RAIB
Rail Accident Investigation Branch

Rail Accident Report

Passenger train collision with a road vehicle at Swainsthorpe level crossing, Norfolk

13 November 2005

Department for Transport

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This investigation was carried out in accordance with:

- The Railway Safety Directive 2004/49/EC
- The Railways and Transport Safety Act 2003
- The Railways (Accident Investigation and Reporting) Regulations 2005

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Introduction

1. The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.

2. The RAIB does not establish blame, liability or carry out prosecutions.

3. This report contains the findings of the RAIB investigation into the collision of a passenger train with a road vehicle at Swainsthorpe level crossing on 13 November 2005.

4. The investigation examined:

   - The performance of the level crossing equipment.
   - The crashworthiness and fire resistance of the train.

5. The reason why the car drove onto the level crossing was outside the scope of the investigation.

6. In this report certain technical terms (shown in *italics)* are explained in a Glossary (Appendix A) at the end of this report.

Summary

Key facts about the collision

7. This report describes the RAIB's investigation of the collision between a passenger train and a car at Swainsthorpe level crossing, near Norwich, on 13 November 2005. Regrettably, the driver of the car was killed. The train was not derailed and none of the passengers or traincrew was injured.

8. The RAIB investigated the performance of the level crossing equipment and the crashworthiness and fire resistance of the train as it became apparent early in the investigation that the car was driven onto the level crossing after the road traffic light signals had been seen to start flashing and the *crossing booms* had lowered. The reasons why the car was driven onto the crossing are outside the scope of the RAIB's investigation.

9. The driving and maintenance of the train and the operation of the level crossing did not contribute to the collision. There was no action that the train driver could have taken to prevent the collision occurring.

10. The train performed well in the areas of both crashworthiness and fire performance.

11. No recommendations are made as a result of this investigation.

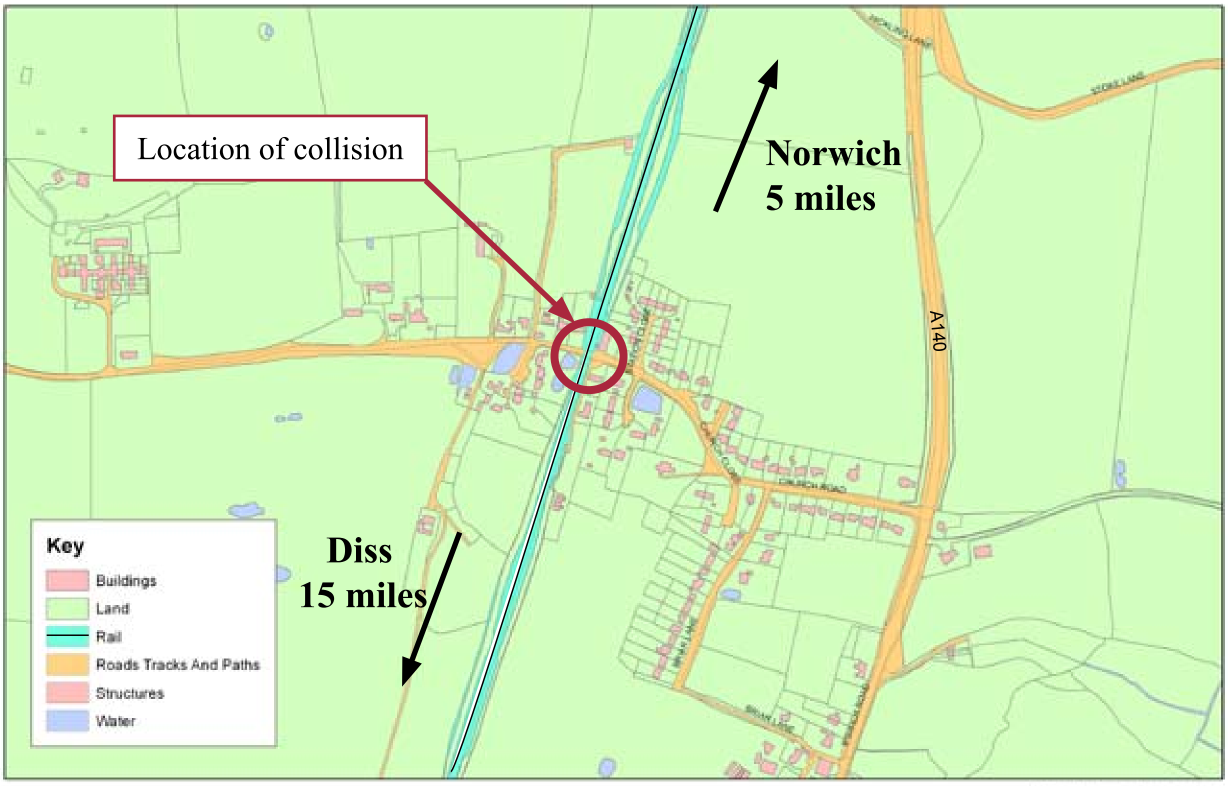


Figure 1: Extract from OS map showing Swainsthorpe and surrounding area

The Investigation

The background

12. At 13.05 hrs on Sunday 13 November 2005, the 13.00 hrs passenger train from Norwich to Diss, reporting number 1G33, struck a car that had driven onto the automatic half barrier (*AHB*) level crossing at Swainsthorpe. The crossing lies on an unclassified road, five miles south of Norwich on the main line railway from Norwich to London (see Figure 1). The weather at the time was cold, sunny and clear. The train was operated by One Railway and the infrastructure is owned and maintained by Network Rail. The car was pushed along the track and caught fire, but the train was not derailed (see Figure 2). The car driver was killed in the collision. There were no injuries to the passengers or traincrew on the train.

Figure 2: Damage caused to class 170 170207 as a result of the collision (courtesy of Norfolk Police)

The collision

13. The maximum permitted line speed at this crossing is 100 mph (161 km/h). The train, consisting of class 170 diesel multiple unit 170207, operated by One Railway, was running at 85 mph (137 km/h) on the *Up* line when it passed the point, 1907 yards (1744 m) from the crossing that initiates the operation of Swainsthorpe *AHB* level crossing. This automatically started the level crossing closing sequence of flashing road lights and the lowering of the *crossing booms.*

14. Following the commencement of the flashing road lights and the lowering of the level *crossing booms,* a motorist, interviewed by the British Transport Police (*BTP*), waiting at the same side of the crossing saw a Ford Escort car drive onto the crossing and position itself directly in the path of the train. The train driver approaching on train 1G33 also saw the car drive onto the crossing when the *crossing booms* were already down. The train hit the car and pushed it 375 m along the track. The car burst into flames on impact and became wedged under the front of the train forward of the train's obstacle deflector. Substantial damage was caused to the exterior of the driving cab by the effects of the impact and the heat generated by the fire.

15. Prior to this, another witness, also interviewed by the *BTP*, stated that she had seen the car parked on the offside of the road close to the level crossing on the east (*Up*) side (ie the side closest to trains travelling in the London direction). In view of the consistency with the technical data, the separate witness evidence, and the fact that there was no damage to the *crossing booms*, which again is consistent with the other evidence, RAIB saw no need to interview these witnesses directly

16. Appendix B Figure 4 shows the relative positions of the car that was positioned on the crossing and the car that was correctly waiting before the flashing road lights on the east side of the crossing just before the collision occurred.

17. Following the collision, the train driver put down *track circuit clips* on the opposite (*Down*) line to ensure any signals for that direction could not be cleared and then contacted the signaller at Colchester signal box.

18. The 15 passengers on the train were not injured and were evacuated from the train by the guard who then guided them back to the level crossing where taxis had been ordered to take them to Diss.

The train

19. The train, crewed by a driver and a guard, consisted of three coaches with an overall length of 70.86 m and weight of approximately 132 tonnes; all vehicles were powered. The train was leased from Porterbrook Leasing Company by One Railway. The train was fitted with Sécheron Teloc 2200 data recorders in the leading and trailing vehicles.

The Infrastructure

20. The railway between Norwich and Diss consists of double track and is signalled with colour light signals and continuous *track circuiting* controlled from the signal box at Colchester. The AHB level crossing (shown in Figure 3) is located at 109 miles 54 chains from Liverpool Street Station and comprises standard flashing road traffic light signals, audible alarms and lifting booms that close off the nearside half of the carriageway width in each direction. Assuming normal operation, for trains running at the maximum permitted speed of 100 mph (161 km/h), the lights illuminate at least 27 seconds before a train's arrival, and the booms are fully lowered at least eight seconds before a train's arrival. Emergency telephones are fitted on the offside of the crossing on both sides that connect to Colchester signal box. An 'Instead' 64 datalogger is fitted which monitors and records the operation of the level crossing. Located 183 m before the crossing on the *Up* line, there is a *two-aspect colour light signal* which the level crossing datalogger indicates was showing green as the train approached it

Figure 3: General view of the eastern (Up side) approach to Swainsthorpe level crossing

Analysis

21. The scope of the RAIB's investigation was restricted to the handling of the train, the damage to the train caused by the collision and the functioning of the level crossing equipment.

22. The driver of train 1G33 had booked on duty at 08.59 hrs and was adequately rested. There were no issues of concern regarding the driver's competence or fitness to drive trains. As the train approached the level crossing, the train driver reported seeing the car drive onto the crossing after already seeing that the *crossing booms* were down. The driver sounded the warning horn and applied the brakes, but there was no possibility of avoiding a collision due to the proximity of the train to the level crossing.

23. The RAIB oversaw the downloading of the train data recorder, and this shows that from the point the driver first made a continuous brake application, the train took 602 m to stop. The data recorder also indicates that the continuous brake application was made 226 m from the crossing following which the horn was sounded 131m from the crossing. From the results of the train data recorder, it is estimated that the train hit the car at a speed of 77 mph (124 km/h).

24. Before the collision occurred, the train driver thought that he had applied the brake into the emergency position, whereas the data recorder indicates that he initially applied the brake into the *'Step 1'* position, released it and then made a *'Step 3'* full service brake application. The emergency position provides an enhanced braking capability. However, given the time for the brakes to apply following operation of the driver's brake handle, and the distance the train was from the crossing, calculation shows that an emergency brake application would have further reduced the speed of the train by less than 5 mph. It is unlikely therefore that this would have made any difference to the outcome of this collision. A copy of the data recorder download is in Appendix C, Figure 5.

25. The level crossing datalogger was downloaded under the control of the RAIB, and this confirmed that the road traffic light signals and *crossing booms* had been working correctly as reported by the witness interviewed by the *BTP*. The RAIB Lead Inspector considered that full *wrongside failure testing* was not necessary given the clear witness evidence and agreed the scope of more limited *functional testing* of the level crossing equipment, prior to re-opening, with Network Rail. This acted as a further confirmation that the crossing had worked correctly. The testing was carried out during the night following the collision, and the key elements of the test were witnessed by the RAIB. As a result of the testing, Network Rail renewed three cables that were found with resistance values lower than those specified in maintenance documentation. The datalogger records showed that the low resistance values had no effect on the operation of the level crossing before the collision occurred. The operation of the crossing was neither a causal nor a contributory factor in the collision.

26. The car was trapped under the front of the unit after it was struck by the train. It appears that the obstacle deflector prevented the wrecked car from reaching the wheels of the train and greatly reduced the risk of the train derailing. Subsequent examination of the

train showed that most of the damage occurred to the driver's side cab area of the leading vehicle due to the fire. There was no distortion of the bodyshell structure, and little other mechanical damage – the trailing vehicle suffered some minor bodyside and body structure damage, as well as damage to the power bogie. This is thought to be impact damage from components of the car that became detached as a result of the collision.

27. After the impact, the car caught fire. The fire burnt fiercely as the petrol in the car's petrol tank ignited. As well as the considerable exterior fire damage to the train driving cab and body structure forward of the leading wheelset, the fire penetrated the cab back wall cubicle containing electrical wiring behind the driver's seat, causing significant damage. This issue was examined by AEA Technology on behalf of the vehicle manufacturer, Bombardier, who concluded that the wiring in the cab back wall cubicle probably ignited due to the fact the self-ignition temperature of the insulation was 330 C, whereas temperatures close by had exceeded 660 C – the melting point of aluminium. The performance of wiring insulation is covered by British Standards BS4066 and BS7622, and the fire experienced gave rise to temperatures well in excess of the performance required.

28. The standard used to assess the fire resistance of structural elements of railway rolling stock is BS476: Part 20 'Heating Curve' and specified in BS6853:1999. AEA Technology concluded that the fire seen on the cab front of the train was well in excess of requirements laid down in BS476. Despite this, the extent of the fire was limited due to the fire resistance performance of the vehicle.

Conclusions

29. The collision occurred because a car was driven onto the level crossing after the approach of train 1G33 had already caused the road traffic light signals to operate and the *crossing booms* to lower.

30. The driving and maintenance of the train and the operation of the level crossing did not contribute to the collision. There was no action that the train driver could have taken to prevent it happening.

31. The train was not derailed, and the RAIB considers that the obstacle deflector fitted to the class 170 was instrumental in preventing this occurrence.

32. This was a collision involving a train designed to modern crashworthiness standards (Railway Group Standard GM/RT 2100), and it appears to have performed very well in the circumstances.

33. The train also performed well in the area of fire performance with only limited incursion of fire into the vehicle despite the fierce fire on the outside.

Recommendations

34. The RAIB makes no recommendations as a result of its investigation.

35. The RAIB is aware of the report by the Railway Safety and Standards Board into the collision with a car parked on the *AHB* level crossing at Ufton Nervet on 6 November 2004, which generated seven recommendations relating to level crossings.

36. One of the recommendations was to conduct research to establish whether a system could be developed to warn train drivers of an obstruction at *AHB* level crossings. It is the RAIB's view that such a system would not have prevented this collision as the car was not in a position of risk until a very late stage, and the train driver immediately applied his brakes to mitigate the consequences of the inevitable collision.

Appendices

Glossary of terms, abbreviations and acronyms — Appendix A

AHB	Automatic Half Barrier
BTP	British Transport Police
Crossing booms	The barriers at the level crossing that close off half the width of the road on each side of the railway when lowered
Down	In the direction away from London
Functional testing	Testing carried out to determine the correct operation of equipment
Step 1	The first of three normal braking steps provided as part of the train's braking system
Step 3	The third of the three normal braking steps representing the full service braking position
Track circuit clips	A device which in an emergency can be placed on the top of each running rail to operate the track circuit and protect an obstruction
Track circuiting	An electrical device using rails in an electric circuit which detects the absence of trains on a defined section of line
Two-aspect colour light signal	A railway signal that can only show two changes of state
Up	In the direction of London
Wrongside failure testing	Testing carried out to determine whether there is a failure which reduces the protection normally provided by the signalling and increases the risk of an incident occurring

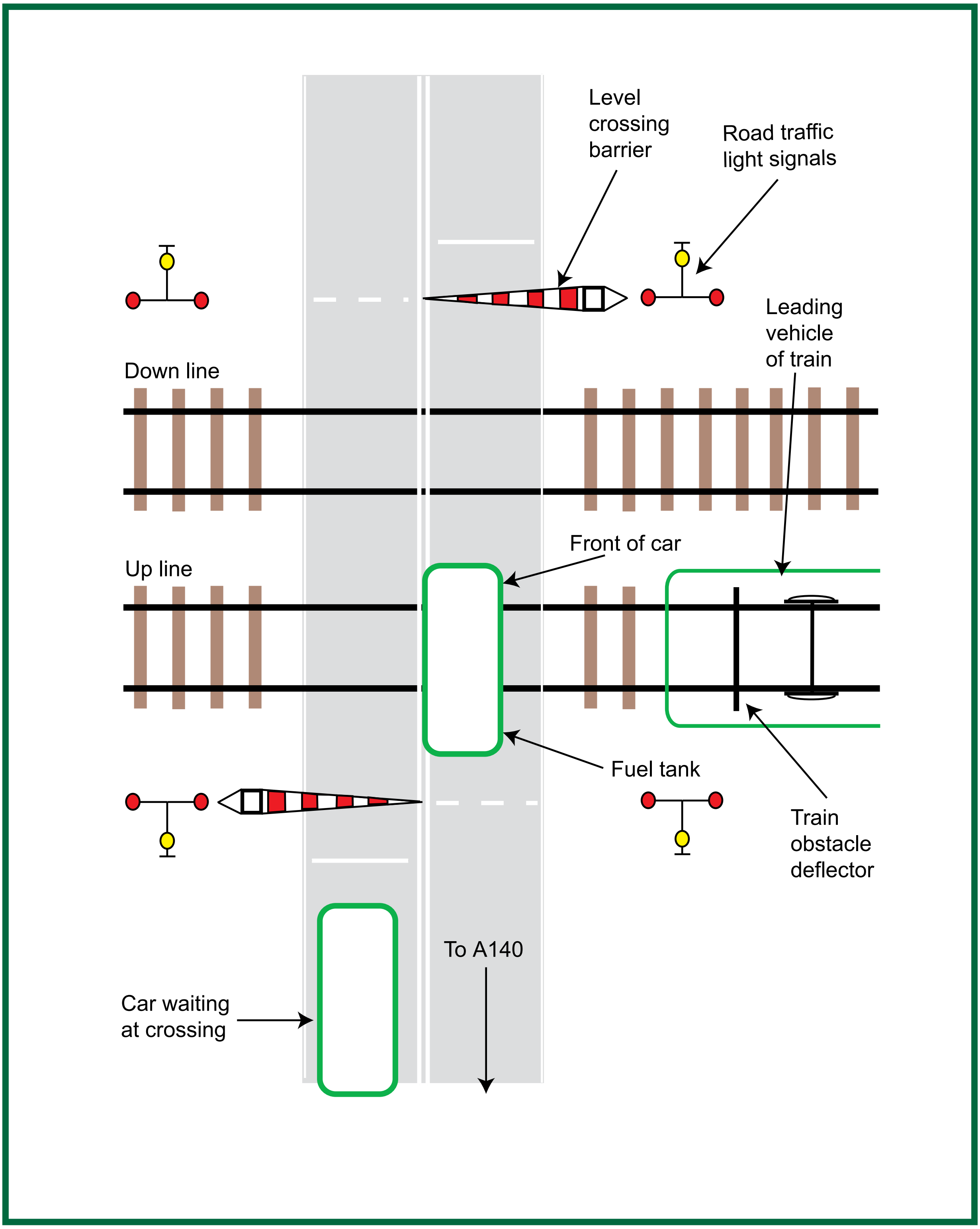
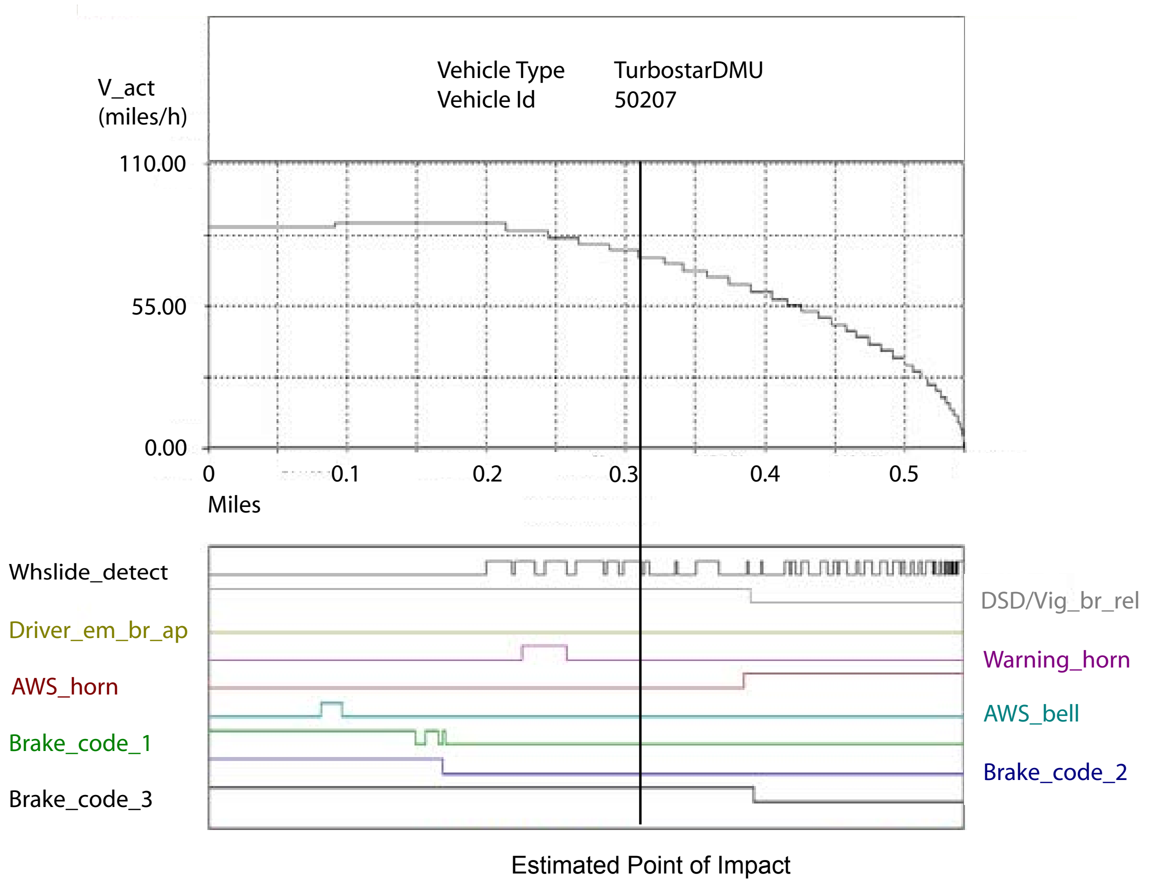


Figure 4: Diagrammatic representation of relative positions of train and cars at impact



Key:		
	V_act	Shows actual speed of train
	Whslide_detect	Shows operation of Wheelslide detection system
	DSD/Vig_br_rel	Shows operation of Driver's Safety Device or Vigilance system
	Driver_em_br_ap	Shows operation of Emergency brake
	Warning_horn	Shows sounding of train warning horn
	AWS_horn	Shows sounding of Automatic Warning System horn (e.g. for a signal at caution or danger ahead)
	AWS_bell	Shows sounding of AWS bell (signal ahead at green)
	Brake_code_1 Brake_code_2 Brake_code_3	All energised: brake released Code_1 de-energised: brake step one Code_2 de-energised: brake step two Code_1 and 2 de-energised: brake step 3 Code_1, 2 and 3 de-energised: emergency brake

Figure 5: Data Recorder download trace from the leading vehicle no. 50207 of train 1G33

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