



Rail Accident Investigation Branch

Rail Accident Report



Runaway of a road-rail vehicle at Glen Garry 5 December 2007

This investigation was carried out in accordance with:

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

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Contents

Introduction	5
Summary of the report	6
Key facts about the incident	6
Immediate cause, causal and contributory factors	7
Severity of consequences	7
Recommendations	8
The Incident	9
Summary of the incident	9
The parties involved	10
Location	11
External circumstances	12
Rail equipment	12
Events preceding the incident	13
Events during the incident	15
Consequences of the incident	16
Events following the incident	17
The Investigation	18
Investigation process	18
Sources of evidence	18
Factual Information	19
Use of RRVs on the UK national rail system	19
Standards governing RRVs	20
Training and Competence	21
Previous occurrences of a similar character	22
Analysis	25
Colmar RRV braking tests	25
Colmar RRV mechanical condition	27
RRV speed	27
Identification of immediate cause, causal and contributory factors	28

Underlying Cause	30
Severity of consequences	30
Additional observations	30
Actions reported as already taken or in progress relevant to this report	31
Recommendations	32
Recommendations to address causal and contributory factors	32
Appendices	33
Appendix A - Glossary of abbreviations and acronyms	33
Appendix B - Glossary of terms	34
Appendix C - Urgent safety advice	36

Introduction

- 1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future incidents and incidents and improve railway safety.
- 2 The RAIB does not establish blame, liability or carry out prosecutions.
- 3 Access was freely given by Network Rail, Edmund Nuttall, Ritchies, QTS, AB2000 and Donaldson Associates to their staff, data and records in connection with the investigation.
- 4 Appendices at the rear of this report contain the following:
 - acronyms and abbreviations are explained in Appendix A;
 - technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B; and
 - the urgent safety advice issued by the RAIB on 21 December 2007 in connection with this incident is in Appendix C.

Summary of the report

Key facts about the incident

- 5 At 01:30 hrs on 5 December 2007, a *road-rail vehicle* (RRV) hauling a loaded trailer was unable to stop as it approached a *work site* where rock face repairs were taking place in a *possession*. Several site staff narrowly avoided injury by jumping clear and, although a low-speed collision between the RRV and another one at the site occurred, the staff in the RRVs were not injured.
- 6 The site of the incident was the Highland main line in Glen Garry, between Blair Atholl and Dalwhinnie. The railway through the glen is on a gradient of approximately 1:75 and the RRV and trailer were travelling down this gradient at the time of the incident. The weather conditions at the time were poor, with wind and heavy rain. Figure 1 shows the location of the incident.
- 7 Vegetation clearance work was taking place close to the rock face repair and the rails that the RRV was running on were likely to have been contaminated by tree debris. The presence of rail contamination could not be confirmed as the rail condition was not observed after the incident.

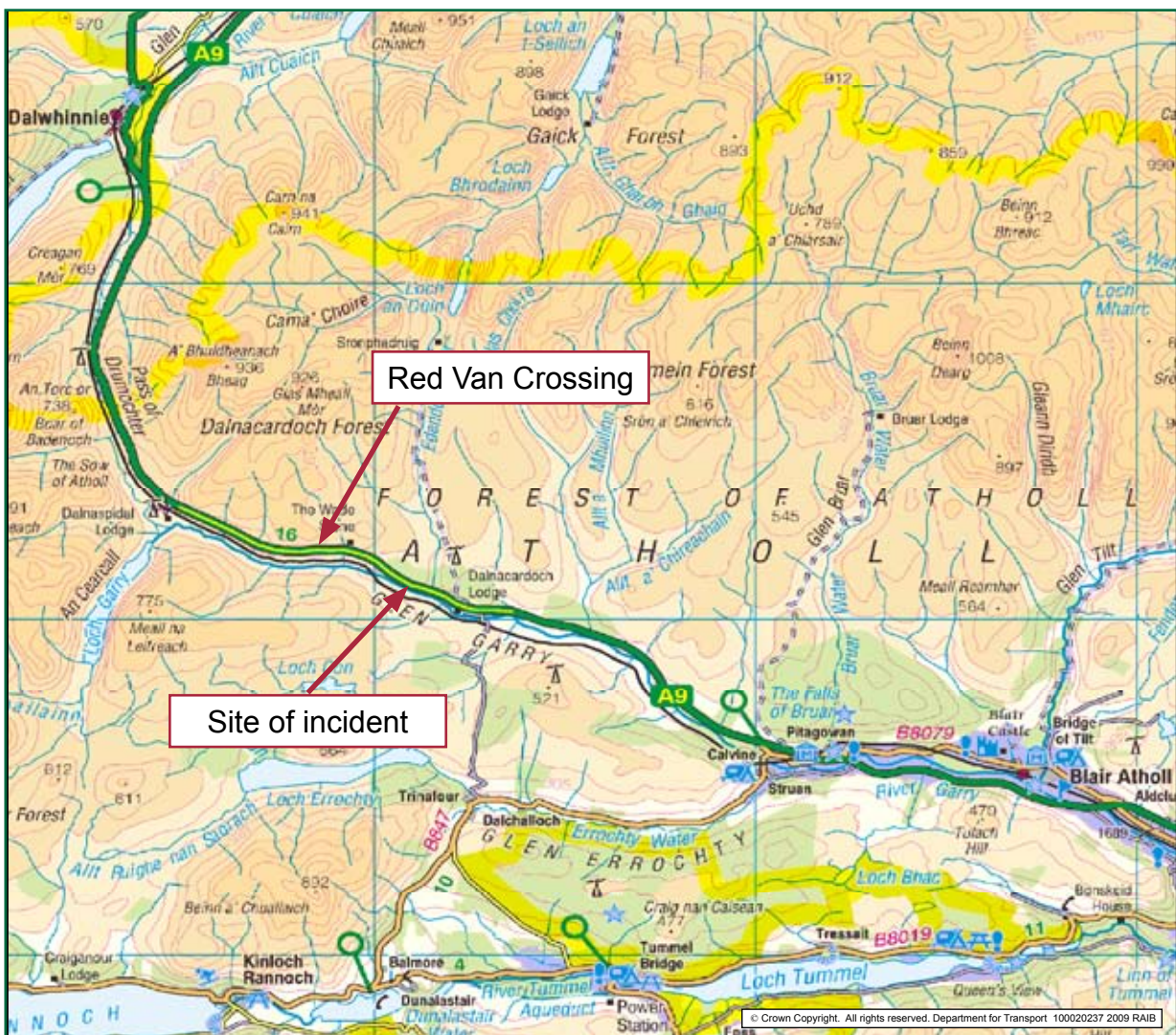


Figure 1: Extract from Ordnance Survey map showing location of incident

Immediate cause, causal and contributory factors

- 8 The immediate cause of the incident was that the RRV and trailer had insufficient adhesion at its braked wheels to stop on the gradient, most likely due to rail contamination from vegetation clearance operations combined with water from the rain.
- 9 The causal factor was:
- The use of a trailer not fitted with *service brakes* on the gradient without measures being taken to address likely adhesion conditions. Network Rail standards allow such use. Measures that could have been taken include reducing the load in the trailer and improved management of activities leading to the contamination.

Contributory factors were:

- 10 Network Rail did not provide information on the gradient at the site to their contractor. The *machine controller* needed this information in order to direct the RRV safely;
- The machine controller did not warn the RRV operator of the gradient or the potential for rail contamination. The operator could have driven the machine at a lower speed and stopped short of the contaminated rail if he had been aware of it.
 - The road tyres of the RRV were not inflated to the correct pressure. This would have reduced the maximum braking effort of the RRV.
 - The RRV was travelling at a higher speed than allowed by the rule book as the driver was not aware of the speed limit for movements within a work site.
 - The RRV operator had received no training on what to do in a braking emergency.
- 11 A possible contributory factor was:
- The use of one large worksite covering all work within the possession lead to RRVs theoretically having to travel long distances at walking pace and may have encouraged the RRV operators to exceed the speed limit.

Severity of consequences

- 12 A total of seven site staff were put at risk by the incident. All had to take rapid evasive action to avoid injury. The site staff on the ground could not see the approaching RRV or hear its warning horn and were warned by an abseiler working on the rock face.
- 13 If rapid evasive action by all of the staff involved had not been taken, a serious accident would have ensued.
- 14 The actual collision between the RRVs only caused superficial damage. The staff in the cabs of the two RRVs were not injured, although the door to the machine controller's seat in the moving RRV became jammed shut.

Recommendations

- 15 Recommendations can be found in paragraph 134. They relate to the following areas:
- publication of gradient information;
 - inclusion of gradient and potential rail contamination in risk assessments;
 - training of machine operators;
 - limiting the unbraked trailing loads of RRVs according to gradient; and
 - phasing out of RRV trailers not fitted with service brakes.

The Incident

Summary of the incident

- 16 Work was being undertaken in an overnight T3 possession of the railway line between Blair Atholl and Dalwhinnie to repair rock cuttings. The repairs consisted of drilling holes in the rock face and attaching mesh to prevent rock falls. The work involved the use of an RRV with a drilling rig standing on the *up line* and reaching across the *down line*. Another part of the work involved an RRV with a trailer loaded with stone and *gabion baskets* running on the down line. Figure 2 shows a sketch plan of the site.

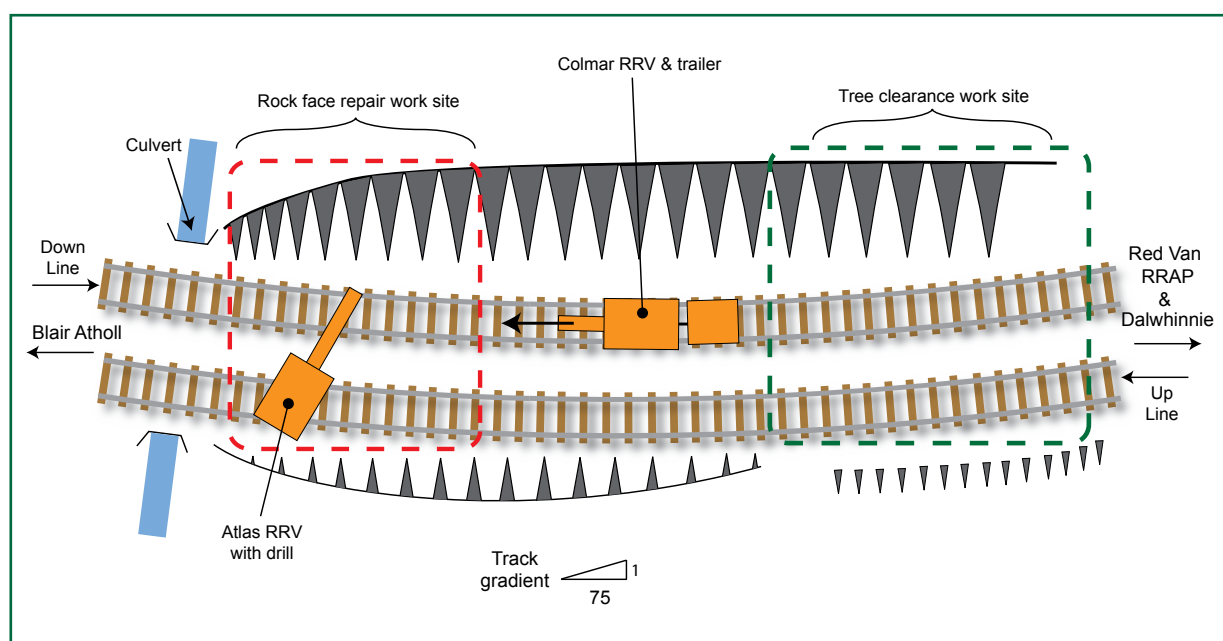


Figure 2: Sketch plan of the site of the incident

- 17 The track through Glen Garry is on an uphill gradient of 1:75 towards Dalwhinnie (ie down trains face the uphill gradient). Both RRVs had *on-tracked* at Red Van road rail access point, which is between the work site and Dalwhinnie, and had to travel downhill to the site. The RRV with the drilling rig was in place on the up line and was drilling the second hole of the shift when the incident occurred.
- 18 Vegetation clearance work had taken place earlier in the shift and this involved dragging trees and branches across the down line. This may have contaminated the rail head with tree debris (paragraph 39). The presence of contamination could not be verified positively as the rail head condition was not examined after the incident.
- 19 The RRV with the trailer and gabion materials was approaching the site from the Dalwhinnie direction, running downhill in very heavy rain. The RRV was driven by a *machine operator* who was accompanied in the cab by a machine controller. As the RRV approached the work site the machine operator applied the RRV's service brake to stop the machine and allow the machine controller to alight. The brakes were not effective and the machine did not stop. The machine operator flashed the headlights and blew the horn repeatedly to warn staff on the track ahead.

- 20 The site staff working on the track could not hear the approaching RRV as they were wearing ear defenders. They could not see it as the drilling rig obscured the view towards Dalwhinnie. An abseiler working on the rock face marking out drill hole locations saw the approaching RRV and trailer and shouted and waved vigorously to attract the attention of the staff on the track.
- 21 The RRV and trailer ran into the work area as staff ran out of the way. The boom of the moving RRV was out in front of the machine and in line with the boom of the drilling rig RRV. The drilling rig RRV operator saw this and quickly raised his boom to allow the other RRV to pass beneath it. A minor collision between the two RRVs occurred which damaged the cab body work on both machines and broke the windows in the drilling rig RRV. The moving RRV continued for a further 90 m before coming to a stand. Figure 3 shows that RRV and its trailer in their final stopping position.



Figure 3: Colmar RRV and trailer immediately after incident (photo courtesy of Edmund Nuttall Ltd).

- 22 Nobody was injured in the incident. However, if the warning by the abseiler and rapid evasive action by all of the staff involved had not been taken, a serious accident could have ensued.

The parties involved

- 23 The line is owned and operated by Network Rail and is part of their Scotland Territory.
- 24 The rock repair work was commissioned by Network Rail Infrastructure and Investment – Construction (Civils).

- 25 The rock repair work was being done by Edmund Nuttall Ltd as principal contractor with Ritchies, a division of Edmund Nuttall Ltd, as specialist geotechnical subcontractor.
- 26 Specialist geotechnical support to Network Rail was provided by Donaldson Associates Ltd.
- 27 Road/Rail plant for the work was hired by Edmund Nuttall Ltd from QTS Ltd.
- 28 The RRV and trailer that ran away were hired by QTS Ltd from AB2000 Ltd.
- 29 The machine operator of the RRV and trailer that ran away was an employee of AB2000 Ltd. The machine controller of this machine, and the operators and machine controllers of the other RRV involved, were all employees of QTS Ltd.

Location

- 30 The site of the incident was in Glen Garry, 46 miles 1080 yards (74.58 km) from Perth, between Blair Atholl and Dalwhinnie stations.
- 31 The line at the incident site is on the west side of the river valley. There is no road access to this side of the valley and the nearest road-rail access point is at Red Van road rail access point, which is 2.4 miles (3.8 km) further up the valley to the north.
- 32 The site compound and messing facilities for the repair works were situated on the east side of the river and pedestrian access to the track was provided by a footbridge over the river. All plant and materials for the repair works were brought to site by rail using RRVs.



Figure 4: Incident site viewed from the opposite side of the glen

External circumstances

- 33 The weather at the time of the incident was very wet with periods of intense rain interspersed with periods of lighter rain.

Rail equipment

- 34 The RRV that ran away was a 'high ride' 360 degree wheeled excavator manufactured by Colmar Ltd (type T4300FS). The RRV was fitted with a *clam shell grab* and was towing a *Philmor trailer* fitted with a load carrying box. The load carrying capacity of the trailer was eight tonnes and its tare weight was two tonnes, giving a maximum total weight of ten tonnes. The load carrying box was loaded with stone gabion filling material, two filled gabions, some gabion mesh and various items of small equipment and materials. The total weight of the trailer and its load was estimated to be between nine and ten tonnes. The actual weight of the trailer's load was not recorded. Figure 5 shows the RRV parked at Red Van road rail access point.



Figure 5: Colmar T4300FS RRV

- 35 The stationary RRV was a 'low ride' 360 degree wheeled excavator manufactured by Atlas (type 1404). The machine was fitted with a drilling mast and rock drill. Figure 6 shows the RRV parked at Red Van road rail access point.



Figure 6: Atlas 1404 RRV

Events preceding the incident

- 36 Repair works had been undertaken on a number of rock faces on the Highland line during a blockade of the line for nine days in November 2007. Following this blockade, some items of work remained to be completed and these were planned to be completed during *rules of the route* possessions over the following weeks. The works being undertaken in Glen Garry on the night of 4/5 December 2007 were part of this work.
- 37 Work was going on at two separate sites within the Blair Atholl – Dalwhinnie section on the night of 4/5 December 2007. One was the site of the incident, and the other was further down the gradient towards Blair Atholl. Both sites involved the use of RRVs. The RRVs for the other site accessed the track at the Pitagowan road rail access point, which is near Blair Atholl.
- 38 The work at the incident site on the night of 4/5 December consisted of the following tasks:
- chipping of previously-cleared vegetation at the north (uphill) end of the rock cutting, including removal of the chippings;
 - drilling holes and installing rock bolts in the rock face on the west side of the cutting; and
 - installing and backfilling gabions at the south (downhill) end of the rock cutting.

- 39 The chipping work involved the use of a low ride RRV manufactured by Unimog and fitted with a wood chipper. This was operating on the up line and the trees, which had been felled six weeks earlier, were dropped from the top of the rock cutting onto the down cess. They were then dragged manually over the down line and fed into the chipper on the up line. The chipper RRV was fitted with a container for the wood chips. When this container was full, the RRV was driven back to Red Van road rail access point and unloaded. At the time of the incident, the chipper RRV was on its way to Red Van road rail access point to unload and its site staff were in the up cess.
- 40 The machine operator for the Colmar RRV was booked to work from 22:00 hrs to 08:00 hrs and arrived at the site compound just before 22:00 hrs. The operator was then directed to Red Van road rail access point to meet the machine controller. The operator met the machine controller at Red Van road rail access point and they carried out their pre-work tasks including inspection of the *engineering acceptance certificate* for the Colmar RRV, as required by Railway Group Standard GM/RT8000, the Rule Book, module On Track Plant (OTP). The machine controller gave the operator a briefing on the safety arrangements and the work to be done. The machine controller had no knowledge of the gradient and was not aware that the wood chipping work involved dragging branches across the line his machine was on. He therefore did not warn the operator about the gradient or the potential for rail contamination from the chipping work.
- 41 The machine operator and machine controller of the Atlas RRV met at Red Van road rail access point and carried out their pre-work checks and briefing. They on-tracked their RRV onto the down line, as they had done on previous nights, and set off towards the work site. After a few minutes travelling they received a phone call from the *engineering supervisor* to tell them to return to the access point and transfer to the up line as the Colmar RRV needed to work on the down line. The Atlas RRV was moved to the up line, set off again and was the first RRV to arrive at the work site.
- 42 The Unimog RRV with chipping attachment was on-tracked onto the up line after the Atlas RRV had departed for site, leaving the Colmar RRV as the only machine on the down line.
- 43 The Colmar RRV was on-tracked and its trailer placed on the line to the north (uphill side) of it. A brake test of the RRV and trailer was carried out and the service and parking brakes were found to be working correctly. The brake test is required by module OTP of the rule book and M&EE Networking Group code of practice COP0014 'Code of Practice for Trailers and Attachments with RRVs and RMMs'. The procedure consists of placing the trailer on the rails and checking that the parking brake is applied by attempting to pull the trailer along the track with the RRV arm (the lifting chains remaining attached). The trailer was loaded with a load box and this was in turn loaded with the necessary materials for the planned tasks. The RRV and trailer then set off for the work site with the machine controller riding in the cab with the machine operator (a machine controller's seat is provided behind the driver's seat). It was raining heavily at the time.
- 44 The windscreen wiper on the Colmar RRV became defective and the machine operator stopped the RRV to attend to it. According to witnesses the RRV and trailer stopped normally. The operator got out and fixed the wiper then got back in to the cab and continued towards the site.

- 45 During the time that it had taken for the Colmar RRV to on-track with its trailer, and to load the trailer with the materials and equipment, the Unimog RRV chipper had filled its chippings container and set off towards Red Van road rail access point on the up line, passing the Colmar RRV on its way. Figure 7 shows the view towards the work site from the approximate location of the chipping work.



Figure 7: View towards the rock drilling site from the approximate location of the vegetation chipping site

- 46 At the site, the Atlas RRV had drilled one hole and was finishing another when the block of rock it was drilling through became loose. Drilling was stopped and the driller called the geotechnical engineer over for advice. An abseiler was working on the rock face setting out hole positions to the geotechnical engineer's instructions and had to stop work when the engineer was called away.
- 47 The drill was pulled out of the hole, but was not withdrawn completely as it was feared that the loose rock might fall. The driller and the geotechnical engineer stood on the Blair Atholl (downhill) side of the drill boom (Figure 2).

Events during the incident

- 48 The Colmar RRV approached the cutting where the work was taking place and the machine controller asked the driver to stop so that he could get permission from the staff working on the site to proceed through their area. The machine operator applied the service brake but the RRV did not stop. The operator and controller said that the RRV slowed slightly but then seemed to accelerate. The site staff at the chipper said that the rubber tyred road wheels were not rotating.

- 49 When the machine controller realised that the RRV was not stopping, he told the operator to sound the horn as a warning. The operator sounded the horn and flashed the lights as the RRV approached the drilling site.
- 50 The abseiler working on the rock face noticed the RRV approaching and realised that it was out of control. He tried to attract the attention of the staff working below by waving and shouting to them. The staff working on the line were wearing ear defenders and could not hear the warnings. However, some staff saw the abseiler waving his arms and they realised something was wrong. The site staff looked up the line, saw the RRV approaching and started warning each other and running out of the way.
- 51 The Atlas RRV operator noticed the abseiler waving and looked round his boom to see the Colmar RRV approaching. The operator could not see the Colmar RRV from his normal operating position due to the position of the boom. Realising that the Colmar RRV was likely to collide with the Atlas boom he tried to move the boom up out of the way. The Atlas RRV was locked in position for drilling and would not move. The operator realised this and quickly released the lock, revved the engine and pulled the boom upwards. This action ripped the loose rock from the face and bent the drill rod but raised the boom sufficiently high that the Colmar RRV was able to pass beneath it without colliding.
- 52 The last people to realise the danger were the staff standing by the drill. The drill operator was attached to the machine by cables that connect the drill to the control panel strapped to his waist. The operator had to undo the strap clips to release the control panel before he could run out of the way. The drill operator and the geotechnical engineer were the last to escape the site and did so by running about 15 m to a culvert, into which they jumped as the RRV passed.
- 53 After passing the drilling site, the Colmar RRV continued for a further 90 m before coming to rest.

Consequences of the incident

- 54 Nobody was injured in the collision.
- 55 Two site staff on the track escaped injury by scrambling up the bank on the up side. Two site staff escaped by running to a culvert on the down side and jumping in it. The two staff on the Colmar RRV were unable to jump clear and stayed in their cab. The operator of the Atlas RRV had no time to jump clear and stayed in his cab.
- 56 If the abseiler had not warned the site staff of the approaching RRV, the four staff on the track and the one in the Atlas RRV cab would have been at risk of serious injury.
- 57 The Atlas RRV's body was positioned at an angle to the track and this meant that its cab was foul of the up line. The cabs of the two RRVs came into contact as they passed, breaking the windscreen of the Atlas RRV and causing damage to the cab structures of both machines. The drill rod on the Atlas RRV was bent and the air hose connecting the drill rig to its compressor was cut through. If the Atlas RRV operator had not raised the jib in time a much more serious collision would have occurred.
- 58 The rest of the work in that night's possession was abandoned.

Events following the incident

- 59 Some of the site staff ran to the Colmar RRV thinking that the operator may have been injured or incapacitated. The RRV was then secured by lowering its jib arm onto the track. All of the staff involved left the site and returned to the site office to report the incident.
- 60 The Network Rail site manager reported the incident to Network Rail Scotland operations control and infrastructure control. The operations controller called a Network Rail *mobile operations manager* (MOM), but the MOM declined to attend the site as a local Network Rail policy stated that MOMs would not attend incidents that occurred in possessions; incidents in possessions were to be dealt with by Network Rail infrastructure investment staff.
- 61 The controller then called the on-call Network Rail engineer. The Network Rail engineer established the basic details of the incident and passed it on to Edmund Nuttall Ltd's on-call engineer. Edmund Nuttall Ltd's engineer spoke to the site staff and instructed them to record the positions of the RRVs and take photographs before clearing the track and giving up the possession.
- 62 Neither Network Rail nor Edmund Nuttall attempted to contact the RAIB, although this incident was one which, under slightly different conditions, might have led to death or serious injury and, as such, should have been reported to the RAIB by the quickest means possible in line with Regulation 4 of the Railways (Accident Investigation and Reporting) Regulations 2005.
- 63 The RRVs had to be taken back up the gradient to reach the Red Van road rail access point so a new operator was found for the Colmar RRV. The Colmar RRV was unable to obtain sufficient traction to travel back up the gradient and the operator phoned the original operator to ask advice on what to do. The remedy that was adopted was to lower the road wheels until they touched the rail head with sufficient force to obtain traction. This mode of operation is not an authorised mode of operation for this machine and is hazardous as there is no control over the relative loading of road and rail wheels; it can lead to excessive unloading of the rail wheels and derailment.
- 64 The RRVs and equipment were removed from the track and the possession given up at 05:25 hrs. There was no delay to train services.
- 65 No rail or wheel swabs were taken and no details were recorded of the rail head condition on the approach to the drilling site. As the incident was a *schedule 1* incident, Regulation 9 of the Railways (Accident Investigation and Reporting) Regulations 2005 requires that Network Rail preserve the scene until the RAIB gives permission for it to be released. Evidence was lost as a result of not doing this.

The Investigation

Investigation process

- 66 The RAIB discovered that the incident had taken place during a routine examination of the Network Rail operations log later that day. Further enquiries were made of Network Rail and, when the details became apparent, the RAIB asked for the RRVs to be quarantined and deployed an inspector to the incident site.
- 67 The RAIB examined the RRVs involved at Red Van road rail access point. The Colmar RRV and its trailer were impounded for further examination and testing.

Sources of evidence

- 68 Information was obtained from the following sources:
- statements by staff on site at the time;
 - evidence gathered on site by the RAIB on 7 December 2007;
 - photographs taken on site at the time of the incident by Edmund Nuttall Ltd;
 - documents obtained from Network Rail, Edmund Nuttall Ltd, Ritchies, QTS Ltd, AB2000 Ltd and Donaldson Associates;
 - operating and maintenance manuals from Colmar;
 - results of tests of the RRV carried out by Edmund Nuttall Ltd, Network Rail and AB2000 Ltd under RAIB supervision;
 - documents supplied by the Network Rail director of mechanical and electrical engineering;
 - information supplied by the *Rail Plant Association*; and
 - examination of RRV running gear by a Colmar RRV specialist under RAIB supervision.
- 69 The operator of the Colmar RRV was tested for the presence of drugs and alcohol following the incident in accordance with normal industry practice and the tests showed that none were present.

Factual Information

Use of RRVs on the UK national rail system

- 70 Prior to 1990 the most common types of RRV used were road lorries fitted with specialist rail gear for use in derailment recovery. The rail wheels fitted to these vehicles were directly powered and braked by *hydrostatic drive units*. There were also a few shunting tractors in use in sidings. These relied on friction between their rubber tyres and the rail for traction and braking and used rail wheels for guidance. Vehicles which have their rubber tyres in contact with the rails to provide traction and braking are referred to as low ride machines. The Atlas RRV involved in the Glen Garry incident was a low ride machine.
- 71 After railway privatisation, the use of RRVs expanded substantially as contractors new to the rail industry started to use them for infrastructure work. These machines were mostly converted from existing road-based machines by adding rail wheel running gear. Some of these new machines were of the low ride design but most were of the high ride type. The high ride design involves the use of idler rail wheels which are driven by friction from the road tyres. The road wheels are lifted completely clear of the rails and all traction and braking effort is transmitted by friction from the rubber tyre to the steel rail wheel, then by friction between the steel rail wheel and the rail. The Colmar RRV involved in the Glen Garry incident was a high ride machine. Figure 8 shows the principle of operation of high ride and low ride RRVs.

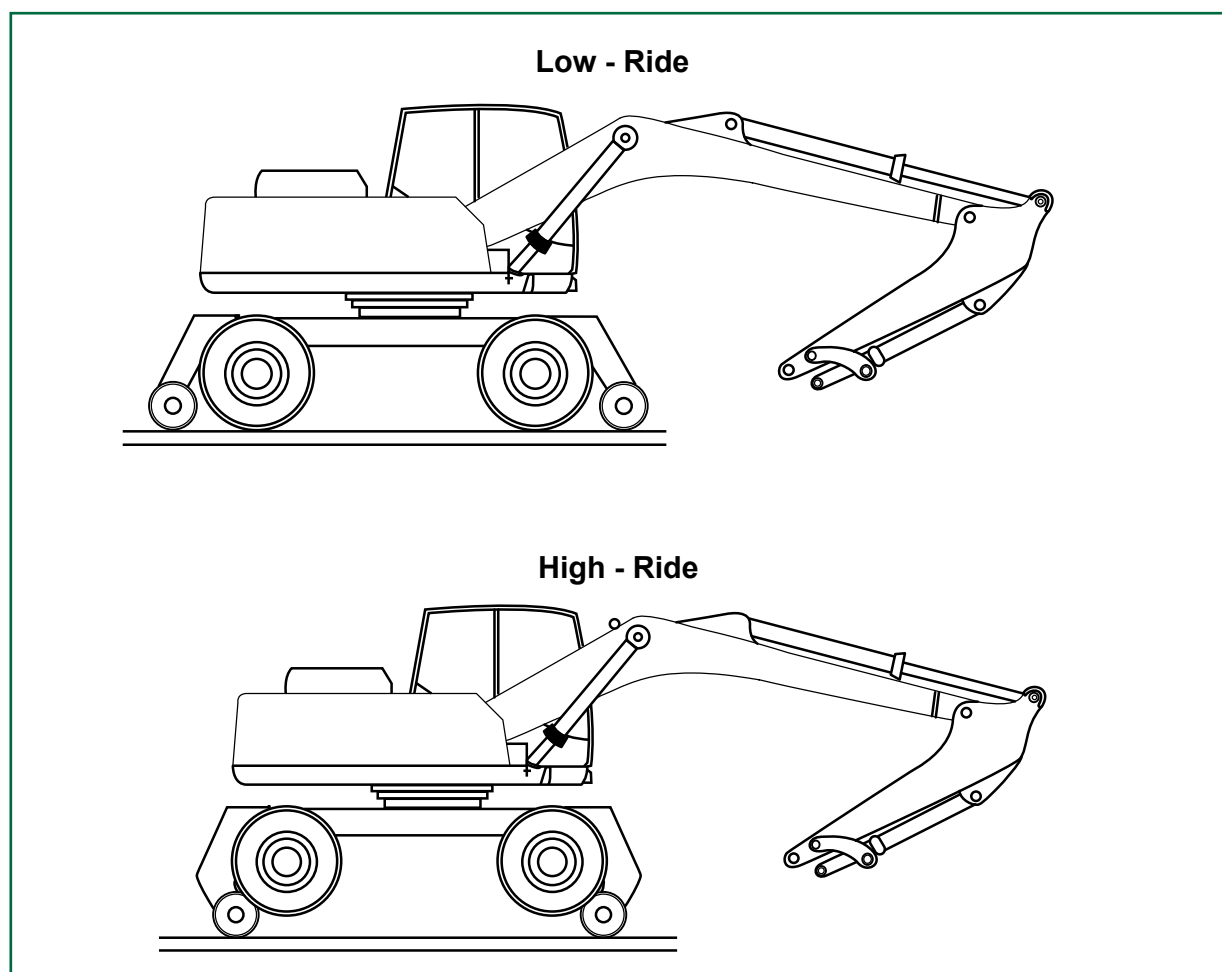


Figure 8: High ride and low ride RRV's

Standards governing RRVs

- 72 The Colmar RRV was built in 1998 and accepted for use on the UK railway system in accordance with Railway Group Standard GM/RT1300 issue 2 'Engineering Acceptance of Road-Rail Plant'. The engineering acceptance certificate was issued by Interfleet Technology Ltd. This standard did not require the RRV to be fitted with a system to apply service brakes on any trailers it pulled. Trailers were also covered by GM/RT1300 issue 2 and were only required to have parking brakes.
- 73 The braking requirements of RRVs in GM/RT1300 issue 2 were specified as a table of allowable stopping distances and a requirement that the vehicle had two independent braking systems. The standard stated that 'Each of the separate and independent braking systems shall be able to stop the machine and hold it stationary on a 1 in 30 gradient'. However, the braking distances in GM/RT1300 were specified for level track with dry rails and applied to the RRV plus any permitted trailing load.
- 74 The Colmar RRV was equipped with shoe brakes on each road wheel, operated by a hydraulic system from the foot brake and an independent hydraulic system from the hand brake. The drive to the road wheels was by a hydrostatic drive system which included two foot pedals, one for forwards and one for backwards. If neither pedal was depressed, the hydraulic lines to the drive unit were both closed and the hydraulic oil was unable to circulate from the drive unit. This would also provide a braking effect with the energy being dissipated as heat in the oil.
- 75 Issue 3 of GM/RT1300 was published in 2002 with a new requirement that the braking system should be 'capable of holding the fully laden vehicle and any permitted trailing load on a 1 in 30 gradient when on-rail'. The key difference from the previous version was that the RRV had also to hold the permitted trailing load on the gradient. The trailing load was limited to 200 % of the RRV's weight and the maximum speed when towing was specified as 10 mph (16 km/h).
- 76 GM/RT1300 was reissued again in 2003 with the note 'Rapid Response issued as a result of incidents with trailer run-aways' in the issue record. The braking clauses were expanded to clarify some points as follows:
- the RRV parking brake shall be capable of holding the fully laden RRV and its permitted trailing load on a 1:30 gradient, unless the trailer parking brake can be applied from the RRV cab;
 - the maximum trailing load shall be stated on the engineering acceptance certificate and displayed prominently in the cab;
 - it shall not be possible to uncouple a trailer unless the parking brake is already applied; and
 - the RRV/trailer combination shall be tested to demonstrate the effectiveness of the brakes in a breakaway situation.

The maximum trailing load of 200 % and a maximum speed of 10 mph (16 km/h) for trailers without service braking was retained.

- 77 GM/RT1300 was replaced by a voluntary industry standard, RIS-1530-PLT 'Engineering Acceptance of Possession-only Rail Vehicles and Associated Equipment', in April 2006. This standard, whilst voluntary, is mandated for suppliers of equipment to Network Rail through their product and supplier approval process. RIS-1530-PLT introduced a requirement that all new RRVs and trailers built after 31 December 2006 had to be fitted with service brakes. This requirement did not apply retrospectively to older machines. RRV/trailer combinations without *continuous* service braking on all vehicles were again limited to 10 mph (16 km/h) and the maximum trailing load was reduced to 100 % of the RRV weight.

Training and Competence

Machine Operator

- 78 The machine operator driving the Colmar RRV at the time of the incident was trained to the requirements of the construction plant competence scheme (CPCS) as an operator of 360 degree wheeled excavators and qualified in March 2005. The CPCS scheme was set up and is operated by the Construction Industry Training Board (CITB). The CPCS operator training covers proficiency in using the machine in road mode only.
- 79 The operator was trained in the use of 360 degree wheeled excavators in rail mode by Plant Skills Ltd in October 2006. The Rail Plant Association provides a scheme for competency assessment and certification for operators of road/rail plant. This includes specific competencies that the operator must be examined on. The assessment includes written and oral questions and practical observation of the operator's performance with the machine. The operator achieved *provisional certification* under the Rail Plant Association scheme as an operator of 360 degree excavator RRVs in rail mode in October 2006.
- 80 Operators with provisional certification are mentored and this is achieved by working with other, more experienced, operators. The operator completed his mentoring period and undertook a Rail Plant Association assessment in November 2007. The operator was qualified to work with a number of RRV attachments, including the clam shell bucket and trailer that he was using at the time of the incident.
- 81 The operator had driven Colmar RRVs for a year and had used trailers with them on most jobs. He had not worked on steep gradients and the gradient at Glen Garry was the steepest he had ever worked on.

Machine Controller

- 82 The machine controller competency is managed through the Network Rail *Sentinel* scheme. This specifies training modules that must be completed in order to attain machine controller competency for each generic type of RRV. A prerequisite is that the machine controller must first be qualified as a *controller of site safety* (COSS). The machine controller of the Colmar first qualified as a COSS in June 2004. The COSS certification is valid for two years and he undertook refresher training and recertified as a COSS in June 2006.

- 83 The Rail Plant Association provide a set of training modules to meet the Sentinel requirements. A machine controller for a 360-degree excavator RRV would need to complete the following modules:
- machine controller core module;
 - generic RRV module 1 (included with first specific RRV module); and
 - RRV module 2 – 360-degree excavator, not lifting.
- 84 The machine controller undertook this training and achieved provisional certification as a machine controller for 360-degree excavator RRVs in June 2006. After a period of mentoring and an assessment, he achieved full machine controller competence in September 2006.
- 85 The machine controller was not certified as a *crane controller* at the time of the incident. The crane controller competence for a 360 degree excavator used for lifting is covered by RRV training module 3 in the Sentinel scheme and the machine controller had not completed this module at the time of incident. Crane controller competence is required in the situation where the RRV must lift its trailer on or off the track, as was the case with the Colmar RRV at Glen Garry. The need for a separate crane controller competency is driven mainly by the need to meet the Lifting Operations and Lifting Equipment Regulations (1998). The machine controller's lack of this qualification was neither causal nor contributory to this incident.

Previous occurrences of a similar character

- 86 Runaway incidents involving RRVs can be grouped into two categories; those where the RRV ran away while being on or off-tracked and those where the RRV failed to stop during normal movement along the track.

Runaway incidents while being on/off tracked

- 87 Two different mobile elevating work platforms (MEWPs) ran away during on or off-tracking in separate incidents at Stockport on 5 and 17 August 2004. These incidents were caused by the RRV being put into an unbraked state due to an error in the on/off tracking process. The track at the road rail access point was on a gradient of 1:77. The industry investigation into these incidents recommended that Network Rail warn their contractors of the track gradient at road-rail access points.
- 88 Incidents involving RRV runaway during on or off-tracking also occurred at Copenhagen Tunnel in London on 15 October 2006, at Birmingham Snow Hill on 31 October 2007 and at Brentwood on 4 November 2007. The track gradient at Copenhagen Tunnel was 1:55, at Birmingham Snow Hill it was 1:53 and at Brentwood it was 1:100. These incidents all involved MEWPs which were put into a state where they had no effective rail wheel braking.

Runaway incidents during normal movements on rail

- 89 An RRV trailer became detached from its RRV on a 1:100 gradient at Auchterarder, between Stirling and Perth, on 3 January 2001 and ran for 10 miles (16 km) passing over two public road level crossings without the barriers being lowered. The trailer brakes were found to be defective due to poor maintenance.

- 90 An RRV trailer ran away at Patchway near Bristol on 10 December 2002 while being uncoupled from its RRV. The RAIB has been unable to find any details of the cause.
- 91 An RRV trailer ran away at Howe & Co Sidings between Armathwaite and Carlisle on 19 January 2003 while it was being uncoupled from the RRV on a gradient of 1:132. The trailer brakes were found to be defective but further details were not available.
- 92 An RRV based on a 'FastTrack' machine manufactured by JCB ran away on a 1:137 gradient at Shieldmuir on 5 May 2004 as a result of the parking brake not being applied correctly. A similar incident occurred at Euston on 7 September 2000 due to a brake defect on a parked RRV. Further details of the causes of these incidents were not available.
- 93 On 6 December 2006 a high ride RRV, manufactured by Case Inc, working in wet conditions at Pontsmill near Par in Cornwall was unable to stop on a 1:40 gradient. No collision or derailment occurred but the work planned for the RRV had to be abandoned. Further use of the same type of RRV at this location ceased following the incident. This incident was not reported to the RAIB.
- 94 There had been four incidents involving RRVs running away reported to the RAIB between October 2006 and December 2007, including the incident at Glen Garry. Two of these, at Brentwood and Snow Hill, were already the subject of an RAIB investigation. Two further incidents involving RRVs occurred in February and May 2008 and the incident at Pontsmill, not previously reported to the RAIB, was discovered. In response to this emerging trend, the RAIB has commenced a wider investigation into the use of RRVs on Network Rail. This will review the investigations into these incidents and examine whether there are any common themes on which the RAIB can make recommendations to improve railway safety.
- 95 A loaded hand trolley ran away at Larkhall on 2 November 2005. This incident was investigated by the RAIB (report no. 20/2006, available at www.raib.gov.uk) and the recommendations made to Network Rail which are relevant to the Glen Garry incident include the following:
- all Infrastructure Controllers should brief relevant contractors and staff of the risks associated with braking performance on gradients, in wet/icy conditions, and with contaminated brakes (Recommendation 13); and
 - Network Rail should review its procedures for accident investigation to ensure that lessons learned from such investigations are adequately reviewed as potential precursor events, and when so identified are briefed on an industry wide basis (Recommendation 16).
- 96 Network Rail rejected recommendation 13 on the basis that the risks were understood and were controlled by a forthcoming revision to the M&EE Networking Group code of practice on the use of trolleys, COP0018. ORR was considering its response to this rejection at the time of publication of this report. Network Rail accepted recommendation 16 and implemented it by a revision to their standard on accident investigation. ORR was considering its acceptance of Network Rail's implementation of this recommendation at the time of publication of this report.

- 97 A loaded trailer ran away from its RRV at Scout Green in Cumbria on 15 February 2004 and ran 3.25 miles (5.2 km) down the gradient to Tebay where it struck and killed four track workers. The trailer brakes were found to have been disabled following earlier damage and criminal proceedings were brought against the trailer owner. The RSSB report into the incident included a recommendation that 'The Hazard Directory should contain gradient details where the severity and/or length of these merit attention'. This was implemented by adding a new hazard type to the hazard directory to denote gradients of 1:50 or steeper. The actual gradient is not shown.

Analysis

Colmar RRV braking tests

- 98 The Colmar RRV and trailer was capable of stopping on the 1:75 gradient at Glen Garry as it stopped by use of its own brakes prior to the collision, when the operator got out to fix the wipers (paragraph 44), and after passing the collision point. For both instances the weather was similar with heavy rain falling and both sites of work (rock drilling and wood chipping) were on the same gradient which was constant and extended over the whole work site. The distance after the brakes were applied that the RRV ran without stopping before collision was not measured but has been assessed by the RAIB from information available as being at least 200 m and possibly as much as 400 m. The wood chipping site was between 100 m and 150 m from the drilling site and the staff at that site saw the RRV flashing its lights as it approached, indicating that the brakes had already been applied. The earliest point that the RRV operator could have seen the site was 400 m away, due to the curvature of the line and the hillside above it.
- 99 Tests were conducted to measure the braking performance of the RRV and trailer in various conditions. The tests were carried out both on level track and on a similar gradient to the incident site. Each test consisted of running the RRV at a given speed and then applying the brake. The distance taken to stop was measured. Tests were conducted with dry rails and wheels, with wheels soaked by clean water and with simulated leaf mulch on the rails. The water was applied to the wheels by a gravity feed system from tanks attached to the RRV. The leaf mulch simulation was done using the same system that is used when training train drivers on how to handle trains in leaf-fall conditions. This consists of layers of paper tape stuck to the rail surface and is one of the methods detailed in Railway Group Standards guidance note GM/GN2643 'Guidance note for wheel-rail low adhesion simulation'.
- 100 The trailer was attached to the RRV during these tests and was loaded with steel weights to give a total mass of trailer and load of ten tonnes. The actual loaded mass of the trailer at the time of the incident was not recorded but witnesses gave a consistent description of the quantity of material loaded into it which indicates that the total mass was likely to have been between nine and ten tonnes.
- 101 The results of the braking tests on the gradient are shown in Figure 9 as deceleration rates. Calculations were made using the coefficients of friction derived from the test results to determine the maximum gradient on which the RRV could hold its load in wet and dry conditions with one or two trailers. These calculations indicated that the gradient at which the RRV would not be able to hold the weight of two trailers in the wet was between 1:25 and 1:34. Since RRVs of this type are allowed to operate with two trailers on gradients up to 1:30 without regard to the weather conditions, a hazard existed. Consequently, the RAIB issued an urgent safety advice to the industry on 21 December 2007 to bring this to their attention. One of the measures advised by the RAIB was to carry out a *running brake test* of the RRV/trailer consist when starting out, so that the operator has a feel for the conditions that prevail at the time. The full text of the urgent safety advice is given in Appendix C.

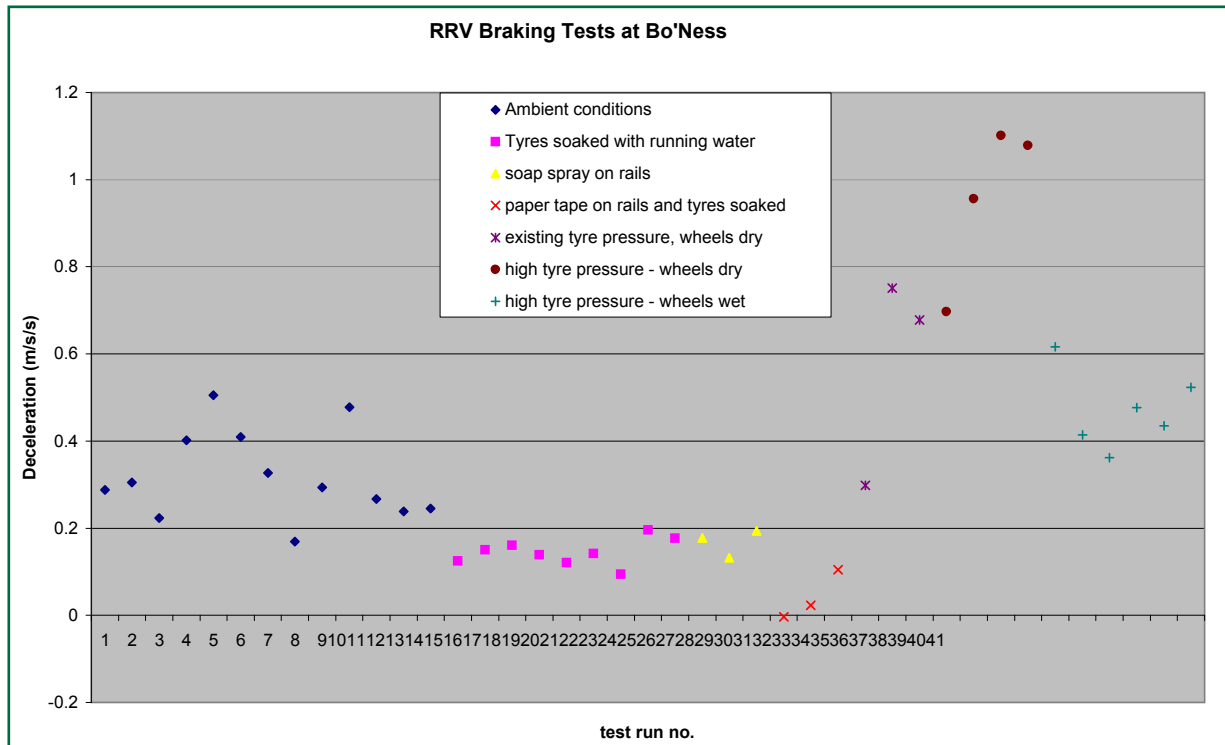


Figure 9: Deceleration rates for Colmar RRV and trailer on 1:66 gradient from tests at Bo'ness

- 102 The tests with simulated leaf mulch on the gradient showed that the RRV and trailer was unable to stop on the contaminated rail, with slip occurring between the steel wheels and the rails. The coefficient of friction derived from the first test was 0.02, which is similar to friction values measured during braking tests on trains in low adhesion conditions. The paper tape, when used with trains, is quite robust but in the tests with the RRV it was found that the RRV wheels damaged the tape as they passed over it. Consequently, each of the following test runs encountered better adhesion conditions than the previous run as sections of paper tape were removed by each pass of the RRV. The friction coefficient therefore improved with each run; on the second run it was 0.03 and on the third it was 0.04. After each test run the RRV had to travel back up the gradient ready for the next run. When the RRV attempted to travel back over the paper tape it was found that the friction available between its wheels and the rails was insufficient to push the trailer up the slope.
- 103 During an attempt to travel back up the slope the RRV and trailer were stopped on the paper tape by application of the handbrake. This applied the trailer brakes as well as the RRV brakes. When the handbrake was released and the RRV brake applied, the RRV and trailer started to slide down the gradient with the RRV wheels locked. This showed that the adhesion available between the RRV rail wheels and the rail was insufficient to hold the weight of both the RRV and the trailer.
- 104 The tests showed that the RRV with its trailer was able to stop on the gradient in wet conditions provided that the rails were not contaminated. If the rails were contaminated such that the friction was reduced to a similar level to that experienced by trains in poor adhesion conditions, the RRV would be unable to stop with its trailer and be unable to hold that trailer on the gradient.

Colmar RRV mechanical condition

- 105 The RRV was examined by the manufacturer's UK service agent under RAIB supervision. The rail and road wheels were examined and found to be within manufacturer's recommended limits with the exception of road wheel tyre pressure. These were found to be too low (between 4.0 and 4.8 bar, compared to the recommended 6.9 to 7.6 bar). Tyre pressure is significant in a high ride RRV as the relative position of the road and rail wheels is fixed by the rail wheel lowering mechanism, and so the contact area between the tyre and the rail wheel is also fixed. This means that the force between them is heavily dependent on the tyre pressure.
- 106 The RRV maintenance procedures used by AB2000 did not state explicitly the required tyre pressure but their fitters adjusted it to 70 psi (4.8 bar). This value was based on their experience with these tyres on high ride RRVs. Further tests were done to measure the effect of tyre pressure on the braking ability of the RRV and trailer. The same test site and test load was used as in previous tests and the test runs were done with the wheels dry and with them soaked using the gravity feed irrigation system. However, examination of the tyres during and after the tests at higher tyre pressure (but in accordance with the tyre manufacturer's specification) showed them to have been severely damaged by the testing. The rubber surface was softened and pieces of rubber broke off and adhered to the rail wheels.
- 107 There is a conflict between high tyre pressure assisting traction and braking of the RRV in rail mode, but leading to high tyre temperature and wear. The balance between these factors is critical in the design of high ride RRVs. This matter will be investigated further in the wider RAIB investigation into RRV incidents (paragraph 94).

RRV speed

- 108 The rule book, GO/RT/8000, module On Track Plant (OTP) covers the use of RRVs and, in clause 1.3, states that they can only be used within a possession. There can be several work sites within a possession and each of these should be under the control of an engineering supervisor. The remainder of the track in the possession that is not under the control of an engineering supervisor is under the control of the *person in charge of possession* (PICOP).
- 109 Rule book module OTP covers speed of movements in clause 7.6 and states that the operator must not exceed the maximum speed laid down in the on track plant instructions, must not exceed walking pace within a work site and must always be able to stop the on track plant within the distance that can be seen to be clear of obstruction. This clause also specifies a maximum speed between work sites of 40 mph (64 km/h). The clause mentions that, within a work site, the engineering supervisor can authorise a different maximum speed for the movement in the work site, but does not give any advice on how this speed is to be set.
- 110 In the case of the Colmar RRV and trailer, the maximum speed of the RRV quoted by the manufacturer is 16 mph (25 km/h) but RIS-1530-PLT (paragraph 77) defines a maximum speed of 10 mph (16 km/h) as the RRV was hauling a trailer not fitted with service brakes. This speed would apply in the possession area between work sites.

- 111 The possession at Glen Garry included areas of work at the incident location and at the cutting further up the line near Blair Atholl. However, the whole possession was declared a single work site and was under the supervision of one engineering supervisor. This should have required all RRV movements anywhere within the work site to be made at walking pace unless varied by the engineering supervisor. The engineering supervisor had not made such a variation. Witness evidence suggested that the speed of the RRV as it approached the site of the wood chipping was between 9 and 11 mph (14 and 18 km/h).
- 112 The interpretation of 'walking pace' in rule book module OTP clause 7.6 is left to the individual operator. A common interpretation within Network Rail is 5 mph (8 km/h) and the local investigation carried out by Network Rail and Edmund Nuttall Ltd stated that the maximum speed within a work site was 5 mph (8 km/h).
- 113 The need to move at walking pace is impractical where RRVs have to travel several miles between working locations and the RAIB has commented on this practice before in connection with the collision between two on-track machines at Badminton on 31 October 2006 (report 30/2007 available at www.raib.gov.uk). This investigation made the recommendation (Recommendation 1) that 'RSSB should make a proposal, in accordance with the Railway Group Standards Code, to amend module T3 of the rule book to require work sites to be kept as short as possible'. This change to was made in the rule book amendments module effective from 6 December 2008.
- 114 The Rail Plant Association training course for machine operators tests their understanding of maximum speed within a work site by observation; the operator is not questioned on his understanding of the term 'work site' or the maximum speed that he can drive at within the work site. The Colmar operator had been examined whilst operating the machine on a short section of track where it is unlikely that he would be able to exceed 5 mph (8 km/h) during the test.

Identification of immediate cause¹, causal² and contributory³ factors

Immediate cause

- 115 The RAIB concludes that the friction at the site was less than for wet rail and has therefore concluded that contamination of the rails from the tree clearance work was likely. This, combined with the wet weather, lowered friction to the point where the RRV had insufficient brake force to stop itself and the loaded trailer on the gradient and this is regarded as the immediate cause of this incident (paragraph 104 and Recommendations 2 and 3).

¹ The condition, event or behaviour that directly resulted in the occurrence

² Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

³ Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

Causal factor

116 Analysis of the results of the tests carried out with the RRV and trailer showed that the RRV could stop its own weight on the gradient in the conditions that were likely to have prevailed on the night but could not stop itself and the loaded trailer. The use of a trailer with no service brakes is allowed by both GM/RT1300 and RIS-1530-PLT. The use of a near-fully loaded trailer with no service brake is a causal factor in this incident (paragraphs 98 and 103 and Recommendations 6 and 7).

Contributory factors

- 117 Following the incidents at Stockport in August 2004 (paragraph 87), the Network Rail investigation recommended the publication of gradient information to their contractors. This was not done at Glen Garry. No information on gradient was provided to Edmund Nuttall Ltd. The RAIB investigation into the runaway of a trolley at Larkhall recommended that Network Rail make their contractors aware of the risk of gradient and contamination on brake performance (of trolleys, in this case). Network Rail not providing gradient information to their contractors is one of the contributory factors in this incident (paragraphs 87 and 95 and Recommendation 1).
- 118 The machine controller not being made aware of the gradient and potential for rail contamination is a contributory factor (paragraph 40).
- 119 The low tyre pressure is not regarded as causal as the friction available between rail wheel and rail was insufficient to hold the RRV and trailer and the increased tyre pressure would not have helped this. The low tyre pressure may, however, have been contributory as correcting it would have improved the likelihood of the RRV stopping before it encountered the rail contamination or stopping more quickly once the contamination was passed (paragraph 106).
- 120 The speed of the RRV as it approached the site of the work was higher than allowed in the rule book. If the RRV had been travelling at a lower speed it would have improved the likelihood of it stopping before encountering the rail contamination and so the speed of the RRV is considered a possible contributory factor (paragraph 111 and Recommendation 4).
- 121 The operator of the RRV was relatively inexperienced and was not aware of some of the actions he could have taken to stop the RRV in an emergency. In particular, applying the handbrake on the RRV would also have applied the parking brakes on the trailer and provided some additional braking force. Operators are not trained in what to do in an emergency such as this and this lack of briefing is regarded as a contributory factor (paragraph 81 and Recommendation 5).
- 122 The practice of having one large work site within a possession leads to RRVs having to travel long distances at walking pace according to the rule book, unless the engineering supervisor authorises a higher speed (paragraph 109). The time taken to transition such work sites may encourage operators to exceed the speed limit. The speed of the RRV is a possible contributory factor (paragraphs 113, 120 and Recommendation 4), and the practice identified is a possible contributory factor to the speed of the RRV in the incident.

Underlying cause⁴

123 The underlying cause of the incident was that Network Rail did not understand:

- the need to warn Edmund Nuttall Ltd of the gradient at the site; and
- the potential of rail contamination affecting RRV operations.

Severity of consequences

124 The collision that occurred between the two RRVs was relatively minor and there were no injuries to staff. It was very fortunate that the abseiler was in a position where he could see the approaching runaway and was able to attract the attention of the site staff in its path.

125 The warning from the abseiler enabled the operator of the Atlas RRV to take prompt evasive action. If this had not been the case, a serious collision between the RRVs could have occurred.

126 There was no obvious place of safety at the work site where the staff would have been clear of the runaway RRV and a potential collision with the static RRV. The staff had to decide quickly on their own position of safety and run there. It was fortunate that space was available in the culvert close by as two of the staff did not have sufficient time to run across both tracks and up the bank on the up side of the line.

127 The staff who warned others and took evasive action should be credited for doing so since they had received no training for such a situation.

Additional observations

128 The machine controller for the Colmar RRV did not hold crane controller competency at the time of the incident. The *secure counterpart* to the Sentinel card which records these competencies contains a note that crane controller competency is required if the RRV has to lift a trailer on or off track. This omission was neither causal nor contributory to this incident, however.

⁴ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

Actions reported as already taken or in progress relevant to this report

- 129 Network Rail Scotland Territory have revised their arrangements for calling out staff to deal with incidents in possessions so as to enable a MOM to be called, if required.
- 130 Network Rail Scotland and Network Rail Infrastructure Investment have re-briefed the relevant staff on the need to report incidents to the RAIB (paragraph 65).
- 131 AB2000 Ltd are fitting their RRVs and trailers with a service braking system.
- 132 Network Rail has issued instructions to RRV operators to carry out a running brake test when operating an RRV with a trailer (paragraph 101).
- 133 RSSB published a change to the rule book on 6 December 2008 requiring work sites within a possession to be as short as possible (paragraph 122).

Recommendations

134 The following safety recommendations are made⁵:

Recommendations to address causal and contributory factors

- 1 Network Rail should publish the gradient of lines in an easily accessible way, for example in the sectional appendix and at track access points (paragraph 117).
- 2 Network Rail should brief their contractors using on track plant on the hazards of rail contamination and gradient to RRV operation (paragraph 115).
- 3 Network Rail should require that contractors include the risks from rail contamination and gradient in their risk assessments along with proposed mitigation measures (paragraph 115).
- 4 Network Rail should enhance the Sentinel On Track Plant documentation for RRV operator training so that positive confirmation of the operator's understanding of the speed limit within a work site, and of the meaning of the term 'work site', is obtained (paragraphs 120 and 121).
- 5 Network Rail should enhance the Sentinel On Track Plant documentation for RRV operator training to include advice to trainee operators on:
 - operating on gradients;
 - operating in low adhesion conditions; and
 - what to do in a braking emergency (paragraph 121).
- 6 Companies who own or operate RRV/trailer combinations not fitted with service brakes should provide clear guidance to machine operators on the maximum speed and hauled load that the RRV can operate to, given the gradient and track conditions expected or existing at site (paragraph 116). This guidance could take the form of a duty chart, covering all duties, displayed in the cab.
- 7 Network Rail should provide a time-bound plan for the elimination of the use of RRV trailers not fitted with service brakes from its network (paragraph 116).

⁵ Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Incident Investigation and Reporting) Regulations 2005, these recommendations are addressed to ORR to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 167 to 171) can be found on RAIB's web site at www.RAIB.gov.uk.

Appendices

Appendix A - Glossary of abbreviations and acronyms

COSS	Controller of site safety
ES	Engineering supervisor
MEWP	Mobile elevating work platform
PICOP	Person in charge of possession
RRV	Road-rail vehicle

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis' British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com

Cess	The area to either side of the railway, immediately away from the ballast.
Crane controller	A person trained and authorised to direct the operation of a rail mounted crane.*
Clam shell grab	A type of excavator bucket.
Continuous brake	A brake that is applied on every vehicle in the consist.
Controller of site safety	A person who ensures a safe system of work on the railway.
Down line	The line on which the normal direction of travel is away from London. At this site the down direction is towards Dalwhinnie.
Engineering acceptance certificate	A certificate issued by a vehicle acceptance body that certifies that the vehicle meets the required standards and gives any necessary operating restrictions.
Engineering supervisor	A person nominated to manage the safe execution of works within a worksite that has been set up on the railway.
Four foot	The space between the running rails.
Gabion basket	A wire mesh basket filled with broken stone or rubble, used as an efficient but plain reinforcing or retaining structure for earthworks.*
High ride/high rail	The system whereby an RRV is powered by its rubber tyres driving onto idler rail wheels.
Hydrostatic drive unit	A mechanism which causes an axle to rotate by application of hydraulic pressure.
Low ride/low rail	The system whereby an RRV is powered by its rubber tyres bearing directly on the rails, with the idler rail wheels just providing guidance.
Machine Controller	A person trained and authorised to control and supervise an item of rail mounted plant other than a rail crane.*
Machine operator	A person qualified to drive an item of construction plant.
Mobile operations manager	A Network Rail manager who is tasked with managing the aftermath of an operating incident.
On/off tracking	The process whereby an RRV transfers from road to rail or vice versa.
Person in charge of possession	The person who manages safe access to the track for work to take place during a possession.

Philmor trailer	A type of RRV trailer manufactured by Philmor Ltd.
Possession	A period of time during which one or more tracks are blocked to trains to permit work to be safely carried out on or near the line*.
Provisional certification	Newly-trained RRV operators are mentored for a period following training. During this period they are considered to have provisional certification.
Rail Plant Association	Industry association for organisations involved with the operation of rail plant.
Road rail access point	A designated place where a RRV can safely transfer from road to rail or vice versa.
Road-rail vehicle	An road vehicle that has been adapted to make it capable of running on railway track as well as on the road.
Rules of the route	The document agreed between the infrastructure controller and the train operating companies that records when possessions may be taken.*
Running brake test	A test where the brakes are applied on a train, shortly after starting out, to check that they retard the train as expected.
Schedule 1	Part of the Railways (Accident Investigation and Reporting) Regulations 2005 which lists the types of incident and accident which must be reported to the RAIB immediately.
Secure counterpart	A document which is issued to staff qualified to control machines under the Sentinel system and records which types of machine they are qualified to work with.
Sentinel	The system used by Network Rail for managing the competence of staff working in certain safety critical roles.
Service brakes	A braking system designed to stop the vehicle during normal travelling operation.
Up line	The line on which the normal direction of travel is towards London. At this site the up direction is towards Blair Atholl.
Work site	The area within a possession that is managed by an engineering supervisor (ES). A work site is delimited by marker boards when engineering trains are present. These are illuminated signs placed in the <i>four foot</i> at each end of the work site. The operator must stop his machine at each of these signs and obtain the permission of the engineering supervisor (if entering a work site) or PICOP (if leaving a work site) before proceeding.

Appendix C - Urgent safety advice

The following urgent safety advice was issued by the RAIB on 21 December 2007 as a result of this incident.

2. URGENT SAFETY ADVICE	
USA DATE:	21 December 2007
TITLE:	Braking of 'high rail' RRVs
SYSTEM / EQUIPMENT:	RRVs which rely only on the friction between rubber tyres and the tread of the rail wheel to generate the braking force on the steel wheels
SAFETY ISSUE DESCRIPTION:	1. A 'near miss' incident occurred during a T3 possession of the Highland main line between Blair Atholl and Dalwhinnie. The incident involved a Colmar T4300FS 'high rail' road/rail excavator hauling a loaded Philmor eight-tonne trailer. The road/rail vehicle (RRV) was towing the trailer down a 1:70 gradient in heavy rain and was unable to stop when it approached a worksite where another RRV was operating. Vegetation clearance work at the site may have led to rail contamination in the area.
CIRCUMSTANCES:	2. Staff at the worksite narrowly avoided injury by jumping clear and a minor collision between the two RRVs ensued. A serious collision was avoided by prompt warning from a member of site staff and a prompt response by the operator of the static RRV who was able to raise its boom above the moving RRV.
CONSEQUENCES	3. A number of site staff narrowly avoided serious injury. 4. A minor collision occurred between the two RRVs.
REASONS FOR ISSUE:	5. The brakes of the Colmar RRV were tested after the incident and found to be operating in accordance with Rail Industry Standard RIS-1530-PLT, which requires the brakes to be tested in dry conditions. The rail head at the approach to the worksite was wet and may have been contaminated with leaf mulch at the time. 6. Further tests of the braking performance of the RRV involved in the incident were carried out under controlled conditions with dry wheels and then with the road wheel surfaces lubricated with running water. In the tests, the RRV pulled the trailer involved in the incident, loaded with eight tonnes of steel weights. These tests showed that the friction between the rubber tyres and the tread of the rail wheels was significantly reduced in the wet and that the machine was unable to stop on level track from 10mph within the 18m distance specified (for dry conditions) in RIS-1530-PLT. 7. The incident shows that compliance with the standard RIS-1530-PLT may not necessarily guarantee the safe stopping ability of RRV and trailer combinations under all conditions of gradient and environment encountered during operation.

ADVICE:

Users of RRVs which rely only on the friction between rubber tyres and the tread of the rail wheel to generate the braking force on the steel wheels and which may or may not haul one or more trailers not fitted with a service brake should ensure their operation takes into account the following risks:

- A. Wet weather conditions will reduce the brake force available from the RRV; and,
- B. Rail contamination may further reduce this force to the point where the RRV and trailer combination has insufficient braking force to stop on a gradient.

Organisations using these types of RRVs should consider:

- (1). The potential for significantly extended stopping distances when doing the risk assessment for the work;
- (2). Taking steps to deal with rail contamination around the worksite;
- (3). Performing operator-conducted running tests of the braking capability in wet conditions of the RRV with any trailer(s) and loads to be attached; and
- (4). Taking steps to ensure that the RRV and any trailer(s) and load(s) can stop in wet conditions on the steepest gradient it is required to run on within an acceptable distance
- (5). Making an evaluation of the suitability of using trailers with no service brakes.

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