

RAIB Bulletin 07/2010

Fatal accident at a user worked crossing on 2 September 2009

Description of the accident

- 1 On 2 September 2009, at approximately 11:35 hrs, train 0Z97, a single locomotive running along the Cambrian Coast line, collided with a car at a user worked crossing (UWC)¹, No. 451, at Penrhyndeudraeth in North Wales. The car was crossing the line in a northerly direction just as the locomotive was reaching the crossing, travelling in a south westerly (down) direction. Figure 1 shows the accident location and the directions of movement of the car and train.

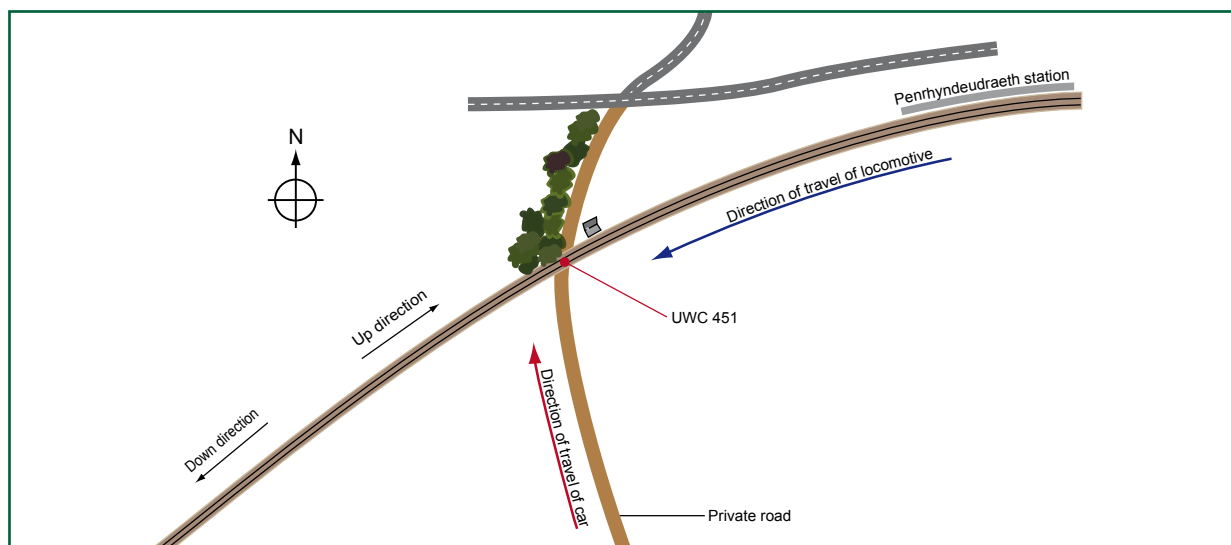


Figure 1: Location of the collision and movements of the car and train

- 2 The locomotive struck the driver's side of the car and pushed it along the track a distance of approximately 74 m before they came to rest. Following the collision the driver of the locomotive contacted the signaller at Machynlleth and requested the emergency services attend. Paramedics and the Police arrived at the scene at approximately 11:41 hrs. The car was severely damaged and its driver suffered fatal injuries. The locomotive and track were superficially damaged. The weather at the time of the accident was damp and overcast.

¹ UWCs are level crossings where railways intersect with private roads, or minor public roads, and where road users are responsible for operating gates or barriers when crossing the railway. In some cases there is no additional equipment to warn of approaching trains, and the user has to look, listen and decide for themselves whether it is safe to cross. In other cases there are telephones to enable users to contact the signaller in order to obtain information on the whereabouts of trains, or lights to provide a warning when a train is approaching.

- 3 The RAIB, British Transport Police and North Wales Police undertook examinations on site with the assistance of representatives of Network Rail (the infrastructure manager) and Serco (the train operator).

Description of the crossing and its intended operation

- 4 The crossing lies on a section of single line approximately 150 metres west of Penrhyndeudraeth station and on a private road which provides access to a farm and house. There is also an adjacent foot path with access gates for pedestrians (figure 2). The distance between the crossing gates is 8.3 m and the distance between each gate and the nearest running rail is 3.4 m.
- 5 Between the station and the crossing the track curves to the left such that a train approaching the station cannot see the crossing. There are no whistle boards² either side of the crossing requiring trains to sound their horns. The road approach to the crossing from the south side is shown in figure 2. Telephones and signs with instructions in both Welsh and English on how to use the crossing are provided on each side of the crossing. At the time of the accident, the sign on the south side was partially obscured by vegetation.



Figure 2: View of the crossing approaching from the south

- 6 The signage provided at each side of the crossing reads in both Welsh and English as follows: **“Stop. Always telephone before crossing with vehicles or animals to find out if there is time to cross. Tell the crossing operator if the vehicle is large or slow moving. Open far gate before crossing with vehicles or animals, cross quickly, close and secure gates after use. Maximum penalty for not doing so £1000”.**

² Whistle boards are located by the track side and instruct train drivers to blow the train’s horn to warn users of a crossing ahead.

- 7 The telephones are provided because the sighting distance³ of approaching trains is too short to be able to make a safe crossing in a road vehicle. As a result, the crossing user is required to contact the signaller by telephone to check whether The safe operation of UWCs with telephones, of which there are 1661 out of a total of 2814 UWCs on Network Rail infrastructure, is dependent on the use of the telephones.

Findings of the RAIB

The train

- 8 The locomotive was on an authorised driver route-reviewing run at the time of the accident. There had been four previous runs since 10 August 2009, the purpose of which was to keep drivers familiar with the route in preparation for services which were to start in February 2010. There were three drivers in the cab at the time of the accident, one of whom was at the controls. The other two drivers were also participating in the route review. All three drivers were already passed as competent to drive over that route.
- 9 Train 0Z97 was not a scheduled passenger train service and therefore did not stop at Penrhyndeudraeth station. Passenger trains normally pass through the crossing (in either direction) at intervals of approximately 90 minutes and stop at Penrhyndeudraeth station. The previous train over the crossing was a passenger train at 10:39 hrs, travelling in the south westerly direction.
- 10 Information downloaded from the on-train data recorder (OTDR) showed that the locomotive was accelerating as it approached the crossing and reached a speed of 27 mph (43 km/h) close to the crossing before the emergency brake was applied, at the same time as the traction power was shut off. The line speed over the crossing, first indicated to the driver at the east end of Penrhyndeudraeth station, was 55 mph (88 km/h). Trains running in the south westerly direction are unable to reach this speed in practice due to a permanent speed restriction of 20 mph (32 km/h) on the approach to Penrhyndeudraeth station and a steep uphill gradient of 1 in 65 between the station and the crossing.
- 11 Following the accident, it came to light that the trackside signage at the east end of Penrhyndeudraeth station was not consistent with the sectional appendix⁴ for that section of line, which shows a 20 mph (32 km/h) limit over the crossing. It is understood from Network Rail that the incorrect location of the signage has existed unnoticed since around 1980. The incorrectly located trackside sign has now been moved to a position about 20 m on the approach to the crossing in the down direction to be consistent with the sectional appendix and the speed limit over the crossing is now 20 mph.

³ The distance from the crossing to an approaching train when the train first becomes visible to a crossing user.

⁴ Network Rail document containing local rules and instructions and details for each part of the rail network.



Figure 3: View of the crossing from the driving cab of the locomotive at a distance of approximately 10 m from the crossing

- 12 The train driver's view of the car approaching from the south side of the crossing was restricted by a large bush (figure 3). The train driver reported that he first noticed the car when the locomotive was about 10 m from the crossing. The proximity of the locomotive to the crossing when the car first appeared was also confirmed by one of the other drivers. Travelling at 27 mph (43 km/h), the locomotive would have covered this distance in about one second. Had the speed of the train over the crossing been 20 mph (32 km/h), i.e. the sign had been placed in accordance with the sectional appendix, it is considered unlikely that the impact would have resulted in a significantly different outcome.
- 13 Post-accident testing showed that the locomotive's speedometer, brakes, lights, windscreen wipers and horns were in correct working order and within the relevant specifications.

The crossing user

- 14 Mrs Sally Hudson, the car driver involved, had lived in the house accessed from the crossing for about 37 years and is believed to have used the crossing several times each week, either by car or by bicycle. She was one of three authorised users⁵ listed on Network Rail's records for the crossing.
- 15 The evidence from the signal box at Machynlleth, which controls this section of line, indicates that the crossing telephone had not been used just prior to the accident. It therefore appears that Mrs Hudson decided to cross the line on the basis of visual sighting alone, perhaps supported by her prior knowledge of the train timetable, which may have led her to believe there would not be another train approaching until about 12:10 hrs. It is unlikely that she would have been aware of the driver route familiarisation runs by single locomotives.

⁵ People who are formally registered by Network Rail as being authorised to use the crossing and to whom correspondence is sent from time to time about crossing safety issues.



Figure 4: Restricted view from road on the south side of crossing in the direction of Penrhyndeudraeth station

- 16 From the position a car driver would normally have parked their car to open the gates, and from which they would then have driven onto the crossing, the visibility of the approaching locomotive would have been severely restricted by the same bush which restricted the train driver's view (paragraph 11). The restricted view is shown in figure 4.

The crossing

- 17 From the gate at the south side of the crossing, the sighting distance for a train approaching from Penrhyndeudraeth station was approximately 64 m and less from a position 1 to 2 m back from the gate due to the large bush (figure 4). Although not relevant to this accident, sighting from the north side of the crossing was about 150 m from the gate, reducing rapidly further back from the gate to about 5 m from a position 2 m back from the gate due to a house at the railway boundary. Sighting distances for trains approaching in the 'up' direction (ie towards Penrhyndeudraeth station), were 260 m from the south side of the crossing and 440 m from the north side.
- 18 Both telephones at the crossing were tested by the RAIB after the accident and found to be in working order. The gates were also tested and found to be in working order. There was evidence that the gates were being shut after use as they should have been. There was no eye witness to the accident who could confirm whether or not the gates were already open.

Network Rail's evaluation of the risk at Penrhyndeudraeth UWC

- 19 User worked crossings are surveyed every three years by Network Rail in order to collect data for the purpose of assessing risks, in accordance with Network Rail standard NR/L3/OCS/041/5-23, "Level crossing site visits and censuses", Issue 3, June 2009. The last survey prior to the accident was conducted on 5 April 2007. In addition to the sighting distances and crossing usage, several other factors are recorded in the survey. The data collected was entered into a computer model called the ALCRM (All Level Crossing Risk Model) which evaluated individual risk⁶ (ranked A to M where A is high risk) and collective risk⁶ (ranked 1-13 where 1 is high risk). This risk ranking was used to inform decision making by the infrastructure owner regarding the risk at this crossing relative to other crossings. The survey results from 5 April 2007 led to a risk ranking of "E9", which signifies relatively low individual and collective risk. It was based on the following assumptions:
- Number of trains per day: 16
 - Road traffic: 1 car/day; 0 pedestrians/day; 0 cyclists/day
 - Sighting: 300 m in all directions (measured from just inside the railway boundary, approximately 3 m from the nearest running rail)
 - Gates: always closed
 - Telephones usage: always used
 - Train speed: 20 mph (as specified in the sectional appendix)
- 20 The above sighting distances, train speed and the assumed road traffic and telephone usage in that survey did not reflect the situation at the time of the accident. The sighting distances were significantly less on the day of the accident (paragraph 17) and records at Machynlleth signal box showed that the last time the telephone was used at this crossing was 17 August 2009. However, the crossing was used almost every day, either by the deceased or delivery vehicles and other farming-related traffic. The reason the telephones were assumed to be always used when the April 2007 survey was done was that there had been no reports of misuse and no near misses or accidents. The signal box records were not checked at that time to ascertain the frequency of calls from the crossing and to compare that with observations on site of likely usage.
- 21 As part of a crossing census, Network Rail standard NR/L3/OCS/41/5-23 requires that the number of calls per day made to the signaller from the crossing being assessed should be established and compared to the estimated usage of the crossing. For very lightly-used crossings where no or very few users are seen during the site visit, it is permissible to estimate the usage from various sources such as information provided by authorised users in response to Network Rail questionnaires, an interview with the user during the site visit, or by observation of other evidence during the site visit, such as muddy tracks, crossing wear, vegetation growth around the gates etc.

⁶ Individual risk is the probability (per year) of fatality to which an individual is exposed from the operation of the railway. Collective risk is the average number of fatalities, or fatalities and weighted injuries (FWI) per year that would be expected to occur from a hazardous event (or group of hazardous events).

- 22 A new survey was carried out after the accident on 3 September 2009 and took account of this fatal collision, the reduced sighting distances and the fact that the telephones are used infrequently. The risk was recalculated and classified as “C8” which represents an increase in both individual and collective risk. Network Rail reports that there have been no previous collisions or near misses at this crossing.
- 23 On lightly-used lines, there may be very long distances between signal boxes, and the signaller may not have any means of knowing precisely where a train is and therefore may not be able to advise the user on how long they have to wait. At this crossing, waiting times could reach 20 minutes and lead to the user making the crossing without obtaining the signaller’s permission. Human factors issues at such locations, which are dependent on telephones for crossing safety but where the nature of train operations is likely to cause user impatience and encourage crossing without permission, are addressed in “Railway Safety Principles and Guidance” (RSPG). This document was originally published by the Health and Safety Executive but now comes under the auspices of the Office of Rail Regulation (ORR). It is a guidance document which sets out best practice, rather than a mandated standard. Section 2E of RSPG concerns level crossings and states that miniature stop lights⁷ should be provided on both sides of a UWC in cases where “the provision of a telephone is impractical because it is difficult to provide reliable information concerning the whereabouts of trains or the information supplied would be so restrictive that it would be likely to cause the user to become unduly impatient and to cross without permission”.
- 24 Following the accident, Network Rail and Serco Rail Operations conducted their own investigation. One element of the investigation was to consider options for lowering the risk at Penrhyndeudraeth UWC. In practice, the only option considered was provision of miniature stop lights, referred to as miniature warning lights (MWL). Network Rail did not consider closure of the crossing because it provides the only means of access to the property on the south side of the crossing.
- 25 While there are costs and some disadvantages of MWLs compared to telephones at a crossing such as Penrhyndeudraeth, the advantages from the users point of view are:
- They provide a visual warning to a crossing user of an approaching train;
 - They obviate the need for a crossing user to make a telephone call to the signaller; and
 - Because the red light is triggered by the train itself, the period during which a user is warned against using the crossing is relatively short (of the order of a minute). Under the current arrangements, the inability of signalling equipment to detect the precise location of the train, means that when a crossing user telephones the signaller, the only information that a signaller can provide is whether a train is within the section of railway that includes Penrhyndeudraeth crossing. The need to ensure the safety of crossing users and people on trains inevitably results in the signaller taking a precautionary approach. As described in paragraph 23, crossing users might have to wait up to 20 minutes before they cross the line at Penrhyndeudraeth with the signaller’s permission.

⁷ Miniature stop lights (also known as miniature warning lights) are provided at some user worked crossings to give warning of approaching train and indicate when it permissible to cross.

- 26 For these reasons, it might be expected that the provision of MWLs would reduce the risk at Penrhyndeudraeth UWC. However, Network Rail's assessment of the effect of MWLs was that they would increase the risk at Penrhyndeudraeth. The reason for this counter-intuitive and apparently incorrect result is that when Network Rail assesses the likely impact of risk mitigation measures, it uses generic risk data from ALCRM rather than data specific to the crossing under consideration. In ALCRM the average risk at UWCs with MWLs is higher than that at UWCs with telephones because MWLs are normally provided at crossings with a higher underlying level of risk (e.g. intensive usage, higher levels of non-compliance by crossing users).
- 27 Network Rail's post-accident assessment did not take into account the circumstances of the accident on 2 September 2009, nor did it take into account the other factors at the crossing which might have increased the risk above the average for all such crossings. The assessment also did not take into account the potential benefits from the introduction of MWLs, as described in paragraph 25.

Learning points

- 28 On the basis of the information collected during its preliminary examination of this accident, the RAIB decided not to conduct a full investigation. This is because further investigation by the RAIB would be unlikely to result in recommendations for the improvement of safety⁸. Nevertheless, the preliminary examination has highlighted a number of learning points which are described below:
- Telephones at UWCs on lines with long signalling sections and where the signaller may not know precisely where the train is, may lead to long waiting times for crossing users and encourage the user to cross without using the telephone. The car driver in this case did not use the telephone to contact the signaller to ask if it was safe to cross. It is important that this factor is taken into account when considering risk and options for improvement at user worked crossings with telephones.
 - The assumptions on telephone usage, train speed and sighting distance at this crossing which were entered into the ALCRM prior to this accident did not reflect the situation encountered by users at the crossing. This point is addressed in recommendation 1 of RAIB report 13/2009⁹, "Investigation into safety at user worked crossings", published in June 2009 (appendix A). That recommendation was that crossing users should be involved in the risk assessments to ensure actual usage and misuse, where prevalent, are taken into consideration. Network Rail has accepted that recommendation.
 - The counter-intuitive and apparently erroneous result of the risk assessment carried out following this accident illustrates the importance of level crossing risk assessors applying expert judgement when evaluating risk data generated by the ALCRM and the need for Network Rail to provide training and guidance to relevant staff on how this should be done.

⁸ It should be noted that this does not affect the industry's obligation to comply with health and safety legislation by conducting its own investigation into the accident/incident and implementing appropriate measures to address this risk.

⁹ Available at www.raib.gov.uk

29 The RAIB has written to the duty holders involved informing them of its decision not to undertake a full investigation and the conclusions of its preliminary examination and has brought the above learning points to their attention.

Appendix A: Summary of findings and recommendations from RAIB report 13/2009, “Safety of user worked crossings”, June 2009

Summary of findings

- The immediate cause of most accidents at UWCs is an error or violation by the crossing user. Errors by railway staff contribute to risk at user worked crossings in about 4% of incidents.
- Contributory factors include:
 - expectation by the user that there will not be any trains in the area;
 - inconsistent or unreliable information available to the user on the whereabouts of trains;
 - absence of guidance on where the decision to cross should be taken; and
 - signs which give confusing instructions on how to use the crossing.
- The industry has undertaken research into improvements to crossings. Network Rail has policies and arrangements in place for managing the risks at UWCs.
- ORR has an ongoing strategy for securing the control of risks at UWCs.
- The legal framework relating to level crossings has not been updated for many years, but the Law Commission now has a project in progress to review and modernise law in this area.
- Involvement of the authorised user, or other appropriate persons, in the preparation of a risk assessment for a UWC takes place at higher risk crossings and can be very valuable in informing the crossing operator (Network Rail) of the control measures needed at the crossing.
- The signage in use at crossings does not highlight the presence of a railway, the nature of the risk, or the responsibilities of the user for their own safety. The signs are not always easy for all users to understand and the risks associated with individual crossings are not taken into account when signs are designed.
- The decision point at crossings is not always marked.
- New methods of providing improved protection at UWCs using ‘predictor’ technology and electronic treadles are available and are now being tested by Network Rail with a trial at ten crossings.
- If a crossing cannot be used safely in its existing form it should be upgraded or closed.
- Other methods of achieving safe use of UWCs, including the removal of gates or use of vehicle holding areas, combined with the use of road-type traffic signals, may be feasible and should be considered further, although changes to the law may be required before they can be implemented.

Recommendations

- 1 Network Rail should invite the authorised user or other invitees (such as persons having business on the land) to participate in the preparation of comprehensive site specific risk assessments for UWCs in all cases. The intention of this recommendation is that all factors affecting the use of the crossing should be considered when risk assessments are carried out, and that this should be done at all crossings, instead of just at those which have been assessed as higher risk.

2 Network Rail should include in the risk assessments that it carries out for UWCs that are not equipped with telephones or lights an evaluation of whether there is sufficient information for users on where they should make a decision on whether it is safe to cross, based on the best sighting of approaching trains. Where deficiencies are identified consideration should be given to:

- enhancement of sighting by the removal of obstructions (including improved management of vegetation), so removing the need for additional guidance to users;
- the moving and/or adaptation of existing signs, gates or barriers;
- the provision of an additional sign or visual feature to mark a point where users can wait in safety, clear of the line, and have sufficient sighting of approaching trains (ie at the final decision point); or
- the upgrading of the crossing to an enhanced level of protection, using telephones or warning lights as appropriate to the location.

The intention of this recommendation is that, as a result of risk assessment, users should be given sufficient information or protection to enable them to use the crossing safely.

3 Network Rail should initiate research into reasonably practicable methods of marking the final decision point at those UWCs where such a solution is assessed as being appropriate. This scope of this research should include:

- the requirement to reconcile the needs of various types of user (eg drivers of vehicles, pedestrians, cyclists and equestrians);
- the various categories of UWC (including those which also include public footpaths and bridleways);
- an analysis of where to locate such signs or visual features in relation to the track; and
- the need to protect the railway from vehicle incursions.

4 Network Rail should, taking into account the results of the current trials with new technology, consider how the protection of UWCs which at present are without telephones or lights, can be improved to give the user reliable, consistent and timely warning of the approach of trains, and implement a programme to upgrade the crossings which would benefit from this protection.

5 Network Rail should carry out an assessment of the risks and benefits of removing the need for the crossing user to open gates or barriers, in conjunction with the protection of the crossing by road traffic signs or lights of an appropriate type. The results of this assessment should be used to inform Network Rail's policy on the upgrading of user worked crossings.

6 Northern Ireland Railways should take note of the findings of this report and review their risk assessment and crossing management arrangements accordingly.

7 The Heritage Railway Association should draw its members' attention to this report so that individual heritage railways can note the findings and review their risk assessment and crossing management arrangements.

- 8 The Department for Transport, in consultation with the Office of Rail Regulation, should review the requirements for signs prescribed by law for use at private crossings, and revise them as necessary, taking into account the need to convey information and instructions clearly and unambiguously to diverse users.

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