



Investigation Report 08120201



**Collision of a train with the gates of level crossing XH066,
Bridgetown, on the Limerick Junction to Rosslare Strand line**

2nd of December 2008

Document History

Title	Collision of a train with the gates of level crossing XH066, Bridgetown, on the Limerick Junction to Rosslare Strand line
Document type	Investigation Report
Document number	08120201
Document issue date	1 st December 2009

Revision number	Revision date	Summary of changes

Function of the Railway Accident Investigation Unit

The Railway Accident Investigation Unit (RAIU) is a functionally independent investigation unit within the Railway Safety Commission (RSC). The purpose of an investigation by the RAIU is to improve railway safety by establishing, in so far as possible, the cause or causes of an accident or incident with a view to making recommendations for the avoidance of accidents in the future, or otherwise for the improvement of railway safety. It is not the purpose of an investigation to attribute blame or liability.

The RAIU's investigations are carried out in accordance with the Railway Safety Act 2005 and European railway safety directive 2004/49/EC.

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Executive Summary

On the 2nd of December 2008 at 09.40 hours an infrastructure maintenance train approached level crossing XH066 at Bridgetown when the level crossing gates were closed across the railway line. The train struck the gates and came to a stop approximately thirty-nine and a half metres beyond the level crossing. XH066 is a CX type level crossing, meaning that the gates are kept closed across the railway unless a train is passing. After the accident the mechanically operated semaphore signal protecting XH066 was found to be displaying an ON aspect, therefore indicating that trains should be prepared to stop in advance of the gates. The signal was reported by the train crew as displaying an OFF aspect, allowing trains to proceed and expect the gates to be open for rail traffic, at the time the train passed it. No fault was found with the signalling equipment. It was not possible to determine conclusively whether the signal was showing an OFF aspect to allow trains proceed through XH066 or it was displaying an ON aspect indicating that trains should stop in advance of the gates. The gatekeeper suffered shock and the gates of XH066 were destroyed. From the investigation weaknesses were identified within the training and competency management of staff, operating instructions, maintenance procedures and the design of the indicators.

Immediate cause, causal factor and contributory factors

The immediate cause of the accident:

- The train struck the gates of Level Crossing XH066, which were closed across the railway line.

The two possible causal factors identified were:

- The Down Distant Signal was displaying either a WRONG or an incorrect OFF aspect when the train passed and this led the train crew to expect the gates to be open across the railway; or
- The train passed the Down Distant Signal whilst it was at ON and the necessary actions to stop the train in advance of XH066 were not taken.

The possible contributory factors were:

- The lack of an effective competency management system to ensure staff are suitably trained and competent to carry out their duties;
- A lack of adequate training and procedures to assist the staff responsible for the equipment associated with XH066 and its Distant Signals with carrying out their duties correctly;
- The indicator display was not observed or was mis-read by the gatekeeper when the lever was moved following the last train on the previous night;

- Failure to implement training on safety deficiencies identified in an IÉ investigation report;
- The train crew did not observe or mis-read the Down Distant Signal.

Recommendations

- Iarnród Éireann should review the training and competency management of gatekeepers and signalling maintenance personnel;
- Iarnród Éireann should review the design of signal indicators to ensure their design encourages correct interpretation;
- The Railway Safety Commission should audit Iarnród Éireann's training and competency management system to verify its effectiveness.

Contents

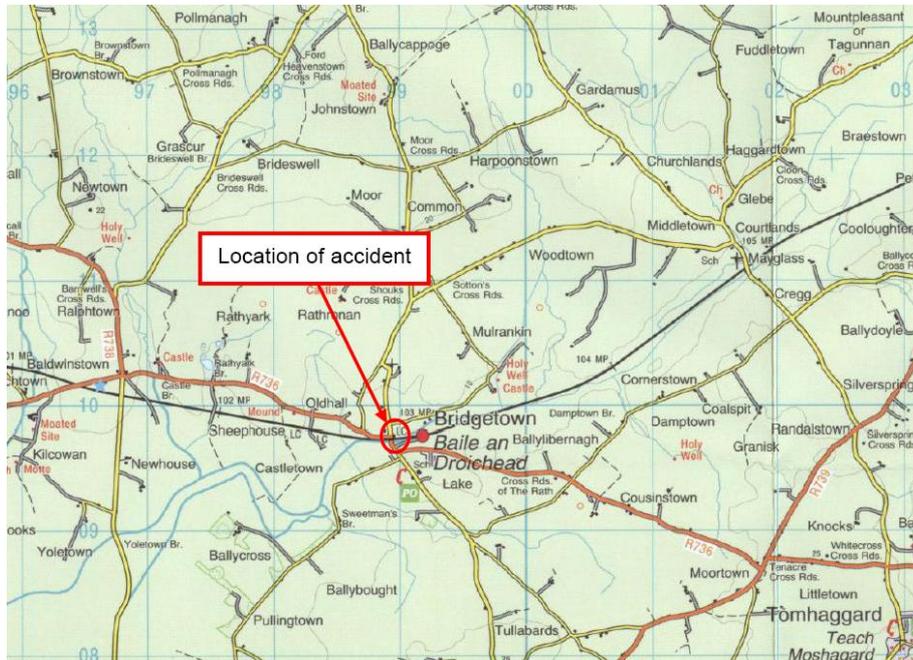
1	Factual information.....	1
1.1	The accident.....	1
1.2	Level crossing	2
1.3	Track	9
1.4	Signalling and communications.....	9
1.5	Rolling stock.....	9
1.6	Operations.....	10
1.7	Fatalities, injuries and material damage	10
1.8	History of accidents/incidents.....	10
2	Analysis	11
2.1	Signal aspect.....	11
2.2	Staff roles and procedures	11
2.3	Training and competency management.....	12
3	Conclusions.....	13
4	Recommendations	14
5	Previous RAIU Recommendations	15
6	Relevant actions already taken or in progress.....	16
7	Additional information.....	18
7.1	Abbreviations.....	18
7.2	Glossary of terms	18

1 Factual information

1.1 The accident

On the 2nd of December 2008, an Iarnród Éireann (IÉ) infrastructure maintenance train departed Waterford Station for Rosslare Strand at 08.52 hours (hrs). As the train approached Level Crossing (LC) XH066, Bridgetown, at 09.40 hrs the gates of the LC were observed by the train crew to be closed across the railway line. The train driver sounded the horn and applied the brakes. The gatekeeper was in the process of closing the first gate (furthest from the train) across the road when the train horn was heard. The gatekeeper pushed the gate across the road and then moved into the wicket gate for safety. The train struck both gates and continued to travel approximately thirty-nine and a half metres (m) beyond XH066 before coming to a stop with the train on the LC. The location of the accident can be seen in Figure 1.

Figure 1 – Location map



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The train involved was an infrastructure maintenance train crewed by a train driver, driver conductor and two guards. The train driver and driver conductor were travelling in the leading cab of the locomotive and the guards were travelling in the rear cab of the locomotive.

The accident occurred during daylight. The weather was dry and overcast with frost in the area. The temperature records from Met Éireann for Johnstown Castle, approximately 3 km from the XH066, show a temperature range of 0.2 to 5.7 degrees Celsius (°C) for the 1st of December 2008 and 2.4 to 5.1 °C for the 2nd of December 2008.

1.2 Level crossing

1.2.1 Description

XH066 is located at the 103 milepost on the Limerick Junction to Rosslare Strand line in the Wellingtonbridge to Rosslare Strand section beside the village of Bridgetown in County Wexford. This is a CX type LC, which means that the gates are kept closed across the railway line and are opened for railway traffic by a gatekeeper. The gatekeeper is advised of approaching trains via a telephone line by the local signalman in either Wellington Bridge or Rosslare Strand depending on the direction of travel of the train. There is a telephone in both the gatekeeper's hut and the porch of the gatekeeper's house for contact with either signalman on the telephone line.

The LC gates consist of two 5.18 m wide, 1.06 m high, wooden gates that pivot about gate posts. Each gate is fitted with large retro-reflective Xs on both sides. The surface of the LC is rubber Strail units to provide a level surface for road users. There are out-of-use wicket gates on the Rosslare side of the LC. See Figure 2 and Photo 1.

Figure 2 – Layout of XH066

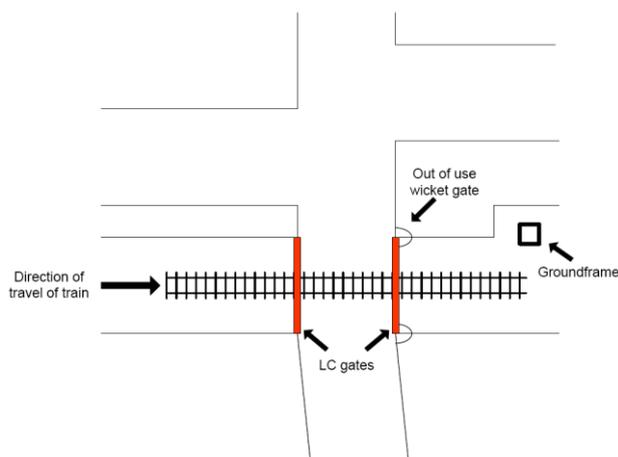


Photo 1 – LC XH066



1.2.2 Protection

XH066 is protected by mechanically operated semaphore signals known as Distant Signals, see Photos 2 and 3. These are normally positioned sufficiently far in advance of an LC to allow any train brake from the maximum line speed to a halt before reaching the LC. They give advance warning to train drivers of whether or not the LC gates are open for railway traffic. For XH066 Distant Signals are positioned 951 m from the LC on the Limerick side referred to as the Down Distant Signal and 1000 m from the LC on the Rosslare side referred to as the Up Distant Signal. These are controlled from XH066 by the gatekeeper.

The Down Distant Signal is positioned at the top of a rising gradient with a straight approach for over 1000 m. During hours of darkness the signal can be seen by the train driver due to the train headlights lighting up the reflective surface of the signal.

Photo 2 – Front of Down Distant Signal

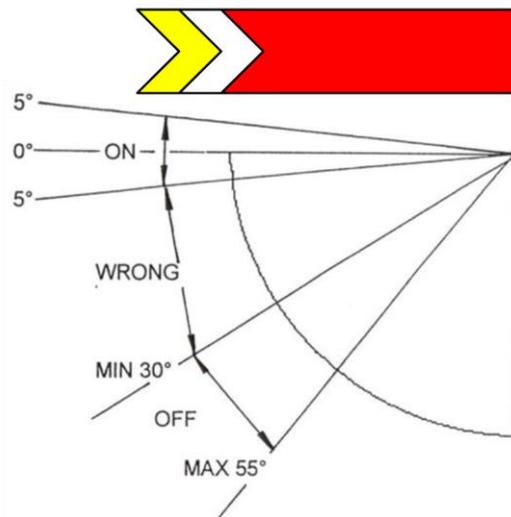


Photo 3 – Back of Down Distant Signal



The semaphore signals display two aspects, ON and OFF. In between ON and OFF the signal is considered to be displaying an incorrect aspect and is called WRONG. For less than 5 degrees (°) above or below horizontal the signal is ON, from 5° to 30° below horizontal the signal is WRONG and from 30° to 55° the signal is displaying OFF, see Figure 3¹.

Figure 3 – Semaphore signal aspect



¹ Catalis (February 1999), Iarnród Éireann Mechanical Signalling Mechanical Signals and Fittings, IEMS Sec 5.doc issue 1.0.

The LC gates and the Distant Signals are interlocked with a three-lever ground frame located on the Rosslare Strand side of the crossing, see Photo 4.

Photo 4 – Distant Signal controls



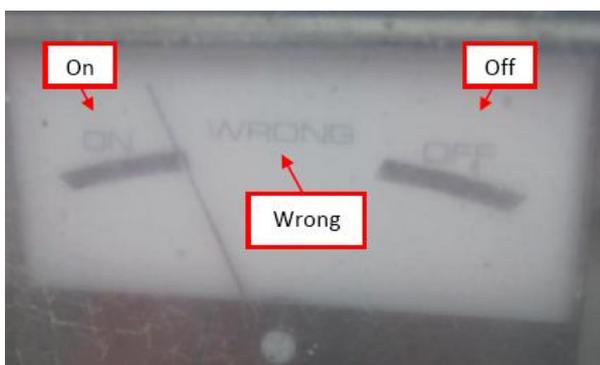
Photo 5 – Close up of Levers



In this ground frame, No. 1 lever works the gate locks and levers No. 2 & 3 operate the distant signals, as seen in Photo 5. The gate lock lever is interlocked with the two signal levers. In the position shown in Photo 4 with the No. 1 lever out of the frame, the gates are unlocked and the distant signal cannot be pulled to the OFF position.

There are indicators at XH066 positioned beside the levers that display the aspect of the Distant Signals for the gatekeeper, the display is shown in Photo 6. The indicators operate electrically and are powered by a battery. If the indicator needle is pointing to WRONG, the signal is to be considered to be showing an incorrect aspect and is regarded as having a fault. The indicators consist of black needles on a black and white background. The indicators operate by displaying ON, OFF or WRONG depending on the voltage detected. The indicator needles are spring mounted and in the absence of voltage to indicate either ON or OFF, they will return to WRONG.

Photo 6 – Down Distant Signal Indicator



The only documentation available that identifies the angle range for a semaphore signal aspect that is ON, OFF or WRONG was the training document on Mechanical Signals and Fittings dated 1999¹.

The Distant Signal that each indicator relates to was not signed, the cover through which the indicators are read was in poor condition and the indicator display was not lit.

1.2.3 Operation

XH066 is attended by a gatekeeper during train operating hours. The gatekeeper receives a telephone call from the signalman at either Wellington Bridge or Rosslare Strand signal cabin to advise of trains that have entered the section and will be approaching the LC. Following this the gatekeeper allows approximately ten to twelve minutes before closing the gates across the road and moving the levers to set the Distant Signal to OFF to permit passage of the train.

The steps involved in allowing a train pass through a CX type crossing (XH066 is a CX type crossing) are outlined below:

- The signalman contacts the gatekeeper to advise of a train entering the section;
- The gatekeeper closes the LC gates across the road;
- The gatekeeper moves the lever for the gates to the locked position;
- The gatekeeper moves the Distant Signal lever to OFF for the direction the train is approaching from;
- The gatekeeper checks that the Distant Signal indicator for the relevant distant signal is displaying OFF;
- The train passes through the LC;
- The gatekeeper checks the train for the presence of rear marker lights;
- The gatekeeper moves the distant signal lever back to the ON position;
- The gatekeeper checks that the Distant Signal indicator is displaying ON;
- The gatekeeper moves the lever for the gates to the unlocked position;
- The gatekeeper closes the LC gates across the railway.

These operating procedure² for XH066 are displayed next to the lineside phone in the gatekeepers hut.

The gatekeeper had received a telephone call from the signalman at Wellingtonbridge. The gatekeeper had started to move the gate closest to the groundframe at the time of the collision. The levers controlling the Distant Signal had not yet been operated.

² Iarnród Éireann (July 2008), Bridgetown Crossing XH066, Instructions to Gatekeeper at 'CX' Type Level Crossing.

The train crew reported that the Distant Signal was OFF when the train passed. A member of the train crew walked back to the Distant Signal to verify its aspect after the accident, it was displaying an ON aspect.

The train involved in the accident was the first train through XH066 travelling from the direction of Waterford that morning. The Down Distant Signal and associated equipment had not been operated since the previous evening during hours of darkness at 18.29 hrs and the indicator was reported as having been checked when the signal was put back to ON using a torch.

Checking the indicator is not identified in the gatekeeper's instructions for CX type LCs. It is clearly identified in the instructions for C type LCs³, which are similar LCs that are normally kept closed across the road.

1.2.4 Maintenance and inspection

Maintenance of the LC gates and associated signalling equipment is carried out by the Signalling, Electrical and Telecommunications Department. Maintenance checks are carried out every three months. The mechanical aspects and the electrical aspects of CX type LCs are checked separately.

In the event that there is a fault at the LC, it is logged in the fault register at the LC and the signal cabin at either Wellington Bridge or Rosslare Strand is contacted by telephone. The fault is then documented and reported either to the signalling office or directly to the signalling linesman.

Tensioning of the wires for the semaphore signals may require adjustment to ensure that the intended aspect is displayed correctly, particularly in hot or cold weather. Adjustment of the tension in semaphore signal wires is identified as part of the duties of gatekeepers in the operating instructions for XH066. The gatekeepers were not trained to adjust the tensioning of semaphore signal wires. They would occasionally observe WRONG aspect indications, which they would sometimes rectify by pulling on the signal wire to clear obstructions, they did not adjust the tension.

³ Iarnród Éireann (September 2007), General Appendix Section G.

The last inspection was carried out on the 28th of September 2008. A fault maintenance visit took place on the 28th of October 2008 due to a sticking gate lock. There was no written maintenance schedule for CX type LCs or the associated semaphore signals in place at the time of the accident. Procedures I-SIG-2381⁴ and I-SIG-2481⁵ for maintenance of the LC gates had been issued in June 2008 but they were not briefed to the maintenance personnel. There were no maintenance procedures in place for the groundframe equipment and the semaphore signals. There were no fault finding procedures in place for CX type LCs or any of the associated equipment. The angle of the semaphore signal arm is checked visually by maintenance staff. Electrical checks of the indicators are carried out by the maintenance staff using a meter to measure the voltage, these are normally carried out without using the levers.

Following the accident, at approximately 11.00 hrs, IÉ carried out a combination of visual and physical checks. They found no faults with the equipment.

Photos from an inspection carried out by the Railway Safety Commission (RSC) on the 21st of April 2009 on the railway line between Limerick Junction and Rosslare Europort were examined. They showed forty-six signal aspects, of which thirteen (28%) were found to be WRONG.

1.2.5 Staff training and competency management

1.2.5.1 Gatekeepers training and competency

There is no formal training procedure for gatekeepers. Gatekeepers are trained to operate the LC by the previous gatekeepers and are then assessed and certified as competent by their supervisor, a District Traffic Executive. Following this initial training, gatekeepers are due to be competency assessed every year. The training of the gatekeepers for XH066 did not cover use of the signal adjusters. The assessments for the two gatekeepers that operate XH066 were found to be in date, however, there had been a period when the gatekeepers' competency had lapsed. The assessments were found not to have included observing the gatekeepers carrying out their duties. The forms did not cover signal adjusters or indicators. Neither gatekeeper was observed operating the LC during their last two competency assessments. One of the gatekeepers was not certified to operate XH066. A recommendation from the IÉ report into a previous gate strike at XN164⁶ on the training of staff about the importance of checking indicators had not been implemented.

⁴ Iarnród Éireann (June 2008), Test Procedure for Manned Gated Level Crossings, I-SIG-2381.

⁵ Iarnród Éireann (June 2008), Maintenance Procedure for Manned Gated Level Crossings, I-SIG-2481.

⁶ Iarnród Éireann (June 2008), Report of the Investigation into the Collision at Sallymount Level Crossing No. XN164, on the 27th of September 2007.

CoStd07 is a policy document that requires supporting documentation for each department. Railway Safety Standard 12 'Training, Monitoring and Assessment of Gatekeepers'⁷ (RSS07/12) covers the requirements for gatekeepers under CoStd7. These requirements include that a person employed to act as a crossing keeper must:

- Have received sufficient training to enable him/her be competent;
- Have been assessed and found to be competent prior to taking up duties as a level crossing keeper;
- Be regularly monitored and found to be performing the duties of a level crossing keeper in a satisfactory manner;
- Be certified as competent and have this certification supported by the requisite training records and details of assessment.

1.2.5.2 Train drivers training and competency

Train drivers were found to be competent. Reading of semaphore signals is covered in the Rule Book⁸ for IÉ staff working on the railway. For LC Distant Signals, a horizontal signal arm means the signal is at Caution and the train should be prepared to stop before it reaches the LC, and a signal arm lowered by 45° means the signal is Clear and the train can proceed over the LC. The Rule Book states that 'indistinctly shown' signals should be treated as being at Caution. There is no explanation included of the meaning of an indistinctly shown signal.

1.2.5.3 Signalling maintenance staff training and competency

The signalling maintenance staff were originally trained by observing other signalling maintenance staff. Between 1999 and 2000 all signalling maintenance staff underwent formal training. No refresher training was carried out after this. The suite of training documents provided by Catalis was found to be mainly briefing documentation on the working of the equipment. It did not provide details of how to inspect or maintain the equipment^{9,10}. Failures types were covered¹¹ but fault finding was not addressed.

⁷ Iarnród Éireann (February 2005), Railway Safety Standard No. 12, Training, Monitoring and Assessment of Gatekeepers, RSS 07/12, issue 2.0.

⁸ Iarnród Éireann (November 2007), Rule Book.

⁹ Catalis (February 1999), Iarnród Éireann Mechanical Signalling Mechanical Signals and Fittings, IEMS Sec 5.doc issue 1.0.

¹⁰ Catalis (February 1999), Iarnród Éireann Mechanical Signalling Mechanical Interlocking, IEMS Sec 6.doc issue 1.0.

¹¹ Catalis (February 1999), Iarnród Éireann Mechanical Signalling Failures, IEMS Sec 9.doc issue 1.0.

1.2.5.4 Overseeing training and competency management

The IE company safety standard on competency management, Company Safety Standard number 7¹² 'Policy and Principles for Training, Competence and Fitness' (CoStd7), identifies requirements for:

- Overseeing the compliance with the Policies and Principles of this Company Standard;
- Ensuring that all personnel engaged in safety – critical tasks are appropriately trained and verified as fit and competent;
- Auditing for compliance with this standard to on a regular basis and not less than annually.

1.3 Track

The line from Waterford to Rosslare Strand is single track with jointed rail. The maximum speed in the vicinity of XH066 is 65 kilometres per hour (km/h).

1.4 Signalling and communications

The signalling system on the Limerick Junction to Rosslare Strand line is Electric Token System. The trackside signals are mechanically operated semaphore signals.

On the Limerick Junction to Rosslare Strand line communication between signalmen and train drivers is through an open channel radio system called Mode C, which allows communication between the signal cabins and the train radios over a short range which varies with the local topography. Communication between signalmen and gatekeepers is over an Omnibus telephone system that allows open communication that can be heard by all parties that pick up the telephone.

1.5 Rolling stock

The rolling stock involved, in the order it was connected in, included: locomotive 078; plough brake van 24852; ballast hopper wagons 24259, 24129, 24116, 24148, 24264, 24128, 24252, 24263, 24250, 26615, 24260, 24142, 24120, 26635, 24119; and plough brake van 24853.

The locomotive was fitted with a Hasler disc, which recorded the speed of the train and brake applications over the previous 1700 m. Following the accident the Hasler disc was removed from the train. This showed that the train had been travelling at approximately 60 km/h leading up to the accident and that the brakes were applied approximately 220 m before the train came to a stop, approximately 175 m before the LC.

¹² Iarnród Éireann (January 2007), Company Safety Standard No. 7, Policy and Principles for Training, Competence and Fitness, CoStd7, issue 3.03.

1.6 Operations

This train is normally worked by a train driver and two guards. The driver conductor was travelling with the train driver at the train driver's request to advise the train driver on route knowledge for areas that the train driver had not travelled since they had been modified. A driver conductor travels with a train driver to familiarise them with changes to a route or to refresh a train driver's memory if the train driver has not travelled the route in the previous six months.

1.7 Fatalities, injuries and material damage

1.7.1 Fatalities and injuries

There were no fatalities or injuries due to the collision. The gatekeeper attended hospital for shock.

1.7.2 Infrastructure damage

The gates of the LC, the shooting bolt on one of the gates and the gate lamps were destroyed.

1.7.3 Rolling stock damage

There was no damage to rolling stock.

1.8 History of accidents/incidents

There were thirteen gate strikes by trains at CX type LCs over the ten years prior to the accident, these are:

- 27th of September 2007 – XN164 Sallymount LC;
- 9th of September 2007 – XL065 Monard LC;
- 14th of April 2007 – XL101 Cappagh LC;
- 5th of November 2005 – XG043 Thomastown LC;
- 11th of October 2005 – XN177 Annacotty LC;
- 10th of August 2004 – XS037 Ballymahon LC;
- 23rd of March 2004 – XE024 Cratloe Station LC;
- 28th of March 2003 – XX043 Foxford LC;
- 3rd of October 2001 – XH042 Kilcavan Number 1 LC;
- 14th of July 2001 – XL065 Monard LC;
- 16th of February 2001 – XM047 Kiltoom LC;
- 22nd of December 2000 – XM047 Kiltoom LC;
- 25th of January 2000 – XM148 Carrick LC.

2 Analysis

2.1 Signal aspect

It was not possible to determine if the Down Distant Signal was showing ON, OFF or WRONG when the train passed it and if this was correctly reflected at the indicators or not, this is because the collision of the train with the gates could have affected the state of the equipment, dislodging evidence an obstruction or a fault.

The signal may have been displaying an OFF or WRONG aspect due to either of the following.

It is possible that the tensioning wire was not correctly adjusted, leading to an OFF or WRONG aspect. This could have occurred due to the lack of adjustment of the tensioning wires or the cold weather overnight. Issues with the lack of correct adjustment of tensioning wires were found in the review of the photos from the RSC inspection.

The Down Distant Signal may have been displaying an OFF or WRONG aspect when the train passed because it had not returned to ON following the last train in the same direction on the previous night due to the presence of an obstruction along the wire run.

Alternatively, the train crew may not have correctly observed and responded in a timely manner to an ON or WRONG aspect.

The design of the face of the indicators at XH066 was not found to offer a strong visual prompt for reading the information. The particular issues observed were the poor condition of the display cover, the colour coding of the display, the narrowness of the needle, the lack of lighting of the display and the lack of signage identifying the signals the indicators related to. This could have led the gatekeeper to omit to read the indicator, mis-read the indicator or read the incorrect indicator after the last train the previous night.

2.2 Staff roles and procedures

The duties of staff in relation to semaphore signal controlled CX type LCs were not found to be clearly identified through instructions and procedures. The procedures and training for gatekeepers were found to be inconsistent with the role of gatekeepers. The operation instructions for XH066 identify adjustment of the tensioning of the semaphore signal wires as part of the duties of the gatekeepers. However, it was found that the gatekeepers were not training to carry out this work and therefore this was not done. Gatekeepers were required to check the indicators for the Distant Signals. The instructions for operation of CX type LCs were found to make no mention of the indicators, unlike the instructions for C type LCs. A previous IÉ investigation report that made a recommendation on

training in the correct operation of equipment and the importance of indicators had not been implemented.

There were no written signalling maintenance or fault finding procedures at the time of the accident, the only procedures related to the checking of the gate equipment and these had not been implemented. The lack of maintenance procedures meant that it was possible that the equipment was not correctly maintained in the lead up to the accident. The lack of fault finding procedures meant that it was possible that the post incident checks could have been carried out in a manner which could have altered the state of the equipment, particularly if destructive tests were carried out prior to non-destructive tests.

The instructions in section C of the Rule Book for train drivers on reading Semaphore signals do not clearly address signal aspects being WRONG. The term indistinctly shown is not defined and there is no explanation of the importance of ensuring a signal is OFF and not WRONG.

2.3 Training and competency management

There was a lack of adequate training and effective competency management of staff in the performance of their duties. This was found for gatekeepers through the absence of training documentation, the ineffectiveness of the competency management processes to ensure staff were observed carrying out their duties and the fact that it was possible for staff to carry out duties without the required competency records as required by RSS07/12. The signalling maintenance staff underwent training in 1999-2000, other than this there was no formal training or competency assessment of the maintenance staff as required by CoStd07.

3 Conclusions

The train striking the gates at XH066 resulted from the train having insufficient time to brake to a stop in advance of the gates, which were closed across the railway line. It was not possible to determine the underlying cause or causes of the accident. However, from the investigation weaknesses were identified within the training and competency management of staff, operating instructions, maintenance procedures and the design of the indicators.

To ensure the weaknesses of training are appropriately addressed, an external audit by the Railway Safety Commission should be carried out independent of IÉ to ensure that IÉ take appropriate steps to implement their own company standards in relation to training and competency.

Immediate cause, causal factor and contributory factors

The immediate cause of the accident:

- The train struck the gates of Level Crossing XH066, which were closed across the railway line.

The two possible causal factors identified were:

- The Down Distant Signal was displaying either a WRONG or an incorrect OFF aspect when the train passed and this led the train crew to expect the gates to be open across the railway; or
- The train passed the Down Distant Signal whilst it was at ON and the necessary actions to stop the train in advance of XH066 were not taken.

The possible contributory factors were:

- The lack of an effective competency management system to ensure staff are suitably trained and competent to carry out their duties;
- A lack of adequate training and procedures to assist the staff responsible for the equipment associated with XH066 and its Distant Signals with carrying out their duties correctly;
- The indicator display was not observed or was mis-read by the gatekeeper when the lever was moved following the last train on the previous night;
- Failure to implement training on safety deficiencies identified in an IÉ investigation report;
- The train crew did not observe or mis-read the Down Distant Signal.

4 Recommendations

The following safety recommendations¹³ are made:

- IÉ should review the training and competency management of gatekeepers and signalling maintenance personnel;
- IÉ should review the design of signal indicators to ensure their design encourages correct interpretation;
- The Railway Safety Commission should audit Iarnród Éireann's training and competency management systems to verify its effectiveness.

¹³ Recommendations shall be addressed to the safety authority and, where needed by reason of the character of the recommendation, to other bodies or authorities in the Member State or to other Member States. Member States and their safety authorities shall take the necessary measures to ensure that the safety recommendations issued by the investigating bodies are duly taken into consideration, and, where appropriate, acted upon. (Railway Safety Directive, 2004/49/EC)

5 Previous RAIU Recommendations

The following is a list of previous RAIU reports and their recommendations that are relevant to this investigation.

'Report into the Collision at Level Crossing XN104 between Ballybrophy and Killonan on the 28th of June, 2007':

- Iarnród Éireann to ensure that a system is put in place for effective implementation of existing standards and to manage the timely introduction of new and revised standards, this should include departmental instructions.

6 Relevant actions already taken or in progress

As of the 29th of October 2009, IÉ had advised that the following actions had been taken in relation to the accident.

All gatekeepers who work at level crossings with mechanically operated signals have been given a competence review and assessment on the correct operation of the crossing. This review has focussed on:

- The observation of the signals/repeaters returning to caution after the passage of trains;
- Reporting to the controlling signalman any defects or failures of signals to return to caution;
- The operation of signal adjusters in accordance with instructions.

A formalised basic training course for new gatekeepers is currently being developed. This course is intended to supplement the existing practical training that gatekeepers currently receive. The current assessment process for gatekeepers will be reviewed in conjunction with the development of the training course and will include an assessment of the gatekeeper's correct performance of their duties.

A review is currently underway of Railway Safety Standard 12 'Training, Monitoring and Assessment of Gatekeepers'.

The conversion of all level crossing signals from mechanical to colour light operation between Limerick Junction and Rosslare has been approved as part of the 2009-2013 Railway Safety Programme. This will remove the mechanical signals, change the existing operating arrangements and provide safe signalling to contemporary standards for these level crossings. Semaphore signals are not inherently fail safe, reliance being placed on the crossing keeper to ensure that the signal has been replaced to the ON position following opening of the gates for road traffic.

All level crossings and mechanical signals on the line were examined. The signal wire runs were examined to ensure they were clear of vegetation overgrowth and had free movement. Following a review of wire adjusting mechanisms along this route, four 'turn buckle' type mechanisms were replaced with a more user friendly wheel operated mechanism.

The signal repeater indications and associated battery power supplies at all the crossings along this route were examined. New illuminated housings have been ordered and a programme is in place to illuminate all repeaters by March 2010. These new housings will have clear covers over the repeater indications so as to improve their visibility. Repeater name plates will be fitted as part of the new illuminated housing installation programme.

The attention of all maintenance staff in the area associated with mechanical signals and level crossings has been drawn to the requirements of signalling standard I-SIG-2481 (issued 24/06/2008) and Test Procedure for Manned Gated Level Crossings I-SIG-2381.

Signalling Maintenance Standard for Mechanical Signals I-SIG-2442 and Test Procedure For Mechanical Signals I-SIG-2342 have been issued. They are currently being briefed to mechanical maintenance staff as part of a refresher training course. This briefing process will be concluded by the end of 2009.

A device to assist in measuring the angle of the semaphore signal when setting the ON and OFF band for the signal indications is currently being developed and will be tried by the mechanical lineman before year end. If satisfactory, it will be used as a checking aid when setting up all mechanical signal controllers.

7 Additional information

7.1 Abbreviations

C	Celsius
Hrs	Hours
IÉ	Iarnród Éireann
LC	Level crossing
m	Metre
°	Degree

7.2 Glossary of terms

Ballast hopper wagon	A wagon used to transport and disperse the ballast material used to support the track.
CX Level Crossing	A manually operated LC that is normally closed across the railway and closed across the road by a gatekeeper in order to allow trains pass.
Destructive test	A test that destroys evidence of the original state of the equipment.
Distant Signal	A signal that is positioned as a minimum at braking distance from the main signal (or level crossing) that displays the same signal aspect as the main signal. Its purpose is to allow a train driver observe a signal at caution in time apply the train brakes and bring the train to a halt at the main signal where not possible to see the main signal from the braking distance.
Electric Token System	A system which uses electric token instruments at each end of the block section. The instruments contain a number of tokens, and are interlocked in such a way that removal of a token from one of the instruments prevents removal of another token until the first token is replaced in one of the instruments. Possession of this token allows a train to enter the section.
Non-destructive test	A test that does not destroy evidence of the original state of the equipment.
OFF	Term used for the position of a semaphore signal when it is between 30 and 55 degrees to the horizontal and indicating that the signal is not at danger and the train can proceed.
ON	Term used for the position of a semaphore signal when it is within 5 degrees of horizontal and indicating that the signal is at caution and the train should stop.
Plough brake van	A vehicle that provides braking in a train and spreads ballast when it is dispersed by a Ballast Hopper Wagon.
Semaphore signal	A mechanical signal controlled by levers at a groundframe through wires that run from the signal to the groundframe.

WRONG Term used for the position of a semaphore signal when it is between 5 and 30 degrees below horizontal and indicating that there is an error with the signal and the train should stop.