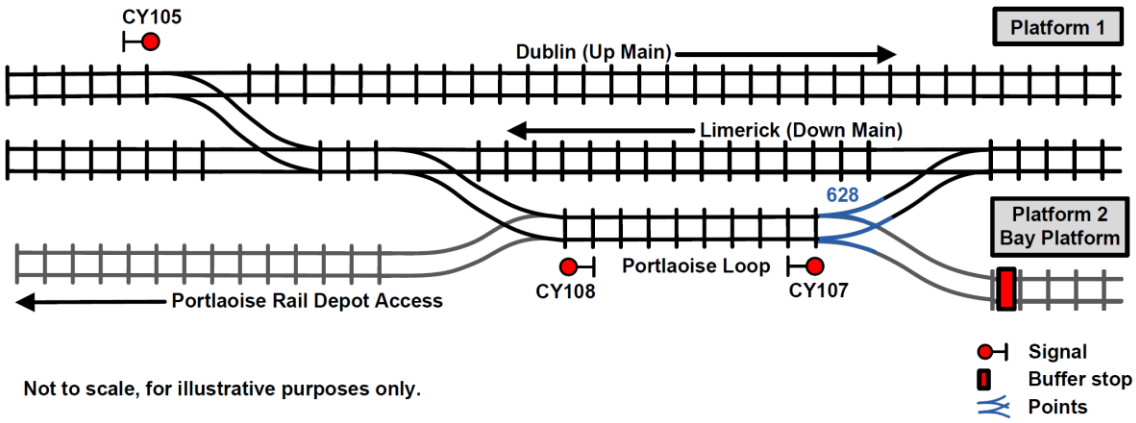

Figure 4 – Signalling layout

11 The RAWIE buffer stop, installed by IÉ, at the former Bay Platform road is a *friction type buffer stop* compliant with IÉ's technical specifications. H.J. Skelton & Company, on behalf of RAWIE, re-certified the buffer stop as part of the maintenance regime on the 6th September 2011, 23 days before the accident. The buffer stop was examined after the accident, and found to be in good condition, with no faults. There are no apparent failures of the buffer stop in relation to compliance with requirements and specifications laid down by IÉ.

12 Portlaoise Loop is plain line with flat bottom *continuously welded rail* (CWR) mounted on concrete sleepers in ballast. The gradient of the track at Portlaoise Loop is 1 in 230, sloping down towards Dublin.

13 Train movements in the vicinity of Portlaoise Station are controlled by the main line signalman. *Track Circuit Block* (TCB) regulations apply to this route. The speed limit on the mainlines is 90 miles per hour (mph) or 145 kilometres per hour (km/h); with a 20 mph (32 km/h) speed limit on the Portlaoise Loop. The means of communication between the train drivers and the main line signalman on this route is through train radio or signal post telephone.

14 Locomotive 082 is a Class 071 type locomotive, which entered service in 1976. It has a mass of 100,600 kilograms (kg) when fully loaded with fuel, oil and coolant and a length of 17.374 m. It had a maximum allowable speed of 145 km/h when hauling carriages, but is restricted to 120 km/h when operating as a *light engine.* The locomotive was not hauling any vehicles at the time of the accident, and was carrying 3785 litres (l) of diesel fuel and 757 l of coolant.

Fatalities, injuries and material damage

15 There were no fatalities or injuries to the Train Driver or any other person as a result of this accident.

16 There was no damage to the locomotive as a result of the impact with the buffer stop. The buffer stop moved, as would be expected, but did not receive any damage as a result of being struck.

Parties and roles involved in the occurrence

17 Iarnród Éireann (IÉ) is the railway undertaking that owns and operates mainline railway services in Ireland. IÉ is also the railway *infrastructure manager*, managing the design, installation, testing, inspection, maintenance, renewal and operation of the railway's physical assets. The IÉ departments associated with this accident are the:

- Intercity and Commuter Network Department (ICCN) – responsible for the operation of trains on the mainline, excluding the DART network. This includes the supervision of train drivers. ICCN is also responsible for the control of train movements through Centralised Traffic Control (CTC) in Dublin and regional controlling signal cabins;
- Chief Civil Engineer's Department (CCE) – responsible for the design, inspection, maintenance and renewal of the railway's structural infrastructure, including buffer stops;
- Chief Mechanical Engineer's Department (CME) – responsible for the specification, purchasing, commissioning and maintenance of rolling stock, including management of the maintenance depots, associated personnel and procedures. CME include the Fleet Technical Services (FTS) Section, who report to the CME Technical Manager and are responsible for setting the maintenance standards and checking compliance of the rolling stock.

18 RAWIE is the company that developed and manufactured the buffer stop at Portlaoise Station. RAWIE have subcontracted H.J. Skelton & Company to certify the buffer stop at prescribed intervals.

19 The Train Driver was an IÉ employee, passed as competent to drive trains (including Class 071s) on the 4th June 1996. He normally drives Class 201 locomotives and Class 22000 Intercity Diesel Multiple Units, while driving Class 071 locomotives intermittently. The last time he had driven a Class 071 prior to the accident was two months previous.

External Circumstances

20 The weather at the time of the accident was bright, fine and sunny. Met Éireann recorded a dry day with maximum and minimum temperatures 18.6˚C and 13.9˚C, respectively. The average wind speeds were 10.6 knots (19.6 km/h).

RAIU Investigation

RAIU decision to investigate

21 In accordance with the Railway Safety Act 2005 the RAIU investigate all serious accidents. Under slightly different conditions, this occurrence may have lead to a serious accident such as a derailment or a collision with a train on the Down Main line where there would be a potential for fatalities, serious injuries and extensive damage. As a result of these possible consequences the RAIU have made the decision to investigate this occurrence.

Scope of investigation

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

- Establish the sequence of events;
- Establish the immediate cause, contributory factors and underlying causes;
- Examine the relevant elements of the safety management system;
- Examine any other significant safety deficiencies identified as a result of this investigation.

Investigation and evidence

23 The RAIU was notified of the accident at 11:34 on the 29th September 2011 and immediately mobilised to the site of the occurrence to conduct an on-site investigation. During the on-site and off-site investigation the RAIU collated and logged the following evidence:

- Photographic record of occurrence site;
- In-situ surveys for positioning of infrastructure and rolling stock;
- Witness testimonies from parties involved in the occurrence;
- Other testimonies from members of the RU with information pertaining to the occurrence;
- Inspection and maintenance records for inspections carried out on the infrastructure;
- RU standards, procedures and other documentation;
- Standards, procedures and documentation from other relevant bodies (e.g. RAWIE);
- Data from the *On Train Data Recorder (*OTDR);
- Reports from simulations conducted by IÉ under the supervision of the RAIU.

Focus of RAIU Report

24 Based on the RAIU investigation, the key areas of interest under IÉ's Safety Management System can be summarised as follows:

- Competency and competency management of the locomotive train driver;
- Performance of the braking system for Class 071 locomotives;
- Performance of the buffer stop.

Evidence

Braking system for Class 071 Locomotives

25 The 071 class locomotive has an *air and vacuum braked* system, which means that the locomotive brakes are operated by air, and the brake control system will control the brakes on either a train composed of air-braked vehicles or a train composed of vacuum-braked vehicles. The main elements associated with the braking system are described below:

- Independent brake – This brake is operated by the train driver and applies the brake to the locomotive only (and to the trailing locomotive(s) when more than one locomotive is connected);
- Combined brake – This brake is operated by the train driver and applies the brakes to the locomotive(s) and any attached vehicles.

26 Components of the braking system, relevant to this occurrence are as follows:

- Brake cylinder – When the brakes are operated, air enters the brake cylinder, moving its piston so as to apply the brakes through a mechanical linkage. Brakes are released when air is exhausted from the brake cylinders. A 071 class locomotive has a total of twelve brake cylinders;
- MU-2B-1 valve (which will be referred to as MU2 valve for the remainder of the report) – This valve is operated by the train driver and is used to enable controls in one cab to be operational at any one time (including the braking system). Only the MU2 in the driving cab should be cut-in to operate the locomotive. This is a two-position valve that can be set by the train driver so as to 'cut-in' the control equipment for the brakes in the cab from which the locomotive (or consist of locomotives) is being driven. Only the MU2 Valve in the cab from which the locomotive is to be driven should be 'cut-in' to operate the locomotive.

27 As mentioned previously, the main elements and components associated with the braking system for this accident are the Independent Brake, the Combined Brake, the Brake Cylinder and the MU2 valve. The critical braking pressures for the Class 071 locomotive are 28 pounds per square inch (psi) or 193 kilopascal (kPa) for full brake application, with the brakes beginning to release under 5 psi (34 kPa), dependent on the gradient of track; with the brakes being fully released at 0 psi (0 kPa).

28 The movements of the locomotive, and the braking pressures, were recorded by the OTDR and are illustrated in Figure 5 below:

Time	Distance (m)	Speed (km/h)	Actions	Recorded braking pressures
10.54.17	0	0	Locomotive stops Dublin side of CY108.	
10.54.30	0	0	MU2 is cut-out with combined brake in release.	28 psi or (193 kPa), brakes are fully applied.
10.57.12	0	0	Locomotive starts to move.	2 psi (13 kPa), brakes are releasing.
10.59.04	254	22.4	Point of impact with the buffer.	
10.59.12	272	0	Locomotive comes to a stop.	

Figure 5 – OTDR download

29 The last *major overhaul* of the braking system on locomotive 082 was completed on the 18th May 2007. There is no formal record of this overhaul or the maintenance works carried out during this overhaul. The next overhaul was due after 350,000 km or 4 years, whichever came first. Given that, since May 2007, there was 193,120 km travelled, the next major overhaul was due in May 2011. This overhaul did not take place.

30 The major overhaul includes the overhauling of the braking system, including the replacement of the isolation cock, which occurs irrespective of its condition.

31 The Motive Power Instruction which forms part of the examinations and included a *brake leakage test* were changed to that of a Vehicle Maintenance Instruction (VMI) in July 2010 by the FTS Section. However, the new VMI omitted the brake leakage test. This omission was not identified at any stage during the 'change of instructions process' or the 'instruction approval process' conducted by FTS Section and the Technical Manager as there was no quality control process in place for changes to maintenance procedures at the time of the accident (such as IÉ's Technical Management Standard, CME-TMS-316, Engineering change request (second version issued in August 2011).

32 Scheduled maintenance requirements for 071 class locomotives are specified in VMI examinations, which fall under four types of examinations, detailed in bullets below. Each of these exams includes more intensive examination than that of the previous (i.e. the ABCD Examination is a more thorough examination than the A Examination), with the tasks in the more frequent lower order exams being included, or replaced by more intensive tasks in the less frequent higher order exams (i.e. An AB Exam includes the A exam).

- 071 Class 'A' Exam Mechanical ('A Exam') – which has a frequency of every 3,000 km or 4 weeks, whichever is first;
- 071 Class 'AB' Exam Mechanical ('AB Exam') – which has a frequency of over every 25,000 km or 28 weeks, whichever is first;
- 071 Class 'ABC' Exam Mechanical ('ABC Exam') – which has a frequency of every 50,000 km or 56 weeks, whichever is first;
- 071 Class 'ABCD' Exam Mechanical ('ABCD Exam') – which has a frequency of every 100,000 km or 112 weeks, whichever is first.

33 These examinations for locomotive 082 were carried out at the correct frequency. In chronological order, the locomotive received an 'ABCD Exam' on the 13th October 2010, an 'AB Exam' on the 10th April 2011 and an 'A Exam' on the 23rd of September 2011, which included either a service or standard brake test, but no brake leakage test. During the 'A Exam' conducted on the 23rd September 2011, six days before the accident, the locomotive successfully passed the 'Service Brake Exam'.

34 The locomotive was examined after the accident and a leak was discovered at the isolation cock for the independent brake pipe hose, see Figure 6. Three other leaks were detected on the locomotive brake system. However, IÉ under the supervision of the RAIU conducted a number of simulations and verified that the leak discovered at the isolation cock for the independent brake pipe hose was the only one which contributed to the accident.

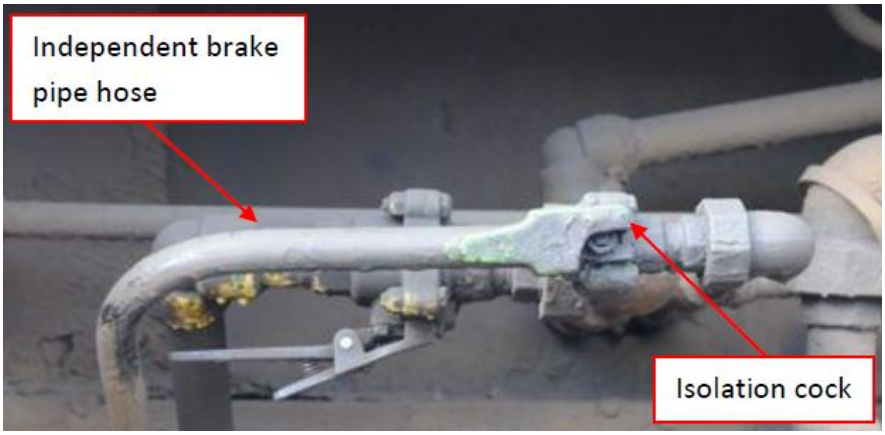

Figure 6 – Isolation cock for the independent brake pipe

Train Driver operation and competency

35 Section 4.1.F, Pre-service checks of IÉ's Drivers' Manual for 071 class locomotives, Volume 3 (operational since 31/05/2005), requires a number of pre-service checks to be conducted, including the brake leakage test.

36 The brake leakage test should be carried out in one of the locomotive cabs, as follows:

i. Ensure that the handbrake is applied;
ii. Apply both brake handles to full service;
iii. Cut-out the MU2 valve;
iv. Check the brake cylinder gauge reading and observe that for 1 minute there is no drop in the brake cylinder pressure;
v. Cut-in the MU2 valve.

37 In relation to vacating a cab during service, Section 4.4.A, 'Cab being vacated', of the train drivers' manual, sets out the following procedure that a train driver must carry out when changing cab ends:

i. Apply both brake handles to the full service position and check that the brake gauges read accordingly;
ii. Apply the train brake handle to the emergency position;
iii. Observe that the brake pipe gauge pressure falls to 0 pounds psi (0 kPa);
iv. Cut-out the MU2 valve;
v. Place the train brake handle in the full service position;
vi. Remove the master control key;
vii. Switch off the engine run and generator field switches;
viii. Switch off the train radio;
ix. Place the CAWS unit in the disable position;
x. Change marker lights as required;
xi. Switch off the headlamps and wipers;
xii. Turn off heaters, hotplate and cab lights;
xiii. Close windows and lock cab doors.

38 Section 4.4.B, 'Cab being occupied' requires train drivers to:

i. Check that both brake handles are in full service position;
ii. Insert and turn on the master control key;
iii. Cut-in the MU2 valve;
iv. Switch on the engine run and generator field switches;

v. Set up the train radio and test its operation;
vi. Set up the CAWS unit as required;
vii. Switch on marker lights/headlamps as required.

39 As the Train Driver qualified prior to the introduction of IÉ's Drivers' Manual for 071 class locomotives, Volume 3 in May 2005, he was issued the manual. There is no evidence available to the RAIU that there was any formal briefing to train drivers in relation to the addition of the brake leakage test and hand brake test as part of the issuing of this manual.

40 IÉ's Railway Safety Standard 16, 'Competence Management System – Train Drivers' requires that train driver's competence is assessed biannually through Formal Driving Assessments (FDA). These must be undertaken on turns of duty that give maximum opportunity to assess competence through direct observation and must be of no less than 90 minutes driving duration. The train driver is expected to drive the train in accordance with IÉ's Professional Driving Policy; and should describe all actions that are being performed (known as 'Commentary Driving'), to confirm underpinning knowledge. This must include:

- What actions are being performed;
- What observations are being made;
- Why are the actions/observations being performed;
- When are the other occasions when these actions/observations will be performed.

41 During the FDA a 'Competency Assessment Evidence Form' is completed, under 'General tasks assessed' in this form the assessor must award the train driver a 'Prompt/ coached', 'Item marked for review' or 'Competent' score, where the assessor has witnessed the train driver undertaking the action. In relation to the last four assessments undertaken by the Train Driver (dated the 07/05/10, 04/11/10, 19/07/11, 09/09/11), the Train Driver was scored 'Competent' on three of these occasions in relation to 'Changing ends/handing over the cab in the correct manner', and in relation to the fourth assessment, the Train Driver was not required to carry out this task and therefore was not assessed on that occasion, with the score marked as 'N/A' (not applicable). However, it is not evident if the Train Driver was assessed for 'changing ends' or for 'handing over the cab in the correct manner'.

42 Refresher training is undertaken every two years, but does not include any retraining on the preparation of the units, such as pre-service checks or the brake leakage test nor does it include any training on changing cab ends. Refresher training is primarily based on retraining for events that the train driver does not normally encounter (e.g. emergency situations).

Events preceding the occurrence

43 As discussed in paragraphs 29 and 33 the locomotive had not undergone it's scheduled major overhaul, but had undergone an 'A Examination' on the 23rd September 2011 where it passed the 'Service Brake Test'. There was no brake leakage test carried out during this examination.

44 The locomotive was driven by a different train driver from Portlaoise to Limerick Junction on the 28th September, the day before the accident. A brake leakage test was not carried out, by this train driver, on this day.

45 When the Train Driver reported for duty at Portlaoise Station there was no locomotive available for him to use, therefore he travelled to Limerick Junction to collect locomotive 082. On boarding the locomotive, the Train Driver did not correctly conduct the pre-service checks as required by IÉ's Drivers' Manual for 071 class locomotives (outlined in paragraphs 35). He did not conduct the brake leakage test (outlined in paragraph 36), and instead, only checked the locomotive for emergency safety equipment.

46 The Train Driver then travelled from Limerick Junction to the outskirts of Portlaoise Station without incident. He stopped the locomotive on the Up Main at signal CY105 (see Figure 7), prior to attempting to manoeuvre into Portlaoise Rail Depot (see Figure 7 for the intended route of the locomotive, which required the Train Driver to cross onto the Down Main and then onto the Portlaoise Loop, stop temporarily on the Portlaoise Loop in order to set the ground frame and travel into Portlaoise Rail Depot).

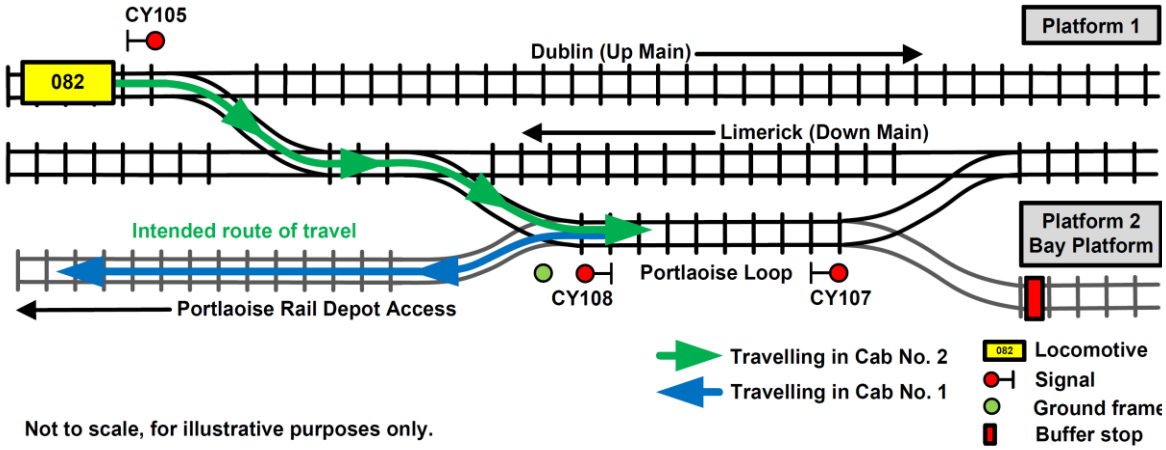

Figure 7 – Intended route of travel for the locomotive

47 The Train Driver crossed from the Up Main onto the Down Main and then onto the Portlaoise Loop where he stopped at signal CY108, see Figure 8.

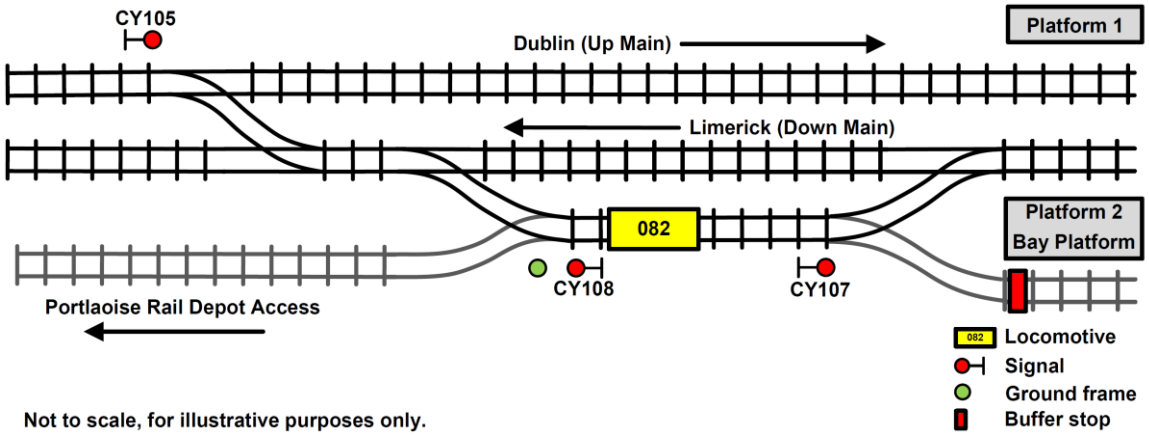

Figure 8 – Locomotive stopped on Portlaoise Loop

Events during the occurrence

48 As the locomotive was being driven from the cab facing towards Dublin, the Train Driver was required to switch ends (from Cab No.2 to Cab No.1) in order to manoeuvre the locomotive into Portlaoise Rail Depot. This required him to follow the procedures set out in Section 4.4.A & 4.4B of the IÉ's Drivers' Manual for 071 class locomotives (outlined in paragraph 37 and 38) in relation to vacating and occupying cabs. This would have resulted in brakes being applied to the full service position, therefore completing the brake circuits, when the MU2 valve in Cab 2 was cut-out (when vacated) and the MU2 valve in Cab 1 cut-in (when occupied); and would not have been affected by any brake leaks. Figure 9, shows what would occur with the MU2 valve cut-out in Cab 2 & cut-in in Cab 1, as procedure dictates (in blue) or having MU2 valve cut-out in both cabs, as occurred on the day of accident (in orange). It should be noted that the figure has had its functionality simplified and is for illustrative purposes only.

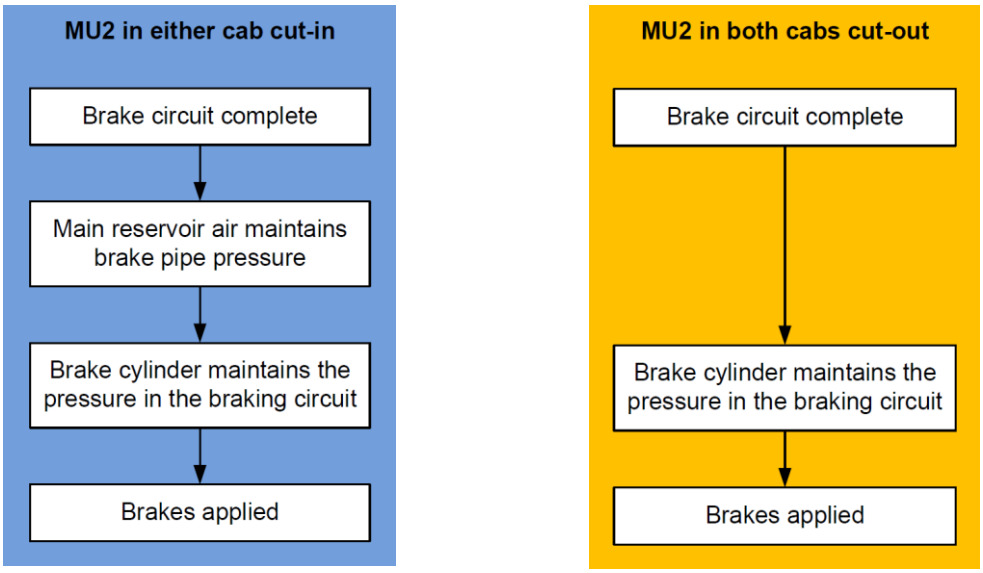

Figure 9 – Illustrating what would occur with either or no MU2 valve cut-in (and no leak)

49 The Train Driver did not follow these procedures in full. Figure 10 compares the actions that should have been taken by the Train Driver, to those actions that the Train Driver actually carried out on the day of the accident in relation to the 'cab being vacated'. In summary, in relation to the 'cab being vacated' the Train Driver did not apply the Combined Brake to the full braking position or the emergency braking position at any stage.

Figure 10 – Actions to be taken by train drivers in relation to vacating a cab according to the manual compared with actual actions taken by Train Driver on the day of the accident.

50 In relation to 'cab being occupied', the Train Driver did not cut-in the MU2 valve, and only placed his equipment in Cab 1, see Figure 11. However, cutting-in the MU2 valve in Cab 1 would still have resulted in the brakes applying, see Figure 9.

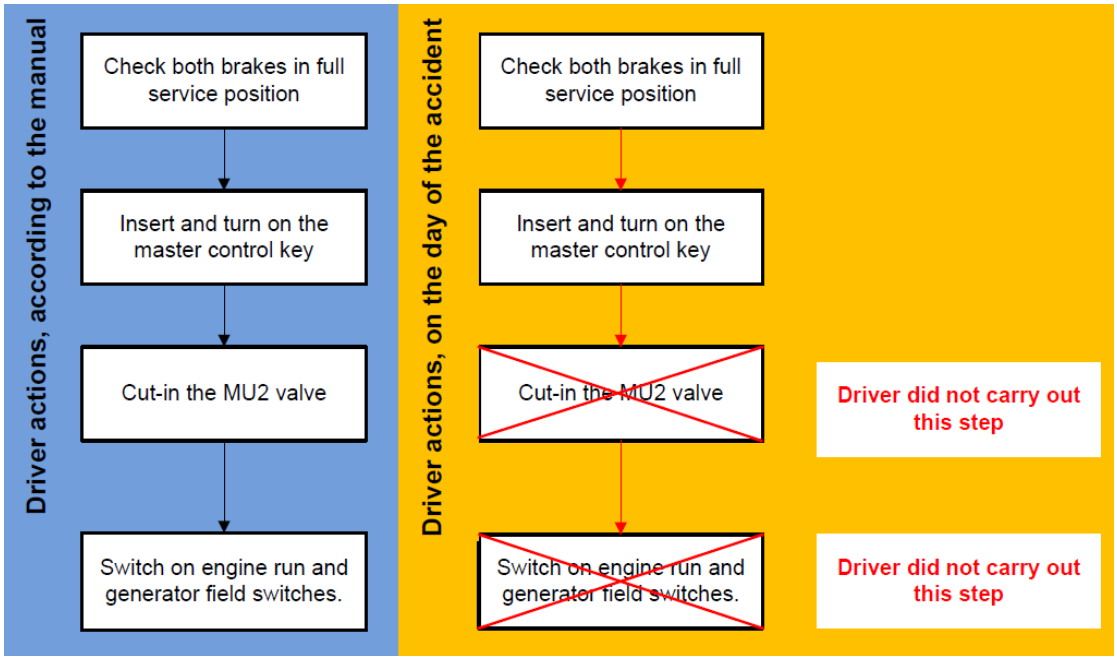

Figure 11 – Actions to be taken by train drivers in relation to occupying a cab according to the manual compared with actual actions taken by Train Driver on the day of the accident.

51 The Train Driver, who believed that the locomotive was secured and was safe to leave unattended; then disembarked, and made his way to the ground frame in order to set the route into Portlaoise Rail Depot. While the Train Driver was operating the ground frame, air leakage caused the locomotive brakes to release 2 minutes and 42 seconds after he had cut out the MU2 valve in Cab No.2, and the locomotive started rolling down the gradient towards Portlaoise Station. Had the full service brakes been applied as per the train drivers' instructions the brakes would have remained applied, despite the leak at the isolation cock for the independent brake pipe hose, see Figure 12. The fact that the combined brake handle was left in release allowed the brake cylinder pressure to drop as a result of the air leak at the isolation cock for the independent brake pipe hose, therefore causing the brakes to release, and the locomotive started to roll down the gradient, see Figure 12.

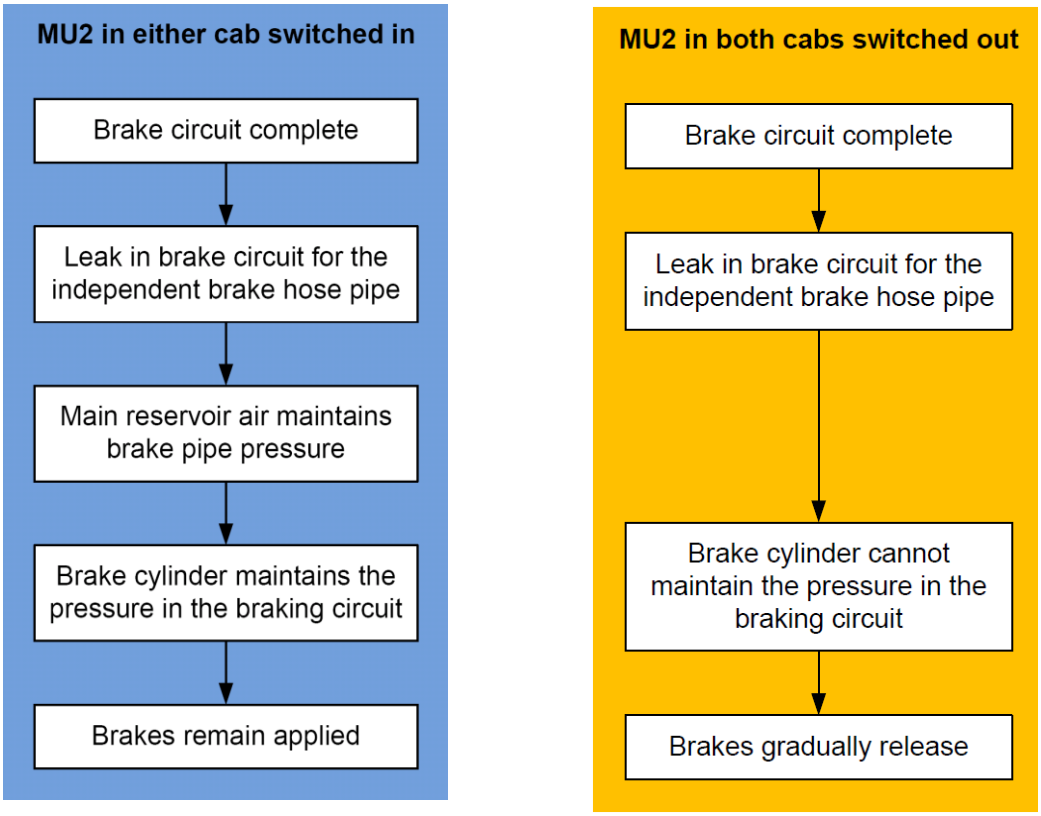

Figure 12 – Illustrating what would occur with either or no MU2 valve cut-in (and the leak present).

52 With the brakes gradually releasing, and the locomotive being on a gradient, the locomotive began to roll towards Portlaoise Station, reaching an approximate speed of 23 km/h, passing signal CY107 at danger and colliding with the buffer stop at the Bay Platform before coming to a stop, see Figure 13.

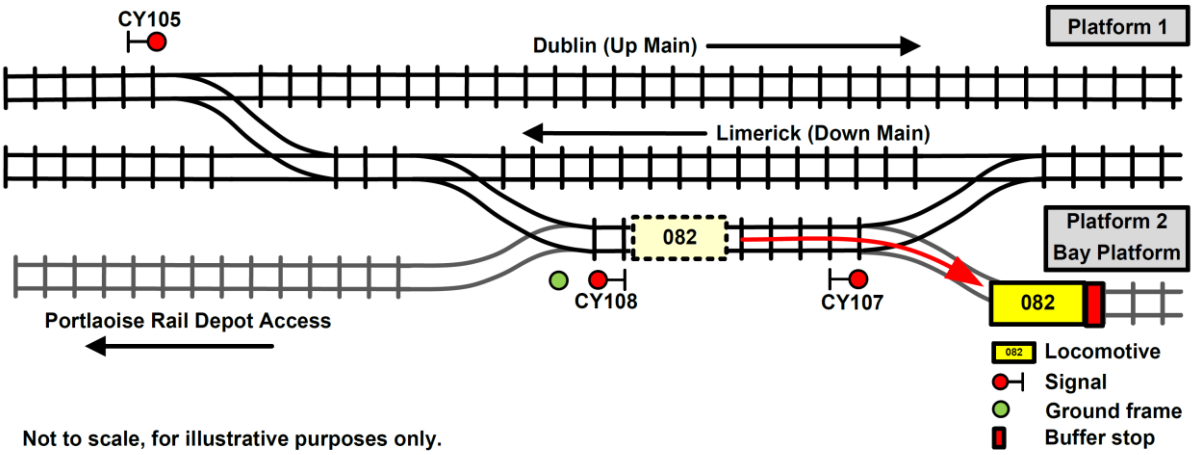

Figure 13 – Locomotive at buffer

Events after the occurrence

53 The Train Driver saw the locomotive running away and ran after it. When the locomotive came to a stop he secured the locomotive by cutting-in the MU2 valve and applying the combined brake to the emergency position before proceeding in notifying the relevant parties of the accident.

Similar occurrences

54 In order of most recent, the following occurrences are similar to this accident:

- On the 23/05/2009, the 18:30 Cork-Heuston service arrived on Platform 6, Heuston Station. Six minutes later, when the locomotive was uncoupled, the train rolled back approximately 16 metres and collided with the buffer stop;
- On the 18/02/2008 a shale train rolled away at the Limerick cement factory siding;
- On the 02/04/2007 a timber wagon ran away for about 60 yards at Westport Station;
- On the 21/12/2006 a locomotive ran away through station level crossing (XX072) at Ballina. The locomotive was being moved during a shunt manoeuvre. The green hose valve (loco brake equalisation line) was found slightly open on locomotive after the occurrence;
- On the 02/11/2006 an MkII vehicle ran away, passing a signal at danger before derailing on *trap points* at Heuston. At the time of the occurrence the MkII vehicle was being shunted with an MkIII set which had incompatible brake systems (air and vacuum);
- On the 26/03/2006 an electric multiple unit ran away and rolled into a dept shutter at Fairview;
- On the 15/08/2005 a locomotive ran away and collided with buffer stop at Drogheda;
- On the 04/06/2004 a carriage ran away from a siding at Heuston, passing a signal at danger and derailing on points;
- On the 08/04/2004, while a train driver was changing locomotives during a shunting operation, at Ballina Station Level Crossing, the locomotive ran away and struck one of the level crossing gates, resulting in damage to the gates;
- On the 30/01/2004, a single vehicle rolled away and collided with a buffer stop at Heuston;
- On the 22/11/2003, while shunting a Guinness wagon which was left on Platform 1 at Athlone Station, the wagon ran away and passed a signal at danger; there were no brakes applied on the Guinness wagon;
- On the 12/07/2003 a Guinness wagon ran away, passing a signal at danger and derailed on trap points at Waterford Station;
- On the 30/07/2002 a brake van on Platform 6 of Connolly Station, ran away, passing a signal at danger, during a runaround movement;
- On the 10/05/2002 air-brake wagons ran away as a locomotive was being hooked up in Portlaoise Yard. One of the wagons collided with a buffer stop and derailed; the buffer stop was damaged as a result of the occurrence.

Analysis

Performance of braking system of locomotive 082

55 The locomotive did not undergo its last major overhaul (paragraph 29), due five months before the accident, which would have included the replacement of the isolation cock, irrespective of condition at the time of overhaul. Therefore had the leak in the isolation cock for the independent brake pipe hose existed at this time of the scheduled overhaul, it would have been replaced as part of this maintenance.

56 The last maintenance, conducted 6 days before the accident passed the 'Service Brake Test', however, there was no brake leakage test required under the VMI, and therefore not carried out (paragraph 33).

57 The FTS Section system for introducing new standards did not detect the omission of the brake leakage test as part of the VMIs, and was only detected after the occurrence resulting in 14 months of no brake leakage tests being conducted on the locomotives (paragraph 31). This omission was as a result of no quality control process being in place in relation to engineering maintenance changes.

58 Examining the actions that the Train Driver took on the day of the accident, had the braking system been fully operational (i.e. without any leaks), the braking system would have been expected to perform despite the Train Driver not following the correct procedures. In addition, given the circumstances on the day of the accident (i.e. the leak being present), the brakes would still have remained applied if the Train Driver took the same actions in relation to vacating Cab 2, but had cut-in the MU2 valve in Cab 1 (Figure 12). However, with the leak present, and both MU2 valves cut out, brake cylinder pressure could not be maintained and therefore gradually released (Figure 12).

Train Driver operations and competency

59 The locomotive was being operated by an experienced train driver, who although supplied with IÉ's Drivers' Manual for 071 class locomotives which outlined the pre-service checks required (outlined in paragraph 35), did not carry out all these pre-service checks including the brake leakage test (outlined in paragraph 36). Without carrying out this test during the pre-service checks, the leak, which is likely to have been present was not detected by the Train Driver.

60 As the Train Driver qualified in 1996, and IÉ's Drivers' Manual for 071 class locomotives, Volume 3 was introduced in 2005 without a formal briefing or training session, this may have resulted in

the Train Driver not having a full appreciation for the importance of the brake leakage test as part of the pre-service checks (paragraph 39).

61 On stopping on the Portlaoise Loop, the Train Driver did not carry out all the instructions in relation to a cabs being vacated and occupied under IÉ's 'Drivers' Manual for 071 class locomotives' (as described in paragraphs 37 & 38). Comparing the actions of the Train Driver on the day of the accident with the actions he should have taken (as compared in Figure 10 and Figure 11) it can be seen that the Train Driver did not apply the Combined Brake into the full service position or the emergency position at any stage and only applied the Independent Brake to the full service position. He also, did not follow the required sequence and switched off the engine run and generator field switches prior to cutting out the MU2 valve. On occupying the other cab, the Train Driver did not cut-in the MU2 valve.

62 The Train Driver not carrying out these actions, combined with the air leak at the isolation cock for the independent brake pipe hose, resulted in the locomotive brakes gradually being released (Figure 12) and the locomotive running away as it was on a gradient, passing a signal at danger and striking the buffer stop.

63 The Train Driver's confidence in thinking that the locomotive was secured and safe to leave unattended may have been enforced by the fact that the Train Driver had not received any formal briefing on IÉ's 'Drivers' Manual for 071 class locomotives' (paragraph 39).

64 In relation to the Train Driver's competency, train drivers are only assessed for changing cab ends, when they are required to undertake this as part of their routine on the day of the assessment (paragraph 40). If the train driver is not required to change cab ends, he is not assessed in this task. 'Changing cab ends' is also grouped with 'Handing over the cab in the correct manner', which has different procedures. Therefore the train driver's competency in relation to employing the correct procedures for changing cab ends may not be assessed, depending on the routine requirements for the train driver on the day of the assessment. In relation to the Train Driver who was driving on the day of the accident, during his last four assessments over a two year period, he was assessed and proved competent in three of the four times in relation to 'Changing ends/handing over the cab in the correct manner'. However, it is not evident if the Train Driver was assessed for 'changing ends' as part of 'handing over the cab in the correct manner' (paragraph 41).

65 The refresher training for train driver's of locomotives is given every two years (paragraph 42) and focuses on one off events that the train driver is not likely to experience as part of his daily routine (e.g. emergency situations). Therefore, the train drivers do not undergo any retraining in terms of pre-service checks (such as the brake leakage test) or changing cab ends.

Conclusions

Performance of the braking system of locomotive 082

66 As a result of the locomotive not undergoing its last major overhaul, due five months before the accident, the braking system for the locomotive did not undergo routine maintenance prior to the accident occurring which would have included the replacement of the isolation cock. Had the isolation cock been leaking at the time of the scheduled overhaul it would have been replaced at this time (paragraph 55).

67 Although the locomotive examination conducted 6 days before the accident and passed the 'Service Brake Exam' no brake leakage test was conducted (paragraph 56).

68 The absence of a quality control process applicable to engineering maintenance documentation (paragraph 57) resulted in the FTS Section and the Technical Manager's not detecting the omission of the brake leakage test as part of the VMIs.

69 Although, under certain conditions the brakes on the locomotive would have remained applied despite the Train Driver not following the correct procedures for vacating and occupying cabs (paragraph 58, Figure 10 and Figure 11); the locomotives brakes did release when the Train Driver did not cut-in either MU2 valves (Figure 12) as a there was a leak in the isolation cock.

Train Driver operation and competency

70 The locomotive was being operated by an experienced train driver who first qualified in 1996. And although he was issued with under IÉ's Drivers' Manual for 071 class locomotives, which prescribed the pre-service checks required, he did not carry out all these checks, in particular the brake leakage test, on the day of the accident (paragraph 59). Without carrying out the brake leakage test during the pre-service checks, the leakage, which is likely to have been present at this stage was not detected by the Train Driver.

71 In relation to vacating and occupying cabs the Train Driver did not carry out all the instructions given under IÉ's 'Drivers' Manual for 071 class locomotives' (paragraph 61). This resulted in the brakes not being adequately applied when the Train Driver disembarked the locomotive; this combined with the leakage resulted in the brakes releasing and the locomotive running away for a distance of 315 m, passing a signal at danger and striking the buffer stop (paragraph 62).

72 As the Train Driver qualified in 1996, and IÉ's Drivers' Manual for 071 class locomotives, Volume 3 was introduced in 2005 without a formal briefing or training session, this may have resulted in

the Train Driver not having a full appreciation of the importance of the brake leakage test as part of the pre-service checks and the importance of following the prescribed instruction in relation to vacating and occupying cabs (paragraphs 60 & 63).

73 As the Train Driver's competency requirements do not specifically require that the train driver be assessed in relation to changing cab ends, the train driver's competency in relation to this task can be overlooked and could continue to be overlooked throughout numerous assessments (paragraph 64). In addition, refresher training does not include any retraining in pre-services checks (including the brake leakage test) or changing cab ends, with the primary focus of the retraining being on situations the train driver is not likely to experience (e.g. emergency situations) (paragraphs 65).

Immediate cause, causal factors, contributory factors and underlying factors

74 The *immediate cause* of the locomotive running away, whilst left unattended on a gradient, was the gradual release of the brakes. This was as a result of the following *causal factors* (CF), which were necessary for the accident to occur:

- CF-01 – An air leak in part of the braking system;
- CF-02 – The Train Driver did not fully comply with the instructions for vacating and occupying locomotive cabs, set out in IÉ's Drivers' Manual.

75 Contributory to the accident occurring are the following *contributory factors* (CoF):

- CoF-01 – The overhaul in the braking system did not occur within the allocated time and therefore the locomotive was only subject to examination which did not include the brake leakage test which may have detected any faults in the braking system;
- CoF-02 – The leak in the braking system was not detected during any pre-service checks carried out by the train drivers.

76 The *underlying factors* (UF) were:

- UF-01 – There was no quality control system in place for the updating of testing procedures which resulted in the omission of the brake leakage test from the newer procedures;
- UF-02 – IÉ's Drivers' Manual for 071 class locomotives had not been formally briefed to train drivers on its introduction in 2005, resulting in the Train Driver not fully appreciating the necessity of the brake leakage test included in the pre-service checks, or the necessity to carry out the braking instructions, in full, in relation to vacating and occupying locomotive cabs;
- UF-03 – There was no system in place to ensure that train drivers are routinely assessed in relation to changing cab ends on locomotives.

Relevant actions taken or in progress

77 The Train Driver has now been briefed on IÉ's 'Drivers' Manual for 071 class locomotives, Volume 3' and additional corrective coaching was included as part of this briefing.

78 The CME, within a week of the accident, reviewed and changed the VMI to include the brake leakage tests.

79 As a result of the accident, braking examinations were carried out all Class 071 locomotives in the fleet. These examinations resulted in five other locomotives having faults detected in relation to their braking system, however, none of these faults were of a safety critical nature and none were similar to the fault detected in this occurrence. These faults were rectified before being re-entered into service.

80 A programme was introduced to have the brake overhaul completed on all Class 071 locomotives by the end of 2011. In addition, the CME Department initiated an interim brake examination which is carried out on a fortnightly basis. This test was performed on all locomotives which had not received their scheduled brake overhaul.

81 The CME has issued an instruction that all changes to VMIs are to be placed through the quality control process, outlined in IÉ's Technical Management Standard, CME-TMS-316, Engineering change request. This standard was updated in February 2012 to ensure that all changes to maintenance procedures must be placed through this quality control process.

Safety recommendations

General description

82 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 RSC. The recommendation is directed to the party identified in each recommendation.

83 As a result of the RAIU investigation, four new safety recommendations have been made in relation to the occurrence.

New safety recommendations related to the occurrence

84 The locomotive was in service, while not having undergone a brake leakage test exam during its last routine inspection (CoF-01); therefore the RAIU make the following safety recommendation to improve rolling stock maintenance procedures:

IÉ should review their VMIs for locomotives to ensure that there are adequate braking tests at appropriate intervals.

85 The brake leakage test was omitted from the VMI, when procedures were updated (UF-01); therefore the RAIU make the following safety recommendation to improve rolling stock maintenance quality control procedures:

IÉ should adopt a quality control system, for the introduction of new maintenance procedures for locomotives.

86 The Train Driver did not complete the pre-service checks and follow the instruction correctly in relation to vacating and occupying cabs (CoF-02); therefore the RAIU make the following safety recommendation to improve train drivers' competency management systems:

IÉ should review their system for introducing new train drivers' manuals, to ensure that train drivers are fully trained and assessed in all aspects of these manuals.

87 The competency management system failed to adequately brief the Train Driver on new procedures in relation to pre-service checks and changing cab ends (CoF-02, UF-02) and the failed ensure that these tasks were assessed during routine assessments (UF-03); therefore the

RAIU make the following safety recommendation to improve train drivers' competency management systems:

IÉ should review their competency management system for train drivers to ensure that all driving tasks are routinely assessed.

Additional information

List of abbreviations

CAWS	Continuous Automatic Warning System
CCE	Chief Civil Engineer
CF	Causal Factor
CME	Chief Mechanical Engineer
CoF	Contributory Factor
CTC	Centralised Traffic Control
CWR	Continuous Welded Rail
ICCN	Intercity and Commuter Network
km/h	kilometres per hour
m	metre
mph	Miles per hour
RAIU	Railway Accident Investigation Unit
TCB	Track Circuit Block
UF	Underlying Factor

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.
Air braked	Describes a rail vehicle equipped with an automatic brake, where the brakes are operated by air pressure.
Brake leakage test	Test undertaken to ensure that the brakes are fully operational, in that there is no air leakage which would affect the brake performance.
Causal factors	Any factor(s) necessary for an occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.
Continuous Automatic Warning System	A form of cab signalling and train protection system to aid train drivers in observing and obeying lineside signals.
Contributory factor	Any factor(s) that affects, sustains or exacerbates the outcome of an occurrence. Eliminating one or more of these factor(s) would not have prevented the occurrence but their presence made it more likely, or changed the outcome.
Colour light signals	Signals which convey movement authorities to train drivers by means of

	coloured lights.
Continuous Welded Rail	Rails welded together to form one continuous rail that may be several kilometres long.
Contributory factors	Any factor(s) that affects, sustains or exacerbates the outcome of an occurrence. Eliminating one or more of these factor(s) would not have prevented the occurrence but their presence made it more likely, or changed the outcome.
Double track	A route with two separate tracks for Up and Down movements.
Down Main	Railway line travelling in the direction of ascending mileposts (in this case towards Limerick Junction).
Extensive damage	Damage that can be immediately assessed by the RAIU to cost at least €2,000,000 in total.
Flank protection	Arrangements for providing additional protection from unauthorised movements on converging lines by utilising other points in the junction as trap points.
Friction type buffer stop	Buffer stop which is specially designed to absorb the energy of a moving train using friction elements rubbing on the railhead, to help to dissipate the energy as the buffer stop is moved backwards. It is designed to stop a variety of rolling stock types at modest speeds.
Ground Frame	A control point that contains levers and switches to permit the local operation of points and, where provided, signals. The local operation is only permitted when the controlling signal box gives a release.
Immediate cause	The situation, event or behaviour that directly results in the occurrence.
Incident	Any occurrence, other than an accident or serious accident, associated with the operation of trains and affecting the safety of operation.
Infrastructure Manager	Any body or undertaking that is responsible in particular for establishing and maintaining railway infrastructure, which may also include the management of infrastructure control and safety systems
Light Engine	Any locomotive not coupled to, drawing or propelling another vehicle.
Loop	A short length of track connected to another line at both ends.
Major Overhaul	Heavy maintenance, typically carried out between two and seven years, required to ensure the safe running of rolling stock.
On Train Data Recorder	A device fitted to trains to store key train parameters and train driver actions.
Railway Undertaking	Organisation that operates trains.
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.
Siding	A low speed track, generally not fitted with any signals, used for stabling, storing, loading and unloading vehicles, as well as an access routes to a facility which is not a main running line.
Track circuit block	A signalling system that uses track circuits to confirm the absence of trains in order to control the safe movement of trains.
Trap points	An assembly of one or more pair of switch half sets of worked switched intended to derail rail vehicles in the event of their unauthorised movement.
Underlying factor	Any factor(s) associated with the overall management systems, organisational arrangements or the regulatory structure.
Up Main	Railway line travelling in the direction of descending mileposts (in this case towards Dublin).
Vacuum braked	Describes a rail vehicle equipped with an automatic brake, normally maintained in the off position by a vacuum.

References

Iarnród Éireann (2005), Drivers' Manual for 071 class locomotives, Volume 3.

Iarnród Éireann (2011) Technical Management Standard, CME-TMS-316, Engineering change request, version 2.

Iarnród Éireann (2010), Professional Driving Policy.

Iarnród Éireann (2008), Railway Safety Standard 16, Competence Management System – Train Drivers