Incident Investigation

COMPLETED REPORT

30/07/2003. Lochinvar (Maitland – Branxton) Track Maintenance Vehicle collision in advertised engineering possession
In accordance with Section 45C(3) of the Transport Administration Act 1988 the names of persons have been expunged from this report.
Contents

1.0 THE EVENT ................................................................................................................. 4
2.0 INVESTIGATION METHODOLOGY ............................................................................. 4
3.0 TERMS OF REFERENCE ............................................................................................... 5
4.0 SUMMARY OF FINDINGS FROM THE INVESTIGATION ............................................... 6
5.0 FACTUAL INFORMATION .............................................................................................. 7
  5.1 INCIDENT RECONSTRUCTION .................................................................................... 7
  5.2 INJURIES, LOSS AND DAMAGE ............................................................................... 10
    5.2.1 Employees injured ............................................................................................... 10
    5.2.2 Damage to BIC plant ......................................................................................... 10
    5.2.3 Damage to Track Australia Plant ...................................................................... 11
  5.3 DESCRIPTION AND FUNCTION OF THE TRACK MAINTENANCE VEHICLES ......... 12
  5.4 INCIDENT LOCATION ................................................................................................. 12
  5.5 TRACK DIAGRAM SHOWING G-SHEET .................................................................... 13
  5.6 POSITION OF TRACK VEHICLES AND PERSONNEL ............................................. 14
  5.7 SAFEWORKING SYSTEM ......................................................................................... 15
  5.8 TOXICOLOGY INFORMATION .................................................................................... 15
6.0 EMERGENCY MANAGEMENT ....................................................................................... 15
  6.1 NOTIFICATION ......................................................................................................... 15
  6.2 WORKSITE PROTECTION ........................................................................................... 15
  6.3 RESPONSE AND RECOVERY ..................................................................................... 15
7.0 ORGANISATION AND MANAGEMENT ISSUES ............................................................. 16
  7.1 HISTORY OF RECENT SIMILAR OCCURRENCES ..................................................... 16
  7.2 IDENTIFIED SAFETY MANAGEMENT SYSTEMS ..................................................... 16
    7.2.1 The rules, procedures and policy for the transfer of track maintenance vehicles .... 16
    7.2.2 Project Safety Management Plan ........................................................................ 16
  7.3 COMPETENCY OF TRACK VEHICLE OPERATORS, EXPERIENCE, AND MEDICAL STATUS .... 17
    7.3.1 Competency and experience ............................................................................ 17
    7.3.2 Medical status .................................................................................................. 17
  7.4 REMOVAL OF EMPLOYEES FROM SAFEWORKING DUTIES .............................. 17
8.0 INCIDENT INVESTIGATION EVIDENCE & FINDINGS - ANALYSIS ............................. 18
  8.1 THE SAFE OPERATION OF THE TRACK MAINTENANCE VEHICLES BY THE OPERATORS ................................................................. 18
    8.1.1 Network Rule NWT-316 ................................................................................... 18
    8.1.2 New Network Procedures from 21 September 2003 ........................................... 19
    8.1.3 Analysis of the Network Rules & Procedures effective from 21 September 2003 .... 20
    8.1.4 Working track vehicles over level crossings ....................................................... 20
  8.2 THE COMMUNICATIONS SYSTEMS FITTED TO TRACK MAINTENANCE VEHICLES ....... 21
  8.3 PRE-WORK BRIEFING(S) DID NOT INCLUDE THE HAZARD OF COLLISION BETWEEN TRACK VEHICLES ......................................................... 21
  8.4 COMMUNICATING TO OPERATORS THE LOCATIONS OF WORKSITES WITHIN POSSESSIONS ................................................................. 21
  8.5 PLANNING THE SAFE MOVEMENT OF TRACK MAINTENANCE VEHICLES .......... 21
  8.6 THE CERTIFICATION OF TRACK MAINTENANCE VEHICLES TO OPERATE AS A TRAIN ............................................................ 22
  8.7 GEOGRAPHIC AND ENVIRONMENTAL FACTORS – LINE OF SIGHT .......................... 22
  8.8 FATIGUE MANAGEMENT – FATIGUE SCORES .......................................................... 23
    8.8.1 Fatigue Scores ................................................................................................... 23
  8.9 DIESEL HAULING TRACK MAINTENANCE VEHICLES ............................................. 25
  8.10 SPECIAL TRAIN NOTICES – QUALITY CONTROL .................................................. 25
  8.11 ALTERING THE SCOPE OF ENGINEERING WORKS AFTER SCHEDULES ARE PLANNED AND PRINTED .................................................... 25
  8.12 SELF-IMPOSED TIME-RESTRAINTS ....................................................................... 25
  8.13 SPEED OF THE TRACK VEHICLES ......................................................................... 25
    8.13.1 Braking performance of Track Australia consist – results from manufacturer .... 26
  8.14 ROUTE KNOWLEDGE .............................................................................................. 26
  8.15 TRACK VEHICLE COMPLIANCE – BRAKING SYSTEMS AND CAPABILITY TO BE HAULED BY A LOCOMOTIVE ................................. 27
  8.16 POWERING OF THE TRACK AUSTRALIA CONSIST IN CONVOY ___________________ 27
  8.17 PLACEMENT OF WORKSITE PROTECTION WITHIN POSSESSION AREAS .......... 27

Completed Report. File No.03R/03952

Ministry of Transport Rail Investigation – Lochinvar 30 July 2003 – Collision between track vehicles
8.18 SERVICE OF TRACK MAINTENANCE VEHICLES ......................................................... 28
9.0 FINDINGS .................................................................................................................. 28
10.0 APPENDIX A ........................................................................................................... 30
  10.1 INTRODUCTION — APPLYING THE REASON MODEL TO THIS INVESTIGATION .......... 30
  10.2 AVOIDING THE "QUICK FIX" TRAP ................................................................. 30
  10.3 ACTIVE FAILURES AND LATENT FAILURES — AN OVERVIEW ...................... 31
11.0 SAFETY ACTIONS ................................................................................................... 32
  11.1 SAFETY ACTION No.1 ......................................................................................... 32
  11.2 SAFETY ACTION No.2 ......................................................................................... 33
  11.3 SAFETY ACTION No.3 ......................................................................................... 34
  11.4 SAFETY ACTION No.4 ......................................................................................... 35
  11.5 SAFETY ACTION No.5 ......................................................................................... 36
  11.6 SAFETY ACTION No.6 ......................................................................................... 37
  11.7 SAFETY ACTION No.7 ......................................................................................... 38
  11.8 SAFETY ACTION No.8 ......................................................................................... 39
  11.9 SAFETY ACTION No.9 ......................................................................................... 40
  11.10 SAFETY ACTION No.10 .................................................................................... 41
  11.11 SAFETY ACTION No.11 .................................................................................... 42
  11.12 SAFETY ACTION No.12 .................................................................................... 43
  11.13 SAFETY ACTION No.13 .................................................................................... 44
  11.14 SAFETY ACTION No.14 .................................................................................... 45
  11.15 SAFETY ACTION No.15 .................................................................................... 46

EVENTS & CONDITIONS CHART ............................................................................... 47
1.0 The Event

At approximately 1215 hrs Wednesday 30 July 2003 a collision occurred on the Down Main line at Lochinvar in the Maitland – Branxton section between Rail Infrastructure Corporation Team 5 track maintenance vehicles and Track Australia track maintenance vehicles. Emergency services were called and attended. The collision resulted in six (6) RIC employees and one (1) Track Australia employee requiring medical treatment.

The track maintenance vehicles were travelling in an advertised engineering possession and were heading in an Up direction over the Down Main line towards the limit of the Local Possession Authority at Maitland to exit the possession area. The vehicles were not travelling on signals but in convoy which was the standard operating procedure for movement of track vehicles within an engineering possession. The weather conditions at the time of the incident were fine, cool and clear. Visibility was excellent. Major damage was caused to plant, there was no damage to track infrastructure or signalling.

2.0 Investigation methodology

The investigation has been conducted according to Australian Standard AS 5022:2001, Guidelines for railway safety investigation. The objective of the investigation is to determine the circumstances surrounding the incident and provide information to prevent the recurrence of similar events.

The investigation is in no case intended to imply blame or liability. However sufficient factual information is included to support the analysis and conclusions. Some information may reflect on the performance of individuals and organisations, and how their actions have contributed to the outcomes of the matter under investigation.

System safety accident investigation (SSAI) techniques have been applied to structure the investigation and analyse the evidence.

The SSAI approach includes;
- Applying the Reason model to analyse accident causation in terms of latent conditions and active errors.
- Identifying and analysing human factors issues.
- Identifying and analysing the risk management strategies that should have prevented the accident.
- Using events and conditions charting to illustrate the incident.

Evidence has been gathered for the investigation from the following sources:

- On-site investigation
- Interviews with personnel involved in the incident.
- NIN telegram
- RMS SRA train control report
- Local Appendix
- RIC Network Rules
- RIC Network Procedures
- RIC Operator Specific Procedures
- RIC Safeworking Policy
- RIC Safety Manual
- Records of Track Vehicle maintenance and brake examinations
- Employee training records and rosters
- Documents from engineering possession
- Train control voice tapes
- Special Train Notices and Safe Notices
- Work on track documentation
3.0 Terms of reference

Date of incident: 30 July 2003
Location: Lochinvar (Maitland – Branxton section)
Details of Incident: Track machines travelling in convoy on Down Main line in a possession area as advertised in STN 1351-2003, collided when lead portion of convoy stopped to remove possession protection.
Type of Inquiry: Railway Investigation, level 2.

Interim report due date: 14 August 2003.

Following a railway incident at Lochinvar NSW, on 30 July 2003, the Ministry of Transport (MOT) directed the establishment of an independent inquiry into the incident, in accordance with the NSW Rail Safety Act 2002.

Section 67.(3) of that Act states:

The Minister may require the Director-General or a rail investigation panel to inquire into and report to the Minister on any railway accident or incident that may affect the safe carrying out of railway operations or the personal security of any railway employee or member of the public using a railway or in an railway premises.

The Director General subsequently authorised the Executive Director, Transport Safety & Rail Safety Regulation (TS&RSR) to chair an investigation panel (comprising a representative from each of the involved railways) to conduct the investigation, in accordance with the terms of reference specified below.

Identify all factors which contributed to the occurrence of the incident.

Identify whether the incident type should have been anticipated and assess the effectiveness of the risk management strategies adopted.

Assess the adequacy of the emergency response to the incident as it affected the safety of all persons involved.

Assess the adequacy and effectiveness of the systems used to maintain the safe distance separation of vehicles during convoy operations.

Advise on any matters arising from the investigation which would enhance the safety of rail operations.
4.0 Summary of findings from the investigation

It has been identified that the procedures adopted to facilitate the movement in convoy of track maintenance vehicles through the engineering works possession were fragile in the face of human error. In consideration of the findings of this investigation the current method(s) of working track vehicles should be reviewed and amended accordingly. In addition to revised and improved administrative controls, appropriate engineering controls should be developed and introduced to reduce the potential of future collisions. Track maintenance vehicles which can operate track circuits should be appropriately equipped and certified to do so.

The primary deficiencies identified in the course of this investigation were related to:

1. The safe operation of the track maintenance vehicles by the operators
2. The Safeworking Rules for the transfer of track maintenance vehicles
3. No Safeworking Procedures in place for track vehicle transfers
4. The communications systems fitted to the track maintenance vehicles
5. Pre-Work Briefings - identifying the hazard of a collision between track maintenance vehicles.
6. Communicating to track maintenance vehicle operators the locations of worksites within possessions
7. The protection arrangements for intermediate worksites within possession areas
8. The identification and control of line-of-sight hazards for track vehicle operators and drivers
9. Planning the safe movement of track maintenance vehicle movements within possessions
10. Fatigue management – rosters and the impact on carrying out rail safety work

The other deficiencies directly relating to the transfer of track maintenance vehicles include:

11. Judgements of Needs (Safety Actions) from previous track vehicle collisions not implemented or only partially implemented
12. The certification of track maintenance vehicles to operate as a train
13. Diesel hauling track maintenance vehicles
14. Special Train Notices - quality control
15. Altering the scope of works after schedules are planned and printed
16. Training and records of competency-based training and assessment in route knowledge for TVO’s and Traffic Officers
5.0 Factual Information

5.1 Incident Reconstruction

The Rail Infrastructure Corporation had possession of various lines in a multi-staged engineering possession vide Special Train Notice 1351-2003 and Safe Notice 594-2003 advertised to operate continuously from 0930 hrs Tuesday 29 July until 1200 hrs Wednesday 30 July.

On Wednesday 30 July the RIC Team 5 employees signed on duty at 0500 hrs the Traffic Officers assigned to work with the track vehicle teams signed on duty at 0600 hrs. The Track Australia employees signed on duty at 0400 hrs.

The employees made their way to their respective locations. The RIC Team 5 employees travelled by bus to Whittingham to work their vehicles which had been stalled at Whittingham overnight. The Traffic Officer assigned to work with Team 5 signed on duty at Whittingham at 0600 hrs meeting Team 5 on-site. The Track Australia employees met their vehicles which were already working about 1km north of Branxton and relieved the other crew taking charge of the vehicles at about 0430 hrs. The Traffic Officer assigned to work with Track Australia met the team on-site at 0630 hrs. Safety briefings were carried out before the respective teams took charge of the vehicles.

Communications between the Traffic Officers and the PPO were via mobile telephones. The track vehicles were all fitted with UHF CB radios for communication between the respective vehicles.

Both the RIC Team 5 employees and the Track Australia employees reported that the work carried out during their shift proceeded without incident.

The Track Australia team completed the work around 1130 hrs. The Traffic Officer was contacted by the PPO and instructed to proceed with the consist to Branxton where he was to contact the protection officer working at that location and arrange to enter the Branxton interlocking. The Track Australia vehicles were coupled - M437 to M440 / M438 / M439. Brake tests were carried out and all was found to be in order.

The Track Australia consist then proceeded towards Branxton via the Up Main line.

The RIC Team 5 had finished work tamping points 200, 203, 202 and 201 at Whittingham on the Down Main line at about 1000 hrs. The Traffic Officer contacted the PPO and he was instructed to cross over to the Up Main line at Whittingham and proceed to Minimbah where they were to wait for a hi-rail to pass on the Down Main line. The RIC consist was coupled - TJO95, BX055, DS004. Brake tests were carried out and all was found in order. The Operator on TJO95 asked the Traffic Officer what speed the consist was to travel through the possession and the Traffic Officer told him 25kph or less.

After the hi-rail passed at Minimbah the Traffic Officer with RIC Team 5 again contacted the PPO and he was instructed to cross over to the Down Main line and travel to Branxton. Both Traffic Officers had been supplied with possession notes which included a list of the worksites located within the possession.

The Track Australia consist travelled to Branxton via the Up Main, the RIC Team 5 consist travelled to Branxton via the Down Main line. The worksite protection at Branxton was located 500m from the worksite.

The Track Australia consist arrived at the protection for the Branxton worksite first on the Up Main line. The Traffic Officer contacted the protection officer in charge of the works at Branxton and requested permission to lift the protection and enter the Branxton worksite (which was located at the platform). The RIC Team 5 consist was following on the Down Main line and both Traffic Officers conversed and agreed...

---

2 A Traffic Officer is a familiar term used for the qualified worker who acts as a Pilot and who also carries out safeworking duties. Whilst the term is no longer shown in safeworking documentation it is a term still widely used and understood by rail workers.

3 The safety briefings for both RIC and Track Australia included identifying hazards and controls during the time the vehicles were working but did not include a risk assessment to identify the hazards associated with the transfer of the vehicles after the work was completed.

4 At the time of the incident TJO95 was fitted with a MetroNet radio and a UHF open channel radio and M437 with a UHF open channel radio only.

5 The times provided by the Traffic Officer with Track Australia and the Operator of M437 Track Australia differ in regards to what time the works were completed.

Completed Report. File No.03R03952
on the arrangements. The Traffic Officer then requested permission to lift the protection to allow the RIC consist to also enter the worksite. Permission was given and the Traffic Officer lifted the protection for both the Up and Down Main lines. It was 1139 hrs. The protection was restored after the track vehicles entered.

Both consists were standing at Branxton platform. The Track Australia consist on the Up Main line and the RIC Team 5 consist on the Down Main line.

The Traffic Officers discussed the travel arrangements and it was agreed that the Track Australia consist would follow the RIC consist to Maitland via the Down Main line, in an Up direction. UHF channel 28 was the radio channel agreed to be used between the respective consists. The PPO advised both Traffic Officers of the location of worksites at Greta (210.961km – 210.327km) and Lochinvar (202.490km – 202.450km).

The RIC consist pulled forward and moved clear of the interlocking so that the points could be set by the Broadmeadow signaliser for the Track Australia consist to shunt to the Down Main line. The RIC Team 5 Traffic Officer lifted the protection on the Down Main line and left it off for the passage of the Track Australia consist. The Track Australia consist Traffic Officer was required to replace the protection on the Down Main line after the Track Australia consist had shunted to the Down Main and was clear of the protection.

The RIC Team 5 consist departed Branxton towards Maitland at about 1145 hrs. The Track Australia consist followed departing Branxton several minutes later. The Track Australia operator in M437 (lead vehicle) estimated the RIC Team 5 consist was 2 – 3 kilometres ahead.

The Track Australia consist proceeded at an estimated speed of between 30 – 35 kph and after a period of time the distance between the two consists was reduced to between 400 – 500 metres (estimated by operator of M437) this distance was maintained for several kilometres.

The Traffic Officer with the RIC Team 5 consist stated that there was no worksite at Greta and the consist was not required to stop and lift worksite protection. They continued towards Lochinvar.

The operators of TJ095 and M437 continued to communicate with each other via the UHF channel 28 radio exchanging information on the progress of the vehicles by identifying the half-kilometre pegs on the Down side.

The leading vehicle TJ095 approached Lochinvar and the operator observed the trackside sign for the Type F level crossing at Lochinvar.

The picture at left shows the trackside signage which advises drivers of the (Lochinvar) level crossing ahead. The board is located at 203.720km on the Up Main line. This distance is approximately 847 metres from the point of collision. Upon passing this sign the leading consist began to reduce speed to prepare for the Lochinvar level crossing.

The Traffic Officer with TJ095 instructed the operator that he would have to slow down and the vehicles would have to close up for the approaching level crossing. The operator of TJ095 contacted the operator of

The initial planning shown in the possession notes had the Track Australia consist scheduled to travel to Maitland via the Up Main line at the end of the possession. The possession notes showed for the RIC Team 5 consist scheduled to travel to Singleton via Down Main line at the end of the possession. Late changes (due to vehicle transfer requirements after the possession) required the RIC Team 5 consist to also travel to Maitland at the end of the possession. In post-incident interview the PPO was asked why the track vehicle consists did not continue to Maitland via the Up Main and the Down Main lines rather than both travel in convoy via the Down Main line. He responded that it was due to engineering works at Greta affecting the Up Main line.

It was identified in the investigation that although the Traffic Officer’s were advised of the location of worksites by the PPO, and they were provided with possession notes which showed the location of worksites, they did not properly brief the operators of TJ095 and M437 of the location of those worksites. The Traffic Officer with M437 did not mention worksites at all to the operator of that vehicle.
M437 by radio and advised that he would be slowing down, this message was acknowledged by the operator of M437 who stated he was about 400m behind the RIC consist at that time and travelling at about 25kph.

The operator of M437 stated he then began to close the gap between the two consists and "reduce speed". This statement would indicate that the speed of the RIC consist was slower than that of the Track Australia consist. The operator of the Track Australia consist stated that he never lost line-of-sight of the RIC consist which, considering the track curvature at Lochinvar, would indicate that the Track Australia consist had closed the gap to a distance estimated to be less than 200m. The vehicles rounded the curve.

The operator of the M437 then noted that the flashing lights were operating on the RIC consist, the rearmost vehicle being the stabiliser. This indicated that the brakes had been applied to the RIC consist. The operator of M437 stated that he thought that the RIC consist was slowing down for the upcoming level crossing as per the last confirmed radio message and not coming to an emergency stop.

The operator in the RIC Team 5 consist had at this time brought the consist to a stand after rounding the curve and shortly thereafter the operator exploding a detonator on the line. The consist was brought to a stand before the second detonator (3 were placed on the line) was exploded. The distance between each of the detonators was 20m indicating that the RIC consist was travelling slow enough to stop within 20m after exploding the first detonator. The detonators and a red flag were placed to protect a worksite located on the Sydney side of Lochinvar level crossing. The red flag had blown over in the wind and was obscured by the ballast profile making the protection almost impossible to see. Employees were noted in the distance but it could not be determined if they were on the track or not.

At this time the operator in RIC Team 5 T095 consist called the operator of M437 to advise that the RIC consist had come to a stand. The message was not acknowledged. The operator in T095 did not repeat the message. He stated that it was only a matter of 2 or 3 seconds before the collision occurred. The Traffic Officer in T095 stated he had just got out of his seat with the intention of moving the detonators when the collision occurred.

The employees did alight from the vehicles with several receiving first aid at the scene from colleagues. The PPO was advised and he then informed the train controller Broadmeadow.

The NSW Ambulance service arrived on-site at 1225 hrs. A total of six injured persons were conveyed to John Hunter Hospital for treatment, four initially and two a short time later. Another person was treated afterwards bringing the total of injured persons to seven. NSW Police on site at 1300 hrs. A MIM was declared at 1300 hrs by the SRA Incident Management Coordinator. Senior RIC representatives on site at 1300 hrs. Breath-testing was carried out on the Track Maintenance Vehicle Operators and Traffic Officers returning a negative result.

The RIC Ballast Regulator BX055 was derailed on impact lifting the front wheels 30cm from the railhead. The rest of the track maintenance vehicles were not derailed however the impact of the collision resulted in a concertina effect. Investigations at the scene revealed the force of the collision pushed the RIC consist forward 19.7 metres from point of impact. It was determined that the RIC consist (lead vehicle) had initially come to a stand at 202.804km and after the impact the lead vehicle came to a stand at 202.844km. It should be noted when looking at these figures that the vehicles were travelling in an Up direction on the Down Main line.

The calculations made during measurements on the day of the incident also concluded that the initial impact point was 202.913 and the lead vehicle in the Track Australia consist (M437) and the rear of the last vehicle in the RIC consist came to a stand at 202.913km. The collision and subsequent derailment did not obstruct the Up Main line.

---

5 The RIC Network Rules (NWT-316) in force at the time of this incident did not instruct operators of track vehicles in convoys to 'close up' before working over a level crossing. However, the amendment to NWT-316 in force from September 21, 2003 does instruct operators to 'close up' before working over a level crossing. A detailed examination of the safe working rules and procedures has been included in this investigation report.
6 Neither T095 or M437 are equipped with dataloggers which would have recorded the speed of the vehicles.
7 It is the responsibility of the PO to regularly check and maintain his intermediate worksite protection.
8 There was a little confusion amongst employees when questioned as to whom called the Ambulance service. The Traffic officer in T095 said an unidentified RIC infrastructure worker on the access road called the Ambulance service. The Traffic Officer in T095 used his mobile phone to advise the Possession Protection Officer at 1215 hrs.
The Pacific National Emergency Response Group were called and arrived on-site at 1330 hrs. After an
assessment of the site, cranes were ordered to assist in retrieving operations. Assistant locomotives were
arranged with locomotive 4717 arriving on-site at 1630 hrs (country end) and locomotives 8173 / 8139
arriving on-site at 1650 hrs (Sydney end).

Workcover New South Wales were called with Assistant Principal Inspector arriving on-site at 1515 hrs. The Workcover Inspector completed his on-site investigation at 1631 hrs.

Retalling operations commenced at 1631 hrs. BX055 was lifted at 1700 hrs with BX055 and TJ095 parted at
1715 hrs. At 1717 hrs BX055 and D8004 were parted and at 1720 hrs BX055 was retalled on the Down
Main line. Work then commenced on the removal of damaged equipment on D8004 and BX055 and this
was completed at 1845 hrs. At 1745 hrs D8004 and M437 Tamper were parted and work commenced on the
removal of damaged equipment from under M437 and this was completed at 1825 hrs. On-site repairs were
carried out and the RIC vehicles were certified fit for travel at 1900 hrs. The Track Australia vehicles were
certified for travel at 1910 hrs.

RIC Tamper TJ095 was required to be chained to BX055 Ballast Regulator to allow vehicles to be hauled
from the section. Locomotives 8173 / 8139 hauled TJ095, BX055 and D8004 departing the site at 1906 hrs
arriving at Teralah at 1936 hrs. M437, M440, M438 and M439 were propelled from the site departing at
1926 hrs and arriving clear at Teralah at 2034 hrs. The Up and Down Main lines were certified in order at
1930 hrs by RIC Track Manager. A11 protection removed at 2015 hrs. Up and Down Main line re-opened to
traffic at 2037 hrs.

5.2 Injuries, loss and damage

5.2.1 Employees injured

Operator TJ095 - Shock / whiplash injuries.
Employee travelling in BX055- fractured Sternum / whiplash injuries.
Employee travelling in BX055 - Back / Whiplash Injuries.
Employee travelling in TJ095 - Whiplash Injury.
Employee travelling in D8004 - Whiplash Injury.
Traffic Officer in M437 - Knee's / whiplash Injuries.
Employee travelling in M438 – Minor unspecified injuries.

Injured employees were treated at John Hunter Hospital. Names of employees injured are retained on the
investigation file.

5.2.2 Damage to RIC plant

TJ095 – Tamper Machine
- Broken fittings on rear bogie hydraulic brake cylinders
- Misalignment on no. 7 axle. Check torque arms and tailshaft for damage
- Chassis below rear cabin bent causing 25mm gap between top of cabin to roof panel
- Rear axle counter and associated frame damage
- Rear cabin panel damage
- Side panel damage adjacent to rear handrails
- No. 2 cabin mounting bolts loose

BX055 – Ballast Regulator

12The investigation team asked the PFO why a “work on track authority” was not issued and were advised that although
the PFO had requested a “work on track authority” the train controller had refused. The train controller insisted that the
line was closed and as such no “work on track authority” was required. This is in breach of the sideworking rules and
procedures which require a “work on track authority” to be issued. This procedural sideworking breach on the part of
SRA has been examined in the Analysis of Evidence.
Twisted longitudinal chassis rails forward of front axle
- Bent crossmembers between front chassis rails
- Front buffer plate and autcoupler U/S
- Fuel tank mounts broken
- Generator mounting crossmembers U/S
- Damage to front steps, engine cover and handrails
- Front windows broken
- Rear broom cover plates damaged
- Rear autcoupler U/S
- Stress marks on rear chassis above rear broom

**DS004 – Dynamic Stabiliser**
- Front autcoupler U/S
- Bent drag link on rear vibration unit
- Rear cabin damaged
- Rear trolley mount broken
- Engine roof panels bent
- Rear pendulum broken
- Associated air cylinders, feeler rods, and rear locks for rear trolley broken
- Rear autcoupler U/S
- Rear buffer plate U/S
- Inner chassis rail bent
- Rear train brake pipes and associated valving damaged
- Rear light assy damaged
- Left rear outside main chassis rail bent

Security for the RIC vehicles was arranged by RIC for initial period of ten days from the date of the incident at Telarah Yard. All machines are secured and locked with the exception of the rear cabin of DS004 where the door is removed and a window is broken. The vehicles were subsequently broken into and sustained damaged by vandals on the evening of 20 or the morning of 21 August 2003. That damage has not been included in this report.

**M437 – Track Australia 09-3X Tamping Machine**
- Front operator cabin, including ancillary equipment, dash, drive desk, ALC Geometry computer, Desk top computer
- Front portion of chassis, including ancillary equipment
- Laser trolley
- Front lining trolley
- V12 Detroit Diesel engine and radiator
- Hydraulic oil tank
- Satellite locking mechanism
- Rear autcoupling and brackets

**5.2.3 Damage to Track Australia plant**

**M439 – Track Australia Plough Trailer**
- Front autcoupling and brackets
- Front chassis end plate
- Rear autcoupling and brackets

**M438 – Track Australia Dynamic Track Stabiliser**
- Front autcoupling and brackets
- Rear autcoupling and brackets

**M439 – Track Australia Broom Trailer**
- Front autcoupling and brackets

Total combined damage costs to track vehicles estimated >$1 million.
5.3 Description and function of the track maintenance vehicles

M437: This vehicle is a 09-3X Continuous Action Production Tamper. The 09-3X is capable of tamping 3 sleepers at a time in a continuous action and can be used on all types of track, except for points and crossings. The principal function of the vehicle is to lift, line and compact the track, physically moving the track back to its designed survey position, and smoothly correcting any geometrical errors, such as bumps, wobbles, super elevation, twist, etc. Visibility for the operator is very good. **Weight = 77 tonnes.**

M440 – M438 - M439: This is a combination vehicle consisting of a Plough Trailer, a Dynamic Track Stabiliser and a Brooming Trailer. **Weight combined = 92 tonnes.** The function of this vehicle is threefold;

1. To restore the design ballast profile of the track after tamping, by ploughing the ballast into the correct profile.
2. Dynamically stabilise the track after tamping, by applying a controlled down force and vibration to the track. All track will settle after tamping. By dynamically stabilising the track it simulates a significant amount of train traffic, resulting in a controlled settlement and a more robust track structure.
3. Finally the track is broomed off or swept clean of any excess ballast, allowing the sleepers and sleeper fastenings to be easily seen and inspected, whilst also providing for a clean and tidy finished product.

TJ-095: This vehicle a combination 09-32/4S Turnout Tamper. The 09-32/4S tamps 2 sleepers at a time in a continuous action and can be used on all types of track, specialising in points and crossings. The principal function of the vehicle is to lift, line and compact the track, physically moving the track back to its designed survey position, and smoothly correcting any geometrical errors, such as bumps, wobbles, super elevation, twist, etc. Visibility for the operator is very good. **Weight = 135 tonnes.**

BX-055: This is a Ballast Regulator. The function of this vehicle is to restore the ballast profile of the track after tamping, by ploughing the ballast into the correct profile. The regulator then brooms or sweeps the track clean of any excess ballast allowing the sleepers and sleeper fastenings to be easily seen and inspected, whilst also providing for a clean and tidy finished product. **Weight = 36.5 tonnes.**

DS-004: This vehicle is a Dynamic Track Stabiliser. The function of this vehicle is to dynamically stabilise the track after tamping, by applying a controlled down force and vibration to the track. All track will settle after tamping. By dynamically stabilising the track it simulates a significant amount of train traffic, resulting in a controlled settlement and a more robust track structure. **Weight = 62 tonnes.**

5.4 Incident Location

The incident occurred on the Down Main line approximately 437m on the country side of Lochinvar level crossing. Both consists were travelling in an Up direction over the Down Main line. The RIC consist was leading with the Track Australia consist following. Lochinvar station consists of 2 unattended platforms and is located on the Main North line at 202.601km. The level crossing is located at 202.496km. RIC Tamper TJ095 came to a stand at 202.844km after the collision. Investigations at the scene determined that the RIC consist was pushed forward 19.7m from the point of impact.

---

Source: RIC Local Appendix North Volume 3.
5.5  **Track Diagram showing G-sheet**

For the RIC and Track Australia track vehicles travelling in an Up direction over the Down Main line the line at that location falls in a 1 in 100 gradient towards Maitland. The track alignment at that location is shown in the diagram below.

**Gsheet for Basecode 10002**

**Main North Down**

**Between 202.500 km and 203.500 km**

**Number of Records 8**

This data represents the current alignment only.

For proposed alignments contact local RIC Surveyor.

<table>
<thead>
<tr>
<th>SUPER RADIUS LENGTH (km)</th>
<th>RAMP (mm)</th>
<th>(10)</th>
<th>(m)</th>
<th>(km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1000</td>
<td>109</td>
<td>202.434</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>202.540 TP</td>
<td>154</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>202.897 TP</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>202.977 TRS</td>
<td>1604</td>
<td>197</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>205.174 TRS</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>203.234 TP</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>203.334 TP</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>203.404 TRS</td>
<td>202.927</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This data represents the current alignment only.

For proposed alignments contact local RIC Surveyor

Investigations at the scene revealed the force of the collision pushed the RIC consist forward 19.7 metres from point of impact. It was determined that the RIC consist (lead vehicle) had initially come to a stand at 202.864km and after the impact the lead vehicle came to a stand at 202.844km. It should be noted when looking at these figures that the vehicles were travelling in an Up direction on the Down Main line.

The calculations made during measurements on the day of the incident also concluded that the initial impact point was 202.933 and the lead vehicle in the Track Australia consist (M437) and the rear of the last vehicle in the RIC consist came to a stand at 202.913km.
5.6 Position of track vehicles and personnel

Legend:
- RIC = Blue
- Track Australia = Red

Location of Personnel:
1. RIC Operator TJ056 (injured)
2. RIC Traffic Officer TJ095
3. RIC Operator (travelling)
4. RIC employee (injured)
5. RIC employee (injured)
6. RIC employee (injured)
7. RIC employee (injured)
8. Operator MA37 (Track Aust.)
9. RIC Traffic Officer (injured)
10. Track Australia employee (injured)

Lochinvar

- 202.64km measured to the rear of each machine
- 202.880
- 202.986
- Dynamic Stabiliser C6 004
- Machines stopped

Note: Pictures of machines at left are not to scale.
5.7 Safeworking system

The Mainland - Branxton section is controlled by automatic signalling. The length of the section is 22.169km. The points and signals at Mainland are operated and controlled by the signaler at Mainland signal box. The points and signals at Branxton are operated and controlled from Broadmeadow signal box. A local control panel has also been provided in the traffic room at Branxton to allow the interlocking to be operated locally. All indications displayed on the local control panel are also displayed on the control panel at Broadmeadow signal box. The interlocking at Branxton was operated by the Broadmeadow signaler to facilitate the shunting movements with the track maintenance vehicles.

5.8 Toxicology information

The operators of M437 and TJ095 and the traffic officers on those vehicles were breathalysed after the incident. All employees returned a negative result.

6.0 Emergency management

6.1 Notification

The Lochinvar collision was a notifiable occurrence under Section 64 of the Rail Safety Act 2002. The Ministry of Transport was advised accordingly and were kept informed of the progress of events during the afternoon and evening of the incident.

The incident resulted in extensive damage to plant and injuries to personnel. Workcover NSW were advised by the NSW Police Service after the incident. The incident was treated as a ‘non disturbance occurrence’ and an Assistant Principal Inspector Country North Workcover, was called to attend by RIC. The first call on the incident was made by the Traffic Officer with TJ095 who called the Possession Protection Officer (PPO) immediately after the collision. The PPO then contacted the train controller. An unidentified RIC employee in a vehicle on the access road called the Ambulance service adjacent to the site.

6.2 Worksite protection

The investigation established that no work on track authority was issued for the restoration work at the site. The Local Possession Authority (Mainland – Mt Owen) was fulfilled at 1356 hrs in order to facilitate the movement of trains at the opposite end of the LPA thus reducing the affected portion of line to Mainland - Branxton. Signal blocking facilities were applied at Branxton E board Broadmeadow and Mainland signal boxes. Both the Up and Down Main lines were protected with detonators and red flags / lamps. The protection was placed at 500m at 205.000km (country end) and 500m Mainland side of the Lochinvar level crossing 201.700km.

Whilst the site was protected it was a safeworking breach on the part of the train controller to deny the request of a work on track authority from the Possession Protection Officer. The train controller argued that a work on track authority was not required because he claimed an emergency possession of the Up and Down Main lines. There was no risk however of any unauthorised train entering the closed line.

6.3 Response and Recovery

A MIM was declared at 1300 hrs by the SRA Incident Management Coordinator. Senior RIC and SRA representatives began arriving on site at 1300 hrs.

The Pacific National Emergency Response Group were called and arrived on-site at 1350 hrs. After an assessment of the site cranes were ordered to assist in rearrailing operations. Assistant locomotives were arranged with locomotive 4717 arriving on-site at 1630 hrs (country end) and locomotives 8173 / 8139 arriving on-site at 1650 hrs (Sydney end).

Whilst Workcover had been advised of the incident there was a delay in calling the Workcover Inspector to attend. The RIC Incident Support Manager was not at the site of the incident but was, at the time, working from home but in contact with RIC personnel at the incident site by means of mobile phone. Advice was given to their officer by the senior RIC personnel on site who reported major damage to the track vehicles (plant) and injuries to employees. It was the opinion of the senior RIC personnel on site that the incident was a non-disturbance occurrence and Workcover should attend. After some delay Workcover New South Wales
were called with Assistant Principal Inspector arriving on-site at 1515 hrs. The Workcover Inspector completed her on-site investigation at 1631 hrs.

Relocating operations then commenced at 1631 hrs. BX055 was lifted at 1700 hrs with BX055 and TJ095 parted at 1715 hrs. At 1717 hrs BX055 and DS004 were parted and at 1720 hrs BX055 was relaid on the Down Main line. Work then commenced on the removal of damaged equipment on DS004 and BX055 and this was completed at 1845 hrs. At 1745 hrs DS004 and M437 Tamper were parted and work commenced on the removal of damaged equipment from under M437 and this was completed at 1825 hrs. On-site repairs were carried out and the RIC vehicles were certified fit for travel at 1900 hrs. The Track Australia vehicles were certified for travel at 1910 hrs.

RIC Tamper TJ095 was required to be chained to BX055 Ballast Regulator to allow vehicles to be hauled from the section. Locomotives 8173 / 8139 hauled TJ095, BX055 and DS004 departing the site at 1906 hrs arriving at Teralah at 1936 hrs. M437, M440, M438 and M439 were propelled from the site departing at 1926 hrs and arriving clear at Teralah at 2034 hrs. The Up and Down Main lines were certified in order at 1930 hrs by RIC Track Manager. All protection removed at 2015 hrs. Up and Down Main line re-opened to traffic at 2037 hrs. MIM cancelled at 2037 hrs.

7.0 Organisation and management issues

7.1 History of recent similar occurrences

The following are similar incidents that have occurred since January 2001:

- Macksville-Eungai 5/4/2001 - Track Machine BX033 collided with rear of NRC train
- Cowan 14/8/2001 - Tamper TJ061 collided with rear of ballast regulator BX035
- Yass 16/2/2002 - Ballast regulator BX052 collided with rear of tamper TJ082
- Emu Plains 19/11/2002 - MVE2 collided with MVE7 at 59.027km whilst travelling in convoy from Katoomba
- Yarrambandai 06/12/2002 - SX110 collided with SX111 while returning to a worksite
- Darnick 11/05/2003 - SM009 / SX106 (coupled) collided with SM105 at 891.000km pushing SM105 forward and colliding with SX112.

A review of the above incidents identified that all were collisions caused by vehicles travelling closely and at such speed that they could not avoid colliding with the vehicle in front. The reports into these incidents were examined and whilst some of the Judgements of Needs (Safety Actions) arising from the investigations have been progressed there are many which have not. Surprisingly there were no Judgements of Needs made in any of the above investigations in regards to the administrative controls for track vehicles. However a sub-committee reviewing the above investigations recommended the development and introduction of a Track Vehicle Operators Handbook. See section 8.1.2 in the analysis of evidence.

The RIC Safety Management System incident coding manual identifies the hazard of collision by track vehicles as a high-risk hazard. The code is A-33-110, Collision – by track vehicle – Operator performance. The principal controls identified in the Hazard Control Outline are Operator skills – training and supervision and plant and equipment maintenance.

7.2 Identified Safety Management Systems

7.2.1 The rules, procedures and policy for the transfer of track maintenance vehicles

Network Rule (NWT-316) was in force at the time of the Lochinvar collision however the RIC did not have in place any Network Procedures for track vehicles. NPR-748 Transferring Track Vehicles was introduced on 21 September 2003. The RIC Safeworking Policy contains route knowledge requirements for track vehicle operators. Examination of the rules, procedures and policy have been included in the Analysis.

7.2.2 Project Safety Management Plan

A Project Safety Management Plan was prepared for the engineering possession. It included detailed Emergency Response Plans in accordance with the RIC Safety Manual instructions for Incident Management.
4.2 Emergency Response. Project Managers are instructed to add or delete from the following emergency responses: Fire, Injury, Bomb Threat, Gas Leak.

There was no Emergency Response Plan for a track vehicle accident/collision. Given the circumstances of the engineering possession and the use of track vehicles in the possession area the potential for a track vehicle accident / collision should have been included as a potential hazard.

7.3 Competency of track vehicle operators, experience, and medical status

7.3.1 Competency and experience

An examination of the employee records established that both the operators involved in the incident held current Track Vehicle Operator class 2 certification. This meant that they were qualified to operate the track vehicles both inside and outside possession areas.

The RIC operator had began training in the operation of the tamper track vehicle in March 2000 and had 3 continuous years of service operating track vehicles before the incident. Part of the training program involved training with Plasser Australia, St Mary’s. The RIC operator had no previous history of safeworking incidents in respect to the operation of track vehicles.

The Track Australia operator had extensive experience working as a plant (track vehicle) mechanic for 9 years before beginning work operating M437 for RSA. Part of the training program involved training with Plasser Australia, St Mary’s. He began working for Track Australia in 1999 and since that time has almost exclusively operated M437. He had an intimate knowledge of the operation of the vehicle and had never before been involved in any safeworking incidents in respect to the operation of track vehicles.

7.3.2 Medical status

Both track vehicle operators were current with their medical certification to operate track vehicles and carry out rail safety work. There were no medical restrictions placed on the operators. Medical records were made available for the investigation.

7.4 Removal of employees from Safeworking duties

Removal of employees from safeworking duties is often automatically carried out when an employee has been involved in an incident. In this incident the cause was principally related to the failure to properly control the track vehicle and maintain separation. Network Rule NWT-316 was in force at the time of the incident, there were no safeworking procedures available. The employees involved were recertified in safeworking NWT-316.
8.0 Incident Investigation Evidence & Findings - Analysis

8.1 The safe operation of the track maintenance vehicles by the operators

The operator of the Railtrack Australia track vehicle consisted of travelling at a reduced speed behind the RIC consist, such that it did not allow time to prevent a collision when the RIC consist stopped ahead of him. When leading the Railtrack Australia consist collided with the RIC consist for the RIC could not stop in time due to the poor condition of the Lochinvar platform.

The operator of M437 stated in his interview that he maintained an average distance of between 400m and 500m from the RIC consist after leaving Braxton. The operators stated they were travelling at about 25kph. The respective operators stated they remained in contact with each other via the UHF open channel CB radio. The operator of M437 stated that on approaching Lochinvar he acknowledged a radio call from the operator of the RIC consist who advised that the RIC consist was slowing down because they were approaching the Lochinvar level road crossing. At this time he stated he was about 400m behind the RIC consist. When the operator of M437 acknowledged the radio call he advised the operator of T3095 that he would be closing the gap between the two consist.

At this time the operator of M437 stated he was travelling at about 25kph. There was no data logger installed on M437. The operator of M437 stated he then began to close the gap between his consist and the RIC consist. He stated he reduced speed and did not lose complete sight of the RIC consist. He observed the flashing lights on the rear RIC vehicle which indicated that the brakes had been applied. The operator did not at this point apply the brakes fully on M437 as he thought that the RIC consist was only slowing down for the road level crossing and did not realise that they had stopped.

The operator of M437 did not hear the radio call from the operator of the RIC consist to advise that they had stopped to lift the worksite protection. The operator of the M437 suddenly realised the gap between the two consists was quickly closing and he made a full brake application but was unable to stop resulting in the collision between the two consists. The Track Australia consist combined weight was 169 tonnes. The stationary RIC consist combined weight was 233.5 tonnes.

8.1.1 Network Rule NWT-316

The current rule for track vehicles is shown in the RIC safeworking rule NWT-316. This rule instructs track vehicle operators to travel as close as safely practicable when travelling in convoy. The instructions in place at the time of the incident for ‘coordinating convoys’ (pre-21 September 2003) NWT-316 stated:

"If travelling as a convoy, track vehicles must travel as closely as safely practicable. The convoy must close up before travelling again:
• if the leading vehicle stops, or
• Before entering sections

When travelling in convoy, track vehicle operators must maintain effective communication. If communication is lost, a convoy must close up and travel at restricted speed until communication is re-established"

The RIC Safety Division Safeworking section made amendments to the current rules and procedures for track vehicles effective from 21 September 2003. The NWT-316 from September 21 2003 remains essentially the same, in respect to the instructions for travelling in convoy, with some minor changes. The new rule states:

"Track vehicles travelling in convoy must travel as closely as safely practicable. Operators of track vehicles in convoy must maintain effective communication. If communication is lost, following track vehicles operators must:
• Travel within sighting distance of the vehicle ahead, and
• Travel at a restricted speed until communication is re-established

The convoy must close up:
• If the leading vehicle stops, or..."
Before entering a section, or
Before working over a level crossing

As can be seen by the above the rules changes are minimal. The rule still instructs operators to travel ‘as closely as safety practicable’. This instruction has been identified as the single greatest potential for collision. The track vehicles being built and used on the RIC network are not small vehicles, they are in some cases heavier than a locomotive. The inherent risk therefore is collision in convoy, inside or outside possession areas. Two or more locomotives / trains would not be placed into the same section with the drivers instructed to follow each other ‘as closely as safely practicable’, the safeworking rules simply do not allow it. However this method of working has been the standard method of working track vehicles for many years and has resulted in a series of track vehicle collisions.

8.1.2 New Network Procedures from 21 September 2003

There were no Network Procedures for transferring track vehicles in place at the time of the incident. However from 21 September 2003 a new procedure has been included entitled ‘Transferring Track Vehicles’ NPR-748.

The new procedure includes
• Preparing track vehicles for travel
• Transferring Track Vehicles
• Travelling in Convoy
• Travelling over Level Crossings

NPR-748 is a 5-page document dealing with the transfer of track vehicles. This procedure is the first provided for track vehicle operators since the abolition of the 500 series safeworking engineering manual and the introduction of the Network Rules & Procedures on November 4 2001. The 900 series manual contained 40 pages of instructions on track vehicle operations. For a period of in excess of 22 months, from 4 November 2001 until 21 September 2003, no procedures existed for the transfer of track vehicles. The RIC Track Machine Subcommittee (July 2002) made the following comments in the document summary:

"The sub-committee reviewed a total of 38 recommendations or judgements of need (JoNs) associated with these incident investigations. The sub-committee recommends actioning 26 of these JoNs. Furthermore, it recommends the introduction of a Track Vehicle Operator’s Handbook and associated training."

The sub-committee identified a need for more robust rules and procedures for track vehicles however the recommended safety action of the introduction of a Track Vehicle Operators Handbook was not carried through. This investigation found the RIC Safeworking section subsequently had the recommendation removed on the argument that the Network Rules & Procedures (amended) to take effect from 21 September 2003 would be adequate in content and as such there would be no need to develop and introduce the Track Vehicle Operators Handbook. The sub-committee recommendations were released in July 2002 and it was 14 months before amendments were introduced for NWT-316 and the release of NPR-748 ‘Transferring Track Vehicles’ on 21 September 2003.

---

14 The Track Machines Sub-committee was a sub-committee of the Safety Action Committee. The following General Managers supported the sub-committee by providing senior and experienced staff to participate in the sub-committee and the commitment to implement the sub-committee’s recommendations –
GM Projects & Support
GM Engineering
GM Safety
GM Safeworking

The purpose of the sub-committee was to initiate the Corporation’s response to five investigations involving track machines. These incidents were:
17/04/01 Calvalla – Robertson, M671 track machine traversed the section without the correct authority. 05/04/01 Macks vlle – Bungal, track machine BX033 collided with rear of NRC freight train 4BW4. 14/08/01 Cowan - Hawkesbury River, track vehicle TJ 061 collided with rear of track vehicle BX 035 standing at signal HR129UM at stp. 16/02/02 Yass Junction, track machine BX052 collided with the rear of TJ 082 - vehicles travelling in convoy in heavy fog. 05/02/02 Nyngan to Cober, collision between TJ 066 and T3063 track machines due to a residual amount of hydraulic oil left from a broken hydraulic hose.
8.1.3 Analysis of the Network Rules & Procedures effective from 21 September 2003

This investigation examined all evidence into the Lochinvar collision on 30 July 2003 in addition to the investigations carried out into previous track vehicle collisions the most recent, prior to Lochinvar, being the collision at Darnick on 11 May 2003. The Darnick investigation included the following Judgement of Needs (Safety Actions) relating to the RIC Network Rules & Procedures:

"There is a need to provide track vehicle operators with procedures to cover routine operations including travelling in convoys, traversing level crossings, working through and crossing trains at unattended interlockings and removing track vehicles from the section in emergencies".

"There is a need for RIC's Safeworking Policy to be amended with regards to the route knowledge requirements of track vehicle operators".

"There is a need to review the requirements of Network Rule NWT 316, particularly in relation to coordinating convoys".

The above safety actions highlight the need for the RIC to review the Safeworking Rules & Procedures. The Network Procedure for the transfer of track vehicles (NPR-748) was not in place at the time the Darnick investigation was released (12 September 2003). However the investigating officer had reviewed the content of NPR-748 and considered it to be less than adequate as it did not sufficiently cover the key areas of concern. This investigation concurs with the above recommendations from the Darnick report.

The larger and heavier track vehicles now being used have created a much higher level of risk. Rules and procedures for the movement of track vehicles are an administrative control and can still be circumvented by employee actions such as a slip or lapse in concentration. In this incident the separation of the track vehicles was dependant only upon the performance of the operators. Slip / Lapses are active errors which involve unintentional deviation from expected behaviour due to typical human fallibility such as lack of attentiveness, distraction or forgetfulness. Mistakes are also unintentional active errors; in this case due to decisions where the individual has selected the wrong action based on incorrect information or inadequate competency. The lack of appropriate rules and procedures has been identified as a primary causal factor in the Lochinvar collision

8.1.4 Working track vehicles over level crossings

The safeworking rules in place at the time of the incident provided no instruction for track vehicles to "close up" before working over a level crossing. However this instruction has since been included in the amended rules which came into force on 21 September 2003. There were no safeworking procedures in place for track vehicles at the time of the incident. The operators of the track vehicles on the day of the incident adopted a method of working which has long been recognised by the industry as the accepted method of working track vehicles over level crossings, to 'close up' the vehicles.

This method has been used by track vehicle operators to avoid vehicles 'stringing out' as they travel over crossings creating a potentially unsafe situation for motorists. A motorist may observe one track vehicle pass and then believing that it was the only 'train', pull out into the path of the following track vehicle. This type of incident has occurred in level crossing incidents, thus the importance of ensuring all the track vehicles 'close up' before moving over the level crossing.

There are essentially 3 types of level crossings they are:

- Type F flashing highway lights and bells
- Type F flashing highway lights and bells with boom gates
- D type signage – Stop signs or Give Way signs.

The level crossing equipment at Lochinvar consists of Type F flashing highway lights, bells, and boom gates. In the track circuited areas many track vehicles are not certified to operate track circuits and thus the Type F warning bells and lights may not operate or cease to operate after the passage of the first track vehicle. The operator of the TJ095 Tamper advised that the vehicle did operate track circuits even though not yet certified to do so.
8.2 The communications systems fitted to track maintenance vehicles

The radios fitted in the track vehicles involved in the incident were less than adequate. They were open channel UHF CB two-way radios that do not provide discreet radio communications between track vehicle operators. On the day of the incident the UHF radio in the track vehicles was set on channel 28 and the traffic officer in M437 made comment in his interview that the radio had a lot of background interference from other (non-rail) users. The operator of M437 did not hear the ‘warning’ message from the operator of the RIC Tamper machine T095 that he was stopping to lift worksite protection at Lochinvar.

Effective communications as defined in the RIC Safeworking rules and procedures glossary states:

"The ability to successfully send, receive, and understand information. The communication does not need to be continuous"

Radio communications and communications protocols have been identified in previous investigations into track vehicle collisions as a contributing factor to the incidents. Whilst some track vehicles are fitted with only UHF CB open channel two-way radios others in the RIC fleet are fitted with GRN radios.

New discreet radio frequency radios have arrived from the USA and are now at Clyde and are progressively being fitted to RIC track vehicles in the Sydney teams. Track Australia have had GRN radios fitted to their vehicles whilst the vehicles have been undergoing repairs. North region teams are being progressively fitted with GRN radios and hand-held GRN radios are used in vehicles not yet fitted with permanent units.

8.3 Pre-Work Briefing(s) did not include the hazard of collision between track vehicles

The investigation identified that the pre-work briefings conducted by both RIC and Track Australia on the day of the incident did not identify and include the 'hazard' of a collision between track vehicles. The potential for a collision between track vehicles was not considered in the risk assessment. The teams assess the risk when the vehicles are working but do not consider the risk associated with travelling in convoy. This has since been identified as an area of concern in that other teams similarly do not include the risk of collision when travelling in convoy in their safety briefings. The RIC should ensure that all track vehicle teams are made aware of the importance of including track vehicle transfers (convoys) in the safety briefings.

8.4 Communicating to operators the locations of worksites within possessions

The respective operators of T095 and M437 were not made aware of worksites located between Branxton and Maitland. The traffic officers accompanying the operators were advised of the location of worksites by the PPO but this information was not passed on to the operators. The traffic officers stated that it was not their normal practice to advise the operator(s) of the location of worksites. As a consequence neither the RIC operator on T095 or the Track Australia operator on M437 were made aware of the worksite at Lochinvar.

The traffic officers had conferred and agreed on the day that when they came upon worksite protection the traffic officer in the RIC consist would gain authority from the relevant protection officer then lift the protection. The vehicles would all pass through and then the traffic officer in the Track Australia consist would restore the protection. The procedures for piloting track vehicles and work trains is shown in the RIC Operator Specific Procedures OSP-03. The RIC Operator Specific Procedures were moved into the RIC Safety Manual from 21 September 2003.

RIC NWT-316 states track vehicles must travel as closely as safely practicable. It is therefore appropriate that the operators of track maintenance vehicles be advised of the location of worksites in order that they can prepare to stop at those locations. In this incident the operator of the Track Australia consist understood that the vehicles would need to slow down and 'close-up' because they were approaching the Lochinvar level crossing, however he did not anticipate that the RIC consist would be stopping suddenly to lift worksite protection.

8.5 Planning the safe movement of track maintenance vehicles

The investigation identified that on the day of the incident the initial intended path for the transfer of the Track Australia consist inside the possession was via the Up Main from Branxton to Maitland. This was separate from the path intended for the RIC consist which was via the Down Main line (in an Up direction) from Branxton to Maitland. The initial intended path was not able to be implemented because of late
finishing works at Greta and Lochinvar which required the PPO to route the Track Australia consist via the Down Main line and subsequently follow the RIC consist. When travelling in engineering possessions there is often a more frequent need for track vehicles to stop because of work sites located within the possession. Both inside and outside possessions track vehicle operators have to negotiate terrain which can reduce line-of-sight of the vehicle ahead. Adverse weather conditions also affect the track vehicle operations. The expectations placed upon each operator to continually travel “as closely as safely practicable” is unrealistic. The probability factor of human error is not genuinely considered. There are no additional safeguards for a lapse/slip on behalf of the operator.

There exists a need to ensure track vehicle movements are planned to provide a separation of the vehicles when the work is completed and they are required to be transferred through the possession to the limits of the Local Possession Authority.

8.6 The certification of track maintenance vehicles to operate as a train

The RIC Tamper TJ095 or the Track Australia Tamper M437 are not yet certified to operate as a train. There are other track vehicles within the RIC fleet which, if appropriate modifications were made (eg vigilance equipment, speedometers, data-loggers) could also be certified to operate as a train. Whilst in this incident the vehicles collided when running in convey through a possession, and they were not travelling on signals, the vehicles are required outside of a possession to operate under block working conditions. Both consists were tabled to run under block working conditions to Broadmeadow and Gosford after the possession on STN 1434.

When working 2 or more heavy track maintenance vehicles within the same block, block working is an inappropriate method of working considering the size and mass of the vehicles. Relatively minor modifications are required to allow the vehicles to be certified to run as a train using the signalling system for transfer rather than the ‘block working’ method. Alternatively the vehicles could be diesel hauled. The RIC Tamper TJ095 weighs 135 tonnes. The tamper vehicles run in coupled consists together with ‘regulators’ and ‘stabilisers’ which bring their gross weight to that in excess of 2 heavy locomotives.

8.7 Geographic and Environmental factors – line of sight

The weather at the time of the incident was cool, clear and dry. Visibility was excellent. The weather conditions did not contribute to the incident outcome. The location of a large shrub on the curve of the Down Main line at Lochinvar has been identified as a contributing factor to the incident. The presence of the shrub has reduced the line-of-sight for vehicles travelling in either direction. A sight inspection on 21 August determined that the line-of-sight for the track vehicle operators on 30 July would have been increased by between 100 – 140 metres if the shrub was removed.

Picture 3. A Down Main line view of the curve approaching Lochinvar in the Up direction. The yellow arrow highlights the shrub which reduces the line-of-sight. Picture 4. A Down Main line view of the curve from Lochinvar end looking North.
8.8 Fatigue management – Fatigue scores

The following table is the rosters of the RIC Track Vehicle Operator and the Track Australia Track Vehicle Operator from 1st July, 2003 through to the date of the collision on 30th July, 2003. It is representative of both team’s rosters for that period. As such, a fatigue analysis of the roster was obtained using the Fatigue Audit InterDyne (FAID) computer software.

<table>
<thead>
<tr>
<th>July</th>
<th>Hrs Worked</th>
<th>Shift times</th>
<th>Shift Fatigue Score</th>
<th>Risk Level</th>
<th>Hrs Worked</th>
<th>Shift Times</th>
<th>Shift Fatigue Score</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>2100 600</td>
<td>28.8</td>
<td>-61.2</td>
<td>9.5</td>
<td>1330 2300</td>
<td>15</td>
<td>-75</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>600 1500</td>
<td>28.4</td>
<td>-61.6</td>
<td>10</td>
<td>900 1900</td>
<td>10</td>
<td>-56.5</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>1 900</td>
<td>67.2</td>
<td>-22.8</td>
<td>5</td>
<td>1400 1900</td>
<td>32.5</td>
<td>-57.5</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>600 1600</td>
<td>65.5</td>
<td>-24.5</td>
<td>11</td>
<td>600 1700</td>
<td>61.6</td>
<td>-28.7</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>2130 600</td>
<td>55.7</td>
<td>-34.3</td>
<td>10.5</td>
<td>800 1830</td>
<td>60.7</td>
<td>-29.3</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>2030 600</td>
<td>69.1</td>
<td>-20.9</td>
<td>12.5</td>
<td>800 2030</td>
<td>61.3</td>
<td>-28.7</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>700 1630</td>
<td>46.7</td>
<td>-43.3</td>
<td>2.5</td>
<td>1800 2030</td>
<td>36.9</td>
<td>-53.1</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>800 1800</td>
<td>63.4</td>
<td>-20.6</td>
<td>11.5</td>
<td>530 1700</td>
<td>54.7</td>
<td>-35.3</td>
</tr>
<tr>
<td>13</td>
<td>17</td>
<td>600 2300</td>
<td>78.6</td>
<td>-11.4</td>
<td>15</td>
<td>500 2000</td>
<td>66.4</td>
<td>-21.6</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>800 1730</td>
<td>75.9</td>
<td>-14.1</td>
<td>2.5</td>
<td>600 830</td>
<td>62.2</td>
<td>-7.8</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>700 1630</td>
<td>86.2</td>
<td>-3.6</td>
<td>5.5</td>
<td>2200 430</td>
<td>70.1</td>
<td>-19.9</td>
</tr>
<tr>
<td>16</td>
<td>9</td>
<td>2030 600</td>
<td>98.0</td>
<td>8.9</td>
<td>4</td>
<td>2400 400</td>
<td>98.7</td>
<td>8.7</td>
</tr>
<tr>
<td>17</td>
<td>9</td>
<td>2030 600</td>
<td>103.4</td>
<td>13.4</td>
<td>4</td>
<td>1300 1700</td>
<td>62.4</td>
<td>-27.6</td>
</tr>
<tr>
<td>18</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>8</td>
<td>400 1230</td>
<td>86.9</td>
<td>-3.1</td>
<td>6.6</td>
<td>1200 1630</td>
<td>113.7</td>
<td>23.7</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
<td>600 1800</td>
<td>80.1</td>
<td>-9.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td>1800 2030</td>
<td>39.7</td>
<td>-51.3</td>
</tr>
<tr>
<td>22</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>500 1700</td>
<td>55.4</td>
<td>-34.6</td>
</tr>
<tr>
<td>23</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>10.5</td>
<td>700 1730</td>
<td>53.4</td>
<td>-30.6</td>
</tr>
<tr>
<td>24</td>
<td>12</td>
<td>1800 600</td>
<td>49.9</td>
<td>-40.1</td>
<td>13</td>
<td>700 2000</td>
<td>56</td>
<td>-34</td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>12</td>
<td>900 2100</td>
<td>35.9</td>
<td>-63.1</td>
<td>13</td>
<td>830 2130</td>
<td>54</td>
<td>-36</td>
</tr>
<tr>
<td>27</td>
<td>12</td>
<td>900 2100</td>
<td>45.7</td>
<td>-43.3</td>
<td>13.5</td>
<td>830 2200</td>
<td>63.4</td>
<td>-26.6</td>
</tr>
<tr>
<td>28</td>
<td>9</td>
<td>700 1830</td>
<td>60.6</td>
<td>-29.4</td>
<td>7.6</td>
<td>900 1630</td>
<td>61.8</td>
<td>-28.2</td>
</tr>
<tr>
<td>29</td>
<td>9</td>
<td>700 1630</td>
<td>68.2</td>
<td>-21.8</td>
<td>12</td>
<td>800 2000</td>
<td>59.6</td>
<td>30.4</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>500 2000</td>
<td>88.4</td>
<td>-1.6</td>
<td>15.5</td>
<td>400 1930</td>
<td>93.1</td>
<td>3.1</td>
</tr>
<tr>
<td>31</td>
<td>10</td>
<td>800 1800</td>
<td>73.9</td>
<td>-16.1</td>
<td>7.5</td>
<td>900 1630</td>
<td>73.2</td>
<td>-16.8</td>
</tr>
</tbody>
</table>

Rosters show a risk for RIC TVO involved in Lochinvar collision

Rosters show a risk for Track Aus TVO involved in Lochinvar collision

8.8.1 Fatigue Scores

The guidelines used by rostering staff for fatigue is to ensure that an individual staff member’s fatigue score does not exceed 100 points for any given shift. If the score is above 100, the rostering staff are to adjust the roster to ensure a score below 100 is achieved. Otherwise, a thorough Risk Assessment is to be undertaken by the Team Manager to manage the high fatigue risk.

RIC Track Vehicle Operator profile – fatigue scores

On one occasion in the RIC TVO’s roster the Fatigue score exceeded 100 points (103.4 on the 17th July). This was the last day of seven straight working days, the last two days being night shift after five day shifts.
On the day of the collision, the fatigue score was 88.4 points. Although this is below the threshold limit of 100 the scores have increased steadily over the previous days from 36.9 on 26th July, nearing the 100-point threshold on the day of the incident.

Track Australia Track Vehicle Operator profile – fatigue scores

On one occasion in the Track Australia’s TVO’s roster the Fatigue score exceeded 100 points (113.7 on the 19th July). This was the last day of eight straight working days.

On the day of the collision, the fatigue score was 93.1 points. It should be noted however that the intended “rostered” shift for 30 July was 12 hours. The 15.5 hours worked on the day was due to the emergency created by the collision. The fatigue score therefore at the time of the incident could be more accurately estimated to be around 84 points, taking the time of the incident into consideration.

On 29 July the operator started work at 0800 hrs and worked through until 2000 hrs that evening, a total of 12 hours. He resumed work the following morning at 0400 hrs, a break of 8 hours. The operator stated in interview that he drove himself to and from work in a company provided vehicle. The Track Australia rostering arrangements include travel time to and from the place of accommodation and this is built into the shift times shown on page 23.

On 30 July it was a little over 8-hours into the shift when the collision occurred.

A copy of the Track Australia Enterprise agreement 2001 - 2004 was supplied. Section 5.1 of the document covers hours of work. The document states:

"The ordinary hours of work for employees are to be an average of 38 hours per week but not exceeding 152 hours in 28 days. The pattern of work may require ordinary hours of work to be rostered between six and twelve hours per day to be worked continuously on any day of the week. A maximum of 12 hours may be worked on any one day in accordance with the Australian Council of Trade Unions (ACTU) Code of Conduct. The daily hours are exclusive of meal break intervals."

It was noted that on several days in the month leading up to the incident the Track Australia operator had worked in excess of 12 hours each shift. The possibility of a micro-sleep at the time of the incident could not be discounted.

Overview

Fatigue, as a contributing factor to this incident could not be categorically dismissed, due to the many factors that cause fatigue. Not least being the unknown factors of an individual’s behaviour outside of work time.

The rosters, which have included all overtime shifts worked in this period as well as changed from day work to night work and back again, could be considered hazardous, and further analysis may be required particularly in regards to the 100 point threshold. It has been noted that many industries have a threshold of 80 points.

Track Australia and the RIC should examine their rostering arrangements for track vehicle operators. The RIC Rostering and Fatigue Management Policy (Version 1.0, 29 April 2003) provides roster guidelines and indicates the minimum break between shifts to be 11 hours. Whilst Track Australia employees work to a different EBA it is recommended that for the purposes of maintaining safety throughout the system Track Australia employees, and other suppliers of track vehicle operators, should adopt the 11 hour minimum break between shifts in line with the RIC Fatigue Management Policy.

Fitness for Duty

Fitness for Duty is defined as “the capacity of an individual to perform their job safely and competently. Your capacity to perform your job safely and competently can be affected by a number of different factors.” Fatigue being one of these factors.

Whilst every effort is made to comply with RIC’s Fatigue Management Policy with regard to rostering of employee’s shifts, the individual has a responsibility to undertake lifestyle management that ensures Fitness for Duty whilst at work. The above scores are representative of working time only, as factoring in individual’s behaviour in their own time is very difficult to estimate for obvious reasons.
8.9 Diesel Hauling Track Maintenance Vehicles

The investigation concluded that diesel hauling track vehicles (outside possessions) presented operational difficulties unless the track vehicles were being hauled for long distances. Short-haul operations (around the Metropolitan area) were not considered a practical option however if the track vehicles are required to work in possessions planned for country regions then diesel hauling could be considered as a safe and viable option. An example of this may be the transfer of track vehicles from the Metropolitan area to Yass Junction for an advertised engineering possession. See section 5.18.

8.10 Special Train Notices - quality control

Whilst the STN(s) was not considered to be a direct or contributing cause to the actual incident the investigation identified errors on the STN's published for the engineering possession. These errors demonstrated a lack of quality control. STN's are safety critical documents and errors or omissions in these documents can create confusion and lead to operator error.

An examination of the STN’s showed that there were a number of errors on STN 1350-2003 some of which were amended by Tables Telegram 409-03V. Errors in Tables Telegram 409-03V were also made and required amendment with Tables Telegram 660-03GM. Errors were also obvious in STN 1434-2003 but these errors were not amended by a Tables Telegram and the document was circulated for use with the engineering possession.

STN 1434 showed the works program and details of track machine transfers. The STN contained numerous errors in respect to the movement of the track vehicle teams. Consist numbers were incorrect and the transfer times shown in STN 1434 did not match the advertised possession times shown in STN 1350. Errors and subsequent amendment documentation issued just prior to the possession only serves to further confuse employees. The quality and accuracy of STN's was recently highlighted in a Level 2 investigation into an incident at Blacktown on 31 May 2003. In that incident the STN was identified as a contributing factor in the incident.

8.11 Altering the scope of engineering works after schedules are planned and printed

During the investigation into the Lochinvar collision the issue of late changes to the scope of engineering works for track vehicles was identified and raised as an area of concern. It was established that on many occasions the scope of works put forward in the initial planning stages would be altered even up until the day of the possession. Late changes create problems in regards to staff rosters, travel arrangements, staff accommodation and stabilising and transfer arrangements for track vehicles. This has the potential to create fatigue issues and operational issues in respect to the transfer of the track vehicles when the possession is due to be returned to traffic. Self-imposed time restraints from the track vehicle operators perspective can also be an issue when the scope of works are unachievable. Late changes also result in errors in Special Train Notices (see section 5.13).

8.12 Self imposed time-restraints

The work on the day of the incident was running overtime and there was pressure on employees to complete the works and restore the lines to traffic. Investigations revealed that had the incident not occurred the possession would have been handed back to traffic about 60 minutes after the advertised finishing time for the LPA. Self-imposed time restraints have the potential to create an unsafe environment. Accidents often occur towards the end of a long shift when fatigue is most likely and employees are hurrying to finish (eg hand the track back to traffic)

8.13 Speed of the track vehicles

The track vehicles were not fitted with data loggers and as such it is not possible to determine the speed the vehicles were travelling at the time of the incident. Prior to the consists departing Branxton in convoy the traffic officer in TJ095 was asked by the operator of TJ095 what speed he should travel through the possession, the traffic officer stated he told him 25kph or less. The traffic officer and the operator on M437 did not discuss the speed to be travelled through the possession. The operator of M437 stated that after shunting at Branxton the RIC consist was 2 or 3 kilometres ahead and he travelled at 30kph - 35kph to reduce the distance between the two consists. He stated that after a period of time the distance between the two consists was reduced to 400m - 500m and this distance was maintained for several kilometres.
The Track Australia consist then closed up the distance between the two consist when approaching Lochinvar level crossing.

The collision impact pushed the RIC consist forward 19.7 metres. Based on the required deceleration rate for track vehicles the operator of M437 would not have made his full brake application until he was only a very short distance from the rear vehicle of the RIC consist. This is taking into consideration the evidence that the RIC consist was pushed forward 19.7 metres on impact.

RIC’s RSU 712 requires that all track vehicles have a deceleration rate of 1.1 to 1.4 m/s². It should be noted that the track at Lochinvar had a 1 in 100 falling grade towards Sydney and with the coupled consist the stopping distances would be slightly greater than those shown in the table below.

---

**Stopping Distance in metres**

---

<table>
<thead>
<tr>
<th>Distance m</th>
<th>Speed km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>150</td>
<td>40</td>
</tr>
<tr>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>60</td>
</tr>
</tbody>
</table>

---

**Stopping distance in**

- m as=-1.4m/s²
- m as=-1.1m/s²

---

8.13.1 Braking performance of Track Australia consist – results from manufacturer

The stopping distance of M437 on its own from 80kph is approx 270m on level track. This takes into account, operator reaction time, and brake system application time. The brake system application time, is the time taken for the braking system to fully pressurise and equalise. Until the pressure is equalised across the entire machine consist, little meaningful deceleration is achieved. It also assumes no skidding of the wheels, with the ideal wheel/rail interface. When the 4 machines (M437 - 440) are coupled together as in this incident the brake system application time is considerably longer (approximately 3 seconds) resulting in a significantly increased stopping distance. This is due to the fact the time taken for the braking system to fully activate occurs at maximum speed. Once the braking system has fully pressurised and equalised, the target deceleration rate is achieved.

8.14 Route knowledge

Track vehicle operators need sufficient route knowledge to know the safe working sections so that they can identify the limits of their authority and in multiple track areas to be able to identify which track they have been authorised to occupy. A knowledge of the signalling interlockings is important. When an operator is not familiar with the area over which the track vehicle is to operate the RIC Policy Manual states: “If at any time a driver or track vehicle operator feels that their knowledge of a route has lapsed relearning and competency assessment must be undertaken”. Both operators had worked in the Hunter region prior to the date of the incident however the RIC and Track Australia could not produce any records of training and competency assessment undertaken for the operators for route knowledge.

Both operators were accompanied by Sydney based traffic officers one of which stated he had worked in the region “between 5 to 10 times” prior to the date of the incident. The other traffic officer stated he had been undergoing training in “route knowledge” and “location of interlocking equipment” on 26 and 27 July just days before the incident. Prior to the 26 July he stated that he had not worked in the Hunter region for a period of “3 to 4 years”. Like the track vehicle operators no records could be produced to verify the training and assessment of competency for route knowledge for the traffic officers.
8.15 Track vehicle compliance – braking systems and capability to be hauled by a locomotive

The RIC and Track Australia consists were not compatible to be coupled together to run as one unit. This is due to differences in the braking systems and the drawbar limitations. Initial investigations into the specifications of the Track Australia track vehicles has revealed some limitations in their capability to be hauled by a locomotive and this essentially relates to the braking systems. All RIC 'heavy' track vehicles fitted with a standard auto-coupler have the Westinghouse train brake system fitted and can be locomotive hauled and the brakes can be operated throughout the consist.

The Track Australia vehicles do not have the Westinghouse train braking system fitted and there are restrictions in the method in which they can be hauled by a locomotive. This restriction requires an operator to be placed in the Track Australia vehicle and 'match trucks' to be placed between the locomotive and the Track Australia vehicle(s). A TOC Waiver is required to be issued to authorise the movement. These arrangements do not apply to the RIC relevant track vehicles shown in the TOC manual.

This also means that the Track Australia vehicles and the RIC vehicles have incompatible braking systems and they should not be coupled together to transfer in a convoy because the entire braking system cannot be operated from the lead vehicle. Drawbar limitations on either RIC or Track Australia vehicles also restrict this movement due to the weight of the vehicles.

RIC specifies the deceleration capability of braking systems fitted to all track vehicles on the RIC system. All RIC vehicles comply with a deceleration capability range of 1.1 – 1.4 m/s². The braking systems of the Track Australia vehicles have to and do comply with the same RIC standards.

8.16 Powering of the Track Australia consist in convoy

The details of the powering arrangements of the Track Australia consist identified that the operator in the Dynamic Stabiliser M438 could provide power to assist to operator of M437 when required. The Track Australia operator in M438 was asked if he had been powering at the time of the incident at he said he had not been applying power.

Track Australia advised that the vehicles are fitted with a mechanism which, if the brakes are applied in the lead vehicle M437, cuts out the power being applied from the rear vehicle M438.

When all of the Track Australia vehicles are coupled together to form one consist of machines, it is sometimes necessary for the operator of the trailing power vehicle (either M438 or M437) to apply power and assist the leading power vehicle (either M438 or M437). This most commonly occurs during moving the consist from a standing start and accelerating up to speed, or during hill climbing.

Both M437 and M438 vehicles are fitted with a system which will not allow both the power and brake to be used at the same time. Braking with the power still applied would greatly reduce the braking efficiency of the vehicle, and have a seriously catastrophic effect on the transmissions.

The braking system of both vehicles has a pressure sensor attached to the brake lines. This pressure sensor then outputs a signal to the PLC computer on board. If the brakes are applied and the brake pressure exceeds 1 bar, the PLC computer automatically cuts any power being applied to any vehicle. It does not matter where in the vehicle, or in fact from which vehicle the brakes have been applied from. Similarly, this is the same system and minimum 1 bar brake pressure which is used to activate the amber flashing lights which signal a brake application. Again it does not matter where in the vehicle, or in fact from which vehicle the brakes have been applied from.

8.17 Placement of worksite protection within possession areas

The investigation and on-site inspection on the day of the incident established that the RIC consist had stopped because they had struck worksite protection at Lochinvar. This protection was afforded 500m from the work being undertaken at Lochinvar however the protection was not clearly visible to the approaching vehicles. The required 3 detonators were in place however the red flag had been blown over in the wind and was lying in the 4-foot. It is the protection officer's responsibility to regularly check and maintain the intermediate worksite protection. His assessment and pre-work briefing should have identified the fact that it was a windy day and a more satisfactory method of securing / displaying the red flag should have been adopted. This investigation has identified a need for the RIC to develop and implement a more visible
warning system to alert track vehicle operators and work train drivers that they are approaching the protection for an intermediate worksite within a possession area.

8.18 Service of track maintenance vehicles

Initial examination of the documents provided by the RIC and Track Australia indicate that all vehicles had been serviced accordingly. The evidence showed the vehicles were serviced regularly.

Service & Repairs:

Each and every day a “Daily Plant Checklist is completed for all machines. Items on this checklist are;

- Service brake
- Park / Emergency brake
- Compulsory signs
- Auto coupling / connections
- Guards / covers
- Environmental spill kit
- Daily checklist in machine
- Attachments / tools
- Air conditioning
- Lights & reflectors
- Amber beacons
- Windscreens & windows
- Windscreen wipers
- Horn
- Seats
- Controls

In conjunction with this checklist is a list of activities to be carried out prior to starting and moving the machines. Servicing of the braking system is carried out on an as required basis. This is determined by qualified plant mechanics from the daily checks, weekly checks and detailed monthly examinations that are carried out. Drive system fluids are changed every 12 months, with engine fluids changed every 200 hours. For machines that are set up for consist travel, these machines are coupled together and the train brakes tested prior to the consist leaving the siding by the operators.

With regard to servicing of the braking systems, apart from the normal checks and adjustments carried out by the trade-staff, a 3 monthly safety inspection is carried out usually by the plant supervisor. This entails a check on the adjustment, operation and pressure settings of the brake system including the train brakes. For Every 12-months a single car brake test is carried out by the plant supervisor or a competent person in train braking systems to certify that the brake system is in working order. For the RIC these inspections are documented in the MIMS system and stored in the track vehicle files.

9.0 Findings

✓ 1. The operator of M437 was unable to stop his consist from colliding with the RIC consist when the RIC consist stopped ahead to lift worksite protection.

✓ 2. The operator of the Track Australia consist was not made aware of the presence of any worksites between Branxton and Maitland.

3. Communications systems fitted to track vehicles. The radios fitted and used in the track vehicles involved in the incident were less than adequate. They were open channel UHF CB radios that do not provide discreet radio communications between track vehicle operators.

✓ 4. The Pre-Work Briefings did not consider the ‘hazard’ of a collision between track vehicles. The potential for a collision between track vehicles was not considered in the risk assessment. This is a training issue in respect to risk management for traffic officers and track vehicle operators.

✓ 5. Safeworking Rules. The current rules state: “If travelling as a convoy, track vehicles must travel as closely as safely practicable”. The expectations placed upon each operator to continually travel “as
closely as safely practicable" are unrealistic. The probability factor of human error is not genuinely considered. There are no additional safeguards for a lapse / slip on behalf of the operator. More rigorous rules should be considered to separate track vehicles, particularly the heavy vehicles.

6. There were no Safeworking Procedures in place for track vehicles (transferring track vehicles) at the time of the incident.

7. Planning of safe movement of track maintenance vehicles. The investigation identified a need for better planning of track vehicle movements inside possession areas. When planning track vehicle movements consideration should be given to separating track vehicles, which cannot be coupled to run as one unit, by a greater distance to reduce the potential for collision rather than allowing them to travel closely. As the work schedules for track vehicles working inside possessions changes depending upon many variables it is important that the movement (transfer) of the vehicles, particularly when travelling in 'convoy', be properly planned. The introduction of engineering 'super possessions' has also created possession areas which extend for long distances and this has increased the potential for human error due to the increase in people, plant, work trains and machinery which have to be managed.

8. Self-imposed time restraints also have the potential to create an unsafe environment. The work on the day of the incident was running overtime and there was pressure on employees to complete the works and restore the lines to traffic.

9. Fatigue Management. Fatigue, as a contributing factor to this incident could not be categorically dismissed, due to the many factors that cause fatigue, not least being the unknown factors of an individuals behaviour outside of work time.

10. The worksite protection placed at Lochinvar (500m on the country side) was placed in such a way that the red flag was not properly supported to prevent it being blown over. On the day of the incident the weather was windy and the flag was blown over and laying in the 4-foot. This made the protection difficult to see for the approaching track vehicles. It is the protection officer's responsibility to regularly check and maintain the intermediate worksite protection. His assessment and pre-work briefing should have identified the fact that it was a windy day and a more satisfactory method of securing / displaying the red flag should have been adopted.

11. Environmental factors. A site inspection was carried out on Thursday 21 August at the site of the incident by the investigation panel. The line of sight for the track vehicles travelling on the Down Main line at Lochinvar on the day of the incident was found to be reduced due to a large shrub which is growing in the cess of the Down Main line on the curve.

12. Certification of the track vehicles to operate as a train. In order to properly manage the movement of heavy track vehicles outside of possession areas the RIC should progress the certification of suitable vehicles to operate track circuits. The track vehicles involved in this incident are not certified to operate track circuits.

13. Diesel hauling vehicles when possible. When track vehicles are required to work at locations which would require them to travel in convoy, particularly over long distances, the vehicles should be diesel hauled whenever possible. This is subject to rolling stock requirements.

14. Special Train Notices and changes to scope of works. The investigation identified a series of errors in STN 1350 and STN 1434. The investigation established that between the time that the STN is drafted and the actual possession date, the scope of works for the movement of the track vehicles changed. The poor quality control of Special Train Notices has been highlighted in previous investigations the most recent being at Blacktown on 31 May 2003.

15. An analysis of previous track vehicle collisions revealed that some Judgements of Need (Safety Actions) had not been implemented or had only partially been implemented.

16. Records of competency based training and assessment in route knowledge for track vehicle operators and traffic officers. The investigation discovered that there existed no formal process for recording the details of competency based training and assessment in route knowledge for track vehicle operators and traffic officers.
10.0 Appendix A

10.1 Introduction – applying the Reason\textsuperscript{16} model to this investigation

Both the individual (employee) and the management systems are examined in this investigation.

This investigation will analyse accident causation in terms of latent conditions and active errors. Latent conditions arise from flaws in management systems, such as planning, training, engineering or maintenance planning. Active errors arise from individual actions.

Errors are a significant contributing factor in almost all incidents, however Reason argues that human error is a consequence rather than a cause, and should be the starting point for further investigation rather than the end of the search for incident or accident causes.

Reason describes this concept thus; "Rather than being the main instigators of an accident, operators tend to be inheritors of pathogens' created by poor design, incorrect installation, faulty maintenance, inadequate procedures and management decisions and the like. The operators part is usually that of adding the final garnish to a lethal brew that has been cooking. In short: unsafe acts in the 'frontline' stem in large measure from bad decisions made by the rear echelons".

For the purposes of this investigation the management system is defined as the safeworking, engineering and management activities that were required to deliver fit for purpose people, equipment/materials, methods, and the physical and supervisory environment for carrying out works within the RIC network.

10.2 Avoiding the "Quick Fix" Trap

An outdated mentality that affects some organisations is a tendency to focus on the individual and apportion blame on the performance of the individual rather than investigate the systemic failures or root causes of the incident. The "quick fix" is a condition which demonstrates a fundamental failure of an organisation to manage its risks.

A 'quick fix', such as simply recommending additional training or taking disciplinary action against individuals, may change behaviour for a short time however the unsafe work practices of the individual will re-appear unless the underlying systemic failures are identified and corrected.

More than just focus on employee performance, it is important to identify and assess the systemic and organisational factors that shape employee performance.

\textsuperscript{17} A simple "fix-the-operator" approach to human performance neglects the reality and influence of other systemic contributors. To have a sustained effect on individual performance, the human factors programs must also address the organisational structures and processes that affect attitude, behaviour, and culture. Corrections to errors or employee performance deficiencies too often focus on individual or crew (employee) remediation (punishment or additional training). Administering discipline or training the individual or crew is usually the quickest, easiest, and most familiar response to a deficiency. It is acknowledged that while there are times when discipline and/or training may be the correct response to an employee performance deficiency, an accident, or incident, too often these "quick fixes" are used as bandages that do not correct the systemic or root causes of the problem. It does very little good to spend a lot of effort building "training vaccinations" or sending memos to change individual performance without considering the departmental and organisational components that contribute to individual performance.

One of the examples of a quick fix is the use of a circular or other such document to correct employee behaviour and work practices rather than investigate and determine why the correct method of working was circumvented in the first instance. This is where systemic failures are most prevalent.

\textsuperscript{16} Professor James Reason, Department of Psychology, University of Manchester England.
\textsuperscript{17} Extract from "Avoiding the quick fix trap" by Vince Mancuso, Ph.D. Delta Airlines Manager, Corporate Human Factors. November 1995, 48\textsuperscript{th} Annual Flight Safety Foundation Conference in Seattle Washington.

Completed Report. File No.03R/03952
10.3 Active failures and latent failures – an overview

Active failures are "unsafe acts" (errors or violations) caused by operators that become immediately apparent to an observer. It is these "human performance deficiencies" (as mentioned above) which often become the key focus of an investigation. \(^{18}\)Latent failures are decisions whose adverse consequences may lie dormant within the system for a long time, only becoming evident when they combine with other factors to cause an incident/accident. Latent failures extend to supervisors and other organisational factors - people generally far removed from the actual occurrence of the incident/accident.

Slip/Lapses are active errors which involve unintentional deviation from expected behaviour due to typical human fallibility such as lack of attentiveness, distraction or forgetfulness. Mistakes are also unintentional active errors; in this case due to decisions where the individual has selected the wrong action based on incorrect information or inadequate competency.

\(^{19}\)Violations are intentional deviations from expected and known requirements. Often these are culturally influenced. In other words the rule or procedure involved is often compromised as part of the accepted local "set of unwritten rules". Sometimes a violation error is a deliberate, deviant behaviour that the culture would not support.

\(^{18}\) Captain Aldo Carlo Perzopane (retired).
\(^{19}\) Jim Jay. BSc MSc University of Queensland. System Safety Accident Investigations in the mining industry.

Completed Report. File No.038/0952 31
11.0 Safety Actions

11.1 Safety Action No.1

General Issue
Administrative controls for the management of track maintenance vehicles.

Safety Action
There is a need to review the requirements shown in Network Rule NWT 316 and Network Procedure NPR-748. Heavy track vehicles should not be permitted to follow each other closely and should be separated. An appropriate method of working track vehicles in convoys both inside and outside possession areas should be developed. See also Safety Action No.3. The RIC could combine and progress this Safety Action with Safety Action No.3.

Discussion of findings
The current Safeworking Rule NWT-316 states: "If travelling as a convoy, track vehicles must travel as closely as safely practicable". The expectations placed upon each operator to continually travel "as closely as safely practicable" are unrealistic. The probability factor of human error is not genuinely considered. There are no additional safeguards for a lapse / slip on behalf of the operator. More rigorous rules, and procedures, should be considered to separate track vehicles, particularly heavy track vehicles.

Two trains are not permitted (justifiably) to travel in the same section / block. However the evolution of track vehicle technology has seen vehicles built which weigh more than a locomotive and any number of these track vehicles can currently be transferred in the same section / block running "as closely as safely practicable".

The investigation identified that the RIC, at the time of the incident, did not have any safeworking procedures for the management of track vehicles and had not had any since the abolition of the 900 series safeworking manual on 4 November 2001. NPR-748 Transferring Track Vehicles was introduced on 21 September 2003.
11.2 Safety Action No.2

<table>
<thead>
<tr>
<th>General Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering controls for the management of track maintenance vehicles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a need to consider the development and installation of an engineering device for track vehicles which facilitates the transfer of track vehicles in convoy both inside and outside possession areas. The device would provide the track vehicle operator with details of the location of the other vehicle(s) in the convoy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current fleet of track maintenance vehicles are not equipped with any device to warn operators of the distance between vehicles travelling in convoy. An investigation into a track vehicle collision at Yass made a recommendation for an engineering control, proximity sensors. The recommendation was shown on 12/08/2002 as ‘completed’ yet no engineering control was ever developed or implemented. A report from the RIC Safety Division to explain the recommendation being ‘completed’ stated: Recommendation - Review the possibility of track machines being equipped with sensor alarms when approaching other machines. 12/8/02 - Completed. The risk will be mitigated by coupling of machinery. The feasibility of sensor alarms was reviewed with RIC Mechanical &amp; Rolling Stock Assurance and SRA Passenger Fleet. Both groups agree that proximity or sensor alarms are possible but no workable solution has been found for rolling stock.</td>
</tr>
<tr>
<td>The statement that the risk of collision will be mitigated by coupling machinery was demonstrated as being totally ineffective with the Lochinvar collision because two separate consists were travelling in convoy in the same section. It is not acceptable to accept that technology does not exist to develop and install an appropriate engineering control to assist in the prevention of track vehicle collisions.</td>
</tr>
</tbody>
</table>
11.3 Safety Action No.3

<table>
<thead>
<tr>
<th>General Issue</th>
<th>Track Vehicle Operators Handbook</th>
</tr>
</thead>
</table>

| Safety Action          | The RIC should develop a Track Vehicle Operators Handbook. |

Discussion of findings

The investigation found the current rules and procedures do not contain sufficient information for track vehicle operators. Track vehicles have evolved to a stage where performance and weight characteristics are similar to that of a train. The number of heavy track vehicles has increased and will increase further as new machinery is manufactured and brought into use. The rules and procedures for the operation of track vehicles must reflect the fact that many track vehicles are like trains and they should not be moved through the network as though they were small pieces of plant.

Currently a track vehicle operator is required to have a copy of the Safeworking Rules, and Copy of the Safeworking Procedures, a copy of the RIC Safety Manual, and the Train Operating Conditions Manual (which contains general instruction pages for track vehicles). Much of this information, and more, could be incorporated into a track vehicle operator’s handbook. See also section 8.1.2.

The handbook should include appropriate procedures to cover routine operations such as:
- travelling in convoys inside and outside possession areas
- traversing road or pedestrian level crossings
- Placing track vehicles and hi-rails on the line
- working through and crossing trains at attended and unattended interlockings
- removing track vehicles from the section in emergencies
- protecting track vehicles in emergencies
- route knowledge requirements
- equipment to be carried on track vehicles
- security of track vehicles left unattended or not in use
- Precautions for passing through worksites
- Passing fixed signals
11.4 Safety Action No.4

**General Issue**
Safety Briefings for track vehicle operations. Safety briefings need to include all aspects of work carried out during the shift including the transfer of track vehicles in convoy.

**Safety Action**
There is a need carry out a documented education campaign for all track vehicle operators in the area of risk assessment for all works undertaken during their shift. This includes the transfer of track vehicles in convoy within the possession area and to and from possessions and other locations within the network. A system should be considered for two types of safety briefing:
- Travelling to and from possessions, and locations, to other locations within the network
- Travelling within the parameters of an engineering possession

**Discussion of findings**
The teams involved in the Lochinvar collision did not consider the risk of collision during their safety briefing(s). They did not consider the risks associated with travelling in convoy after the works were completed and thus did not include any 'controls' in their safety briefing to manage such a risk.

The operator of the Track Australia consist was not advised of the location of worksites between Branxton and Maitland. The investigation established that in general track vehicle operators did not undertake a pre-work briefing before transferring track vehicles in convoy either inside or outside possession areas.

The RIC Safety Manual instructs employees that site-specific pre-work briefings must be held before the commencement of each shift and when work conditions change. Therefore before travelling to a worksite, or other location, a safety briefing must be carried out. A safety briefing is then carried out for the specific work undertaken. When the work group completes work at a site and they are required to transfer the track vehicles through the possession area, then the work conditions have changed once again. The new hazards that arise may be potential collision when travelling in convoy, passing through worksites, and travelling over level crossings. A safety briefing is therefore required before the track vehicles again transfer. Once a work group leaves the limits of an LPA the environment (work conditions) changes again.

In summary, aside from managing safety briefings inside possession areas there is also the obvious hazards associated with transferring track vehicles outside possession areas, when the track vehicles are travelling on 'live lines'. An example of this would be transferring track vehicles from Clyde to Broadmeadow. The operators must carry out a safety briefing to identify the hazards and controls for those hazards.
11.5 Safety Action No.5

<table>
<thead>
<tr>
<th>General Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio communication systems fitted to track maintenance vehicles. Open channel UHF radios should not be used to exchange safety critical information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>All track maintenance vehicles should be equipped with discreet channel GRN radios. Until all track vehicles are fitted with a permanent GRN radio the Operator must be supplied with a hand-held GRN radio. All exchanges of safety critical information must be made via the GRN radio or, if equipped, the MetroNet/CountryNet radio system when the vehicles are compatible.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>The track vehicles involved in the collision at Lochinvar were not equipped with GRN radios and the operators were using open channel UHF CB radios (channel 28) to exchange safety critical information. Any person with a CB radio tuned in to channel 28 could hear all the conversations between the two teams and speak over the top of them. Interference from external sources was reported on the day of the collision.</td>
</tr>
<tr>
<td>Open channel UHF radios are not suitable to use for the exchange of safety critical information. Open channel UHF radios are not used by train drivers to exchange safety critical information and likewise track vehicle operators should not be expected to use open channel UHF radios.</td>
</tr>
</tbody>
</table>
11.6 **Safety Action No.6**

<table>
<thead>
<tr>
<th>General Issue</th>
<th>Planning for works - setting achievable scopes of works and not changing the scope of works or adding additional scope of works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Action</td>
<td>A review should be undertaken on the current planning processes for determining the scope of works for track maintenance vehicles. Unrealistic scope of works and late changes to scope of works create foreseeable, and preventable, operational pressures. A cut-off date should be introduced to avoid late changes and additions to the scope of works for engineering possessions.</td>
</tr>
<tr>
<td>Discussion of findings</td>
<td>Inadequate planning results in unachievable scope of works, changes to rosters for staff, and alterations to tabled working set down in Special Train Notices for the transfer of track vehicles. Unachievable scopes of work result in self-imposed time restraints because operators work late and this results in a 'rush' to clear the possession area so that the LPA can be fulfilled and the lines can be returned to traffic. Better planning would lead to far less operational problems during the possession.</td>
</tr>
</tbody>
</table>
### 11.7 Safety Action No.7

<table>
<thead>
<tr>
<th><strong>General Issue</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning for track vehicle movements working and transferring inside the possession area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Safety Action</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The working and transfer of track vehicles inside the possession area should be planned and included in the Project Safety Management Plan - Work Management Plan. During possessions the Possession Protection Officer should approve all transfer movements through the possession area.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Discussion of findings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The investigation discovered that the track vehicles did not transfer from the section as was initially planned. When planning track vehicle movements consideration should be given to separating track vehicles, which cannot be coupled to run as one unit, by a greater distance to reduce the potential for collision rather than allowing them to travel closely. As the work schedules for track vehicles working inside possessions can change depending upon many variables it is important that the movement (transfer) of the vehicles, particularly when travelling in 'convoy', be properly planned and approved. The introduction of engineering 'super possessions' has also created possession areas which extend for long distances and this has increased the potential for human error due to the increase in people, plant, work trains and machinery which have to be managed.</td>
</tr>
</tbody>
</table>
### 11.8 Safety Action No.8

#### General Issue
Certifying heavy track vehicles to operate as a train

#### Safety Action
To properly manage the movement of heavy track vehicles outside of possession areas the RIC should progress the certification of suitable vehicles to operate track circuits. The track vehicles (tamper) involved in the Lochinvar collision are suitable but not yet certified to operate track circuits.

#### Discussion of findings
The investigation established that the heavy track vehicles involved in the Lochinvar collision have been used to shunt test track circuiting following engineering works (eg replacement of rail, points). This is done to see if the track circuit operates correctly and also to clean rust from the rail-head. It is done for convenience when the vehicles are available and no locomotive is easily available. The Tamper TJ095 weighs 135 tonnes, the Tamper M437 weighs 77 tonnes. Moving track vehicles via the signalling system is the most efficient and safe method of working.

The combined weight of the two track vehicle consists were 169 tonnes (Track Australia) and 233.5 tonnes (RIC).
11.9 Safety Action No.9

General Issue
Fatigue management – track vehicle operator rosters

Safety Action
The RIC should examine the current rostering arrangements for track vehicle operators and ensure that employees do not work excessive hours and the break between shifts is adequate. This should apply to all track vehicle operators working on the RIC network, employee or contractor.

Discussion of findings
The guidelines used by rostering staff for fatigue is to ensure that an individual staff members fatigue score does not exceed 100 points for any given shift. If the score is above 100, the rostering staff are to adjust the roster to ensure a score below 100 is achieved. Otherwise, a thorough Risk Assessment is to be undertaken by the Team Manager to manage the high fatigue risk.

On one occasion in the RIC TVO’s roster the Fatigue score exceeded 100 points (103.4 on the 17th July). This was the last day of seven straight working days, the last two days being night shift after five day shifts. On the day of the collision, the fatigue score was 88.4 points. Although this is below the threshold limit of 100 the scores have increased steadily over the previous days from 36.9 on 26th July, nearing the 100-point threshold on the day of the incident.

On 29 July the Track Australia operator started work at 0800 hrs and worked through until 2000 hrs that evening, a total of 12 hours. He resumed work the following morning at 0400 hrs, a break of 8 hours. The operator stated in interview that he drove himself to and from work in a company provided vehicle. The Track Australia rostering arrangements include travel time to and from the place of accommodation and this is built into the shift times shown on page 23. On 30 July it was a little over 8-hours into the shift when the collision occurred.

Fatigue, as a contributing factor to this incident could not be categorically dismissed. The possibility of a micro-sleep was also considered and could not be dismissed.

The rosters, which included all overtime shifts worked in this period as well as changed from day work to night work and back again, could be considered hazardous, and further analysis may be required particularly in regards to the 100 point threshold. It has been noted that many industries have a threshold of 80 points.

The RIC Rostering and Fatigue Management Policy (Version 1.0, 29 April 2003) provides roster guidelines and indicates the minimum break between shifts to be 11 hours. Whilst Track Australia employees work to a different EBA it is recommended that for the purposes of maintaining safety throughout the system the Track Australia employees should adopt the 11 hour minimum break between shifts in line with the RIC Fatigue Management Policy.
11.10 Safety Action No.10

<table>
<thead>
<tr>
<th>General Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line of sight obstructions on running lines — trees and foliage effecting the view of track and signals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The RIC inspect running lines and identify and remove trees which reduce a track vehicle operators (drivers) view of the line. This should also be done with consideration for vehicles travelling in the wrong-running direction as they do in engineering possessions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>The weather at the time of the incident was cool, clear and dry. Visibility was excellent. The weather conditions did not contribute to the incident outcome. The location of a large shrub on the curve of the Down Main line at Lochinvar was identified as a contributing factor to the incident.</td>
</tr>
<tr>
<td>The presence of the shrub has reduced the line-of-sight for vehicles travelling in either direction but more so for vehicles travelling in an Up direction over the Down Main line. A sight inspection on 21 August determined that the line-of-sight for the track vehicle operators on 30 July would have been increased by between 100 – 140 metres if the shrub was removed.</td>
</tr>
</tbody>
</table>
11.11 Safety Action No.11

General Issue
Intermediate Worksite protection – multiple worksites located within engineering possessions

Safety Action
The investigation has identified a need for the RIC to develop and implement a more visible warning system to alert track vehicle operators and work train drivers that they are approaching the protection for an intermediate worksite within a possession area. The current method of a red flag (often jammed into the ballast) and 3 detonators is less than adequate. A high-visibility sign placed in the four-foot including details of the worksite and the contact details of the protection officer should be a minimum standard. The sign should have the capacity to display red flags and lights.

Discussion of findings
The investigation and on-site inspection on the day of the incident established that the RIC consist had stopped suddenly because they had struck worksite protection at Lochinvar. The traffic officer in T3095 had been advised that there was a worksite at Lochinvar however as the previous worksite he had been warned about (Greta) had finished he thought the same may have applied to the Lochinvar worksite. However the worksite protection was not visible until they were almost upon it. The protection was afforded 500m from the work being undertaken at Lochinvar however the protection was not clearly visible to the approaching vehicles, the required 3 detonators were in place but the red flag had been blown over in the wind and was laying in the 4-foot.

It is the protection officer’s responsibility to regularly check and maintain the intermediate worksite protection. His assessment and pre-work briefing should have identified the fact that it was a windy day and a more satisfactory method of securing / displaying the red flag should have been adopted.

Taking into consideration the chain of events as they unfolded on the day of the incident a high visibility sign, and an unrestricted line-of-sight, may have provided the operator of T3095 with a timely warning that there was a worksite ahead.

---

20 See Safety Action No.10.
11.12 Safety Action No.12

General Issue
Quality control of Special Train Notices – State Rail Authority and Rail Infrastructure Corporation

Safety Action
The RIC and the SRA form a working party to review the current processes for the compilation of Special Train Notices (STN) and Tables Telegrams. The focus should be on quality control and ensuring the safety critical information contained in the documents is clear and concise. The current format of the documents should also be examined in respect to the readability of the documents to the average employee who may not be experienced. A monitoring system should be introduced to ensure the STN’s meet the required standard, with feedback from employees who are required to use the STN’s.

Discussion of findings
Whilst the STN(s) was not considered to be a direct or contributing cause to the actual incident the investigation identified errors on the STN’s published for the engineering possession. These errors demonstrated a lack of quality control. STN’s are safety critical documents and errors or omissions in these documents can create confusion and lead to operator error.

An examination of the STN’s showed that there were a number of errors on STN 1350-2003 some of which were amended by Tables Telegram 409-03V. Errors in Tables Telegram 409-03V were also made and required amendment with Tables Telegram 660-03GM. Errors were also obvious in STN 1434-2003 but these errors were not amended by a Tables Telegram and the document was circulated for use with the engineering possession.

STN 1434 showed the works program and details of track machine transfers. The STN contained numerous errors in respect to the movement of the track vehicle teams. Consist numbers were incorrect and the transfer times shown in STN 1434 did not match the advertised possession times shown in STN 1350. Errors and subsequent amendment documentation issued just prior to the possession only serves to further confuse employees. The quality and accuracy of STN’s was recently highlighted in a Level 2 investigation into an incident at Blacktown on 31 May 2003. In that incident the STN was identified as a contributing factor in the incident.
11.13 Safety Action No.13

**General Issue**

Key recommendations from previous investigations into track vehicle collisions not implemented or only partially implement

**Safety Action**

The RIC and SRA conduct a joint audit of all recommendations (Judgements of Need / Safety Actions) arising from investigations conducted into previous track vehicle collisions. The audit should seek evidence of recommendations shown as completed, those not actioned, and those being ‘progressed’ and their status.

**Discussion of findings**

The RIC 21Track Machine Subcommittee (July 2002) made the following comments in the document summary:

“The sub-committee reviewed a total of 38 recommendations or judgements of need (JoNs) associated with these incident investigations. The sub-committee recommends actioning 26 of these JoNs. Furthermore, it recommends the introduction of a Track Vehicle Operator’s Handbook and associated training”.

The sub-committee identified a need for more robust rules and procedures for track vehicles however the recommended safety action of the introduction of a Track Vehicle Operators Handbook was not carried through. This investigation found the RIC Safeworking section subsequently had the recommendation removed on the argument that the Network Rules & Procedures (amended) to take effect from 21 September 2003 would be adequate in content and as such there would be no need to develop and introduce the Track Vehicle Operators Handbook. The sub-committee recommendations were released in July 2002 and it was 14 months before amendments were introduced for NWT-316 and the release of NPR-748 ‘Transferring Track Vehicles’ on 21 September 2003.

A recommendation for the installation of ‘proximity sensors’ was shown on 12/08/2002 as ‘completed’ yet no engineering control was ever developed or implemented. A report from the RIC Safety Division to explain the recommendation being ‘completed’ stated:

*Recommendation - Review the possibility of track machines being equipped with sensor alarms when approaching other machines. 12/8/02 - Completed. The risk will be mitigated by coupling of machinery. The feasibility of sensor alarms was reviewed with RIC Mechanical & Rolling Stock Assurance and SRA Passenger Fleet. Both groups agree that proximity or sensor alarms are possible but no workable solution has been found for rolling stock. The statement that the risk of collision will be mitigated by coupling machinery was demonstrated as being totally ineffective with the Lochinvar collision because two separate consists were travelling in convoy in the same section. The evidence above and other reports reviewed provide adequate evidence that some safety actions are not properly completed or not actioned at all, or, drawn out over an unacceptable length of time.*

---

21 The Track Machines Sub-committee was a sub-committee of the Safety Action Committee. The following General Managers supported the sub-committee by providing senior and experienced staff to participate in the sub-committee and the commitment to implement the sub-committee’s recommendations –

GM Projects & Support
GM Engineering
GM Safety
GM Safeworking

The purpose of the sub-committee was to initiate the Corporation’s response to five investigations involving track machines. These incidents were: 17/04/01 Calwalla - Robertson, M671 track machine traversed the section without the correct authority. 05/04/01 Macksville - Eungai, track machine BX033 collided with rear of NRC freight train 4BW4. 14/08/01 Cowan - Hawkesbury River, track vehicle TJ 061 collided with rear of track vehicle BX 035 standing at signal HR129UM at stop. 16/02/02 Yass Junction, track machine BX052 collided with the rear of TJ 082 - vehicles travelling in convoy in heavy fog. 05/02/02 Nyngan to Cobar, collision between TJ 066 and TJ063 track machines due to a residual amount of hydraulic oil left from a broken hydraulic hose.
11.14 Safety Action No.14

<table>
<thead>
<tr>
<th>General Issue</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Safety Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a need to introduce a formal combined post-incident management meeting process to discuss the way in which an incident, such as Lochinvar, was managed and to suggest improvements where required. The meeting should be arranged by the General Manager Safety and include respective GM’s, senior managers, and relevant personnel in attendance on the day of the incident.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>There were issues which were identified in this investigation relating to the decision-making processes for worksite protection and restoration. Although it was not made apparent on the day of the incident and not discovered until some time afterwards, the train controller failed to comply with safeworking rules and procedures by not allowing the issue of a ‘work-on-track-authority’ for the rerailing operations. There was also a considerable delay (about 90”) in the commencement of rerailing operations due to the RIC Incident Support Manager (not on site) being indecisive over whether or not to call Workcover to attend. Advice provided by senior RIC managers at the scene suggested that Workcover be advised to attend as the incident was considered by them to be a ‘non-disturbance occurrence’. Eventually the RIC senior managers at the scene decided to call Workcover themselves and requested an Inspector attend so Workcover could investigate and rerailing operations could be progressed. Rerailing operations commenced at 1631 hours as soon as the Workcover Inspector completed on-site investigations.</td>
</tr>
</tbody>
</table>
### 11.15 Safety Action No.15

#### General Issue

Competency based training and assessment and records of competency based training and assessment in route knowledge for track vehicle operators and traffic officers.

#### Safety Action

The RIC and the SRA should ensure that all track vehicle operators (TVO's) and traffic officers (TO's) are competently trained and assessed for their route knowledge by a certified trainer & assessor and a suitable records keeping system must be maintained by management. The system should record the locations, lines and interlockings, where a track vehicle operator or traffic officer has been certified and assessed as competent. Consideration should be given to reviewing the current timeframes for re-assessment as shown in the RIC Safeworking Policy Manual as they are considered excessive.

#### Discussion of Findings

The investigation discovered that there existed no formal process for recording the details of competency based training and assessment in route knowledge for track vehicle operators and traffic officers. No records could be provided by management to show the lines / interlockings over which the track vehicle operators or traffic officers had been certified and assessed as competent or who carried out the training and assessment.

**Date:** 10 October 2003

---

33 The RIC should ensure that this standard is progressed through all other organisations who supply track vehicles

35 Track vehicle operators qualified in signal recognition, currently referred to as TVO class 2.

36 Qualified worker certified in the relevant system of safeworking. Both the RIC and the SRA have their own teams of such persons who are still referred to throughout the network as ‘Traffic Officers’. 
**Lochinvar 30 July 2003. Track vehicle collision between Track Australia and RIC**

**1139 hrs.** The RIC and TA consists entered the Branxton interlocking by mutual arrangement via Up & Down Main lines.

**1145 hrs.** RIC consist departed Branxton, TA consist followed several minutes later. Both consisted travelled in the Up direction over the Down Main line.

**1150 - 1210 hrs.** The two teams ran in convoy with 400m - 500m separation. They communicated via UHF open channel CB radio.

**1210 hrs. (approx).** The RIC operator informed the TA operator that he would be slowing down for the upcoming level x-ing at Lochinvar. TA operator responded.

**1215 hrs.** RIC consist stopped to lift worksite protection and TA consist collided with rear of RIC consist.

**The two consists each have a RIC Traffic Officer to manage safeworking arrangements. These officers confer with the PPO.**

**The two operators exchange information on progress using the half-KM pegs on the Down side to plot progress.**

**Notification!**

**1215 hrs.** Traffic officer with RIC consist calls PPO who in turn calls train controller. Emergency services sent to attend.

---

**Key:**
- RIC = Rail Infrastructure Corporation.
- TA = Track Australia.
- PO = Protection Officer.
- PPO = Possession Protection Officer.