ATSB
Australian Transport Safety Bureau

AUSTRALIAN TRANSPORT SAFETY BUREAU

RAIL INVESTIGATION REPORT

Collision between suburban electric passenger train 6369 and the empty express electric train 6371

Footscray, Victoria
5 June 2001

COMMONWEALTH DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

Department of Transport and Regional Services

Australian Transport Safety Bureau

RAIL INVESTIGATION REPORT

Collision between suburban electric passenger train 6369 and the empty express electric train 6371 Footscray, Victoria

5 June 2001

ISBN 1 877071 01 3 November 2001

This report was produced by the Australian Transport Safety Bureau (ATSB), PO Box 967, Civic Square ACT 2608.

CONTENTS

Terms of Reference

The Victorian Minister for Transport, the Hon Peter Batchelor, requested the Australian Transport Safety Bureau (ATSB) to undertake an independent investigation into the rear-end collision between an empty suburban train and a suburban passenger train at Footscray Station on 5 June 2001. The investigation was conducted in accordance with the provisions of the Transport Act 1983 (Victoria) as amended.

The Investigation will examine all relevant matters including:

1. The events leading to the collision, including determination of the relative contribution of rolling stock, infrastructure and operating procedures.
2. Train maintenance systems.
3. Signal maintenance systems.
4. Training and re-training procedures for relevant staff.
5. Operating procedures and effectiveness of such procedures; and
6. Post collision emergency management arrangements and procedures.
7. Final report format to follow the model Draft AS Guidelines for rail safety investigations.

Executive Summary

An empty suburban electric express train collided with the back of a suburban passenger train at number 4 platform Footscray station just after 0828 on 5 June 2001. The passenger train had about 20 people on board.

The emergency services, including the Police, Fire and Ambulance services attended the scene. As both trains and the rail infrastructure were operated by Bayside Trains, a subsidiary of National Express, the National Express emergency plan was implemented.

The driver of the empty train suffered an injury to his left elbow. Two passengers were taken to hospital for observation but were released with no serious injury.

The evidence available to the investigation suggests strongly that the driver's performance was impaired by a medical condition leading to him being unable to recall events for a period of less than two minutes, between the Maribyrnong River bridge and the point of collision. The driver was taking a course of prescribed medication, which combined with the early start to his working day on the morning of the accident and a history of chronically disturbed sleep, may have resulted in a sleep period (apnoeic episode) while he was driving the train.

There are safeguards or defences to protect against such an eventuality. On this occasion the defences in place failed to prevent the accident. A number of defences were identified as being inadequate in terms of design or application.

The investigation established that the maintenance of the trains was not a factor in this accident. The signalling system and automatic train stop operated within their design criteria. The design criteria of the signal and train stop systems, however, were such that the system could not prevent the collision given the speed of the train involved.

Drivers of suburban trains are required to maintain a given pressure on either a hand or foot pedal 'pilot valve', often referred to as a 'dead-man's handle'. In the event of a driver becoming incapacitated for any reason, the relaxing, or increase of pressure on the pilot valve should automatically apply the train brakes. Examination of relevant literature shows that pilot valves can be intentionally or inadvertently circumvented. In certain circumstances, the foot pedal can be maintained at the correct pressure just by the weight of the lower leg, whether or not the driver is incapacitated. Recommendation 7, below, is made in the full understanding that alternative systems, such as vigilance controls, may not be as effective in a metropolitan rail system, given the density of traffic, the time gap between trains and the workload of train drivers.

The alertness and fitness of drivers to perform their duties is also a defence against accident. While the investigation did not identify any significant defect with driver training, it did find serious defects in the monitoring of driver's health and fitness to operate mass public transport vehicles. The report concludes that the driver of the express train, although experienced and skilled, should not, on medical grounds, have been permitted to drive.

The investigation established that there was a lack of communication and coordination between those responsible for driver management and health professionals. The health standards used to assess driver fitness were themselves deficient.

The report's recommendations are:

1. Medical standards should be reviewed and amended to:
    - better monitor drivers' health and ensure a full past history and current medication regime is recorded, including monitor self medication of over-the-counter and non prescription medication.
    - include an appropriate assessment of the current physiological and psychiatric status of all drivers to ensure operators have all relevant information on which to base an informed decision on driver fitness;
    - include a system to identify drivers 'at potential risk', with provision for monitoring ongoing fitness;
    - ensure that medical examination periods are strictly adhered to and drivers suspended if not holding current medical license;
    - require drivers to produce proof of medical fitness at any time;
    - create an audit system that will allow confirmation of compliance with such standards.
2. The medical examination procedures should be reviewed to manage any perception of a conflict of interest in the future medical fitness system and considers whether such examinations should be conducted by a panel of doctors appointed by, and responsible to, the Accreditation Authority.
3. Australian Standard, AS 4292 should be reviewed in respect of the monitoring of the health and fitness of rail safety staff.
4. The signalling system and overlap should be reviewed with a view to ensuring, to the extent practicable, that trains passing a signal at danger are stopped within a safe distance. In sections before a station this distance would ensure a train is brought to a halt before a possible collision with another train stopped at the station.
5. The anti-collision posts on motor cars on Com Eng trains should be further investigated to identify any deficiency in their design.
6. Rail accident response plans should be reviewed to provide procedures to ensure immediate safety of the track infrastructure, training for station staff at manned stations in immediate response procedures and rapid deployment of staff at unmanned stations.
7. The use of hand and foot pilot valves should be reviewed, given their limitations, to determine whether the system can be made more effective or whether an alternative, equivalent system might make a better safeguard.
8. The train system radio network should be reassessed for radio reliability.

Investigation Methodology

The purpose of this investigation was to enhance rail safety in the Melbourne Metropolitan network, first, by determining the sequence of events which led to the accident and second, by determining why those events occurred. Of particular importance was the need to understand what the accident revealed about the environment within which this particular rail operation was being conducted, and to identify deficiencies with the potential to adversely affect future safety.

The conduct and analysis of this accident was based on the Reason model[1] and the full report was written using the Australian Standard Guidelines for rail safety investigations

During the investigation, information was obtained and analysed from a number of sources, including:

- Visits to the accident site;
- Inspection and analysis of the rollingstock involved in the derailment;
- Recorded train and train control information;
- Track and rolling stock maintenance records, procedures and standards;
- The history of organisational and infrastructure changes associated with the accident site;
- Interviews with personnel directly associated with the accident;
- Interviews with management and safety personnel of organisations relevant to the accident; and
- A review of the driver medical assessment and management system.

The investigation team was assisted by, an independant transport medical specialist. In addition technical analysis and reports were provided from relevant experts on aspects of:

- Rolling stock construction and design;
- Brake systems and pilot valves;
- Signalling and infrastructure.

The investigation team acknowledges the full cooperation received from all parties to this investigation both, individuals and organisations.

1 REASON, J. 1990, *Human Error*, (Cambridge University Press: Cambridge)

1 INCIDENT DESCRIPTION AND FACTORS

1.1 Overview

Footscray Station is located where the Newport/Williamstown-Werribee line diverges from the St. Albans line, 5.6 km from Spencer Street Station. From the west bank of the Maribyrnong River to about 180 m from the eastern end of Footscray Station, at Hopkins Street overbridge, the rail track follows a left-hand curve. About 450 m of track leading into Footscray Station lies in a cutting. That part in the cutting approaching Footscray has a radius of 1200 m. The down[2] suburban line from Melbourne to Newport is the inside track of the four tracks. From the Hopkins Street overbridge there is a short 105 m section of straight track. In addition, about 72 m before the Footscray No. 4 platform, the track again curves to the left for about 240 m (radius 560m to 945 m), through the Footscray No. 4 platform, before a straight stretch of line through to Seddon.

The approach to Footscray Station from Melbourne is mostly in a cutting where the line ahead is obscured by the curvature of the track, the retaining wall on the inside of the cutting and partially obscured by vegetation. Drivers approaching Footscray are unable to see the rear of a six-car train in the platform until the Hopkins Street overbridge, about 160 m from the eastern end of No.4 platform.

FIGURE 1:
Aerial view of track between Maribyrnong River and Footscray Station

2 A 'down' line is used by trains travelling from the city to an outer station. An 'up' line is used by trains travelling from an outer station to the city.

1.2 Background

The collision of 5 June 2001 involved two suburban electric trains operating on the Melbourne Metropolitan network. The trains and infrastructure, including signalling and track, were all operated and maintained by Bayside Trains (NXB), a subsidiary of National Express, either directly or through contractors.

The collision occurred at Platform No. 4 at Footscray, a little after 0828 Eastern Standard Time[3]. The track on which the accident occurred is designated the 'down' 'Through Suburban' Line and carries all Melbourne-Newport line passenger trains.

Bayside suburban train operations include the City Loop-Werribee via Altona service. During the peak hours, and for most off-peak periods, this service is operated on a regular 20-minute frequency. An extra direct service to Werribee via the Geelong main line is provided in the evening peak. In the off-peak periods, and at weekends, the Williamstown line is operated as a Newport-Williamstown shuttle service with a connection with Werribee line trains at Newport. During weekday peak periods, this service is replaced by a direct Flinders Street-Williamstown service, mostly at 20-minute frequency.

In addition to NXB's suburban services, the line also carries V/Line commuter trains to Geelong and West Coast Railway Warrnambool passenger trains. The line is also used to carry a limited number of empty trains to the Newport Workshops. The line is not normally used by freight trains as these use the goods line via Tottenham.

The track between South Kensington, through Footscray to Werribee is not as intensively used as other parts of the Metropolitan rail system. The number of trains scheduled from South Kensington through Footscray on weekdays are:

Service	Number
Werribee via Altona link line	54
Werribee via Geelong Main Line	1
Williamstown	22
Empty cars to Werribee & Williamstown	2
Newport Workshops as required	3
V/Line Geelong & South Geelong	23
West Coast Rail, Warrnambool	3
Weekday total	108

Train 6369 forms the 0816 passenger-train service from platform No. 9, Flinders Street Station stopping at all stations to Williamstown, with a scheduled arrival of 0843. At Williamstown it forms train 6368, the 0850 return service to the City as train 6368.

Train 6371 leaves Flinders Street Station at 0818 as an empty, 'express' train to Williamstown, which is scheduled to follow train 6369 at an interval of two minutes to Franklin Street signal box and then at an interval of three minutes between North Melbourne to Newport.

3 All times mentioned in this report are Eastern Standard Time.

Train 6271 is a routine positioning operation to deploy trains for the commuter passenger demand, in this case to provide a train for the daytime Newport-Williamstown shuttle service. Train 6371 is held in the Newport-Williamtown section until 6368 departs Williamstown at 0850. At Williamtown train 6371 becomes train 6202, the 0900 service to Newport.

1.3 Sequence of Events

The morning of 5 June 2001 in the Melbourne Footscray area was fine, clear and dry.

Metrol[4] infrastructure records, which automatically record signal aspect times and also the occupation of line sections from the Position of Train System (POTS), enabled the investigation team to establish a relatively accurate picture of the position and speed of the two trains involved in this accident.

Train 6369, the 0816 Williamstown suburban passenger service, left platform No. 9, Flinders Street, Melbourne at 0816:32 and was due at Williamstown at 0843.

The train made scheduled stops at Spencer Street (0818:19), North Melbourne (0820:24) and South Kensington (0823:32). It arrived on the Footscray down-line platform at 0826:04.

One minute and 23 seconds (83 seconds) after train 6369 departed the two-unit, empty express, designated 6371, left platform No. 10, Flinders Street Station for Williamstown at 0817:55.

From Flinders Street Station to South Kensington, train 6371 proceeded at speeds between 9 and 48 km/h. The driver of 6371 recalled that the signals generally required him to travel at a restricted speed and on one or two occasions to stop to wait for a signal to clear. Train 6371 followed train 6369, clearing Spencer Street Station 109 seconds behind that train. At North Melbourne Station there was a 90 second interval between the trains and at South Kensington the interval had reduced to 63 seconds.

Train 6371 slowed at some stage between South Kensington and signal SKN 661, some 658 m from Footscray Station, as the time interval between the trains had extended to 105 seconds. From signal timings between South Kensington and Footscray, train 6371 was calculated to have steadily increased its speed, reaching a speed of between 77 km/h and 81 km/h between signals SKN661 and W223.

Signal W223 was at stop when train 6371 passed at 0828:07. The train-stop mechanism operated automatically and applied the train's emergency brake.

At 0828:22, with the signal W 235 at proceed for train 6369 and the doors shut, the brakes were released and the train prepared to move.

Almost simultaneously, train 6371 ran into the rear of train 6369.

Metro Control records show that the track circuit indicator at W235 was occupied at 0828:22, indicating that train 6369 had occupied that section. The automatic emergency application of the train brakes by the train stop slowed train 6371 from about 77 km/h to about 33 km/h at impact.[5]

On impact, the rear of the lead motor car 333 M of train 6371 reared up and derailed the wheels on one axle of the rear bogie. Train 6371 came to a halt 13.05 m from the

---

4 Metrol – The Metropolitan Train Control Centre

5 Based on a linear deceleration from the standard braking curve ($0.83 \pm 0.05 m/s^2$)

point of impact. Train 6369 was propelled forward approximately 15 m and couplings broke between cars 1102T and 504M and between cars 503M and 1102T.

FIGURE 2:
The collision scene Car 504 M and Car 333 M

FIGURE 3:
Collision scene Car 1017T underridden Car 333 M

Ten passengers, who were on board train 6369 were asked by ATSB investigators to complete questionnaires and an appeal was made through the local paper for other passengers to contact the ATSB. In all, six passengers responded. Four of the respondents were sitting in the lead car of train 6369, while one was in car 4 and one in car 5. One of the passengers in car 1 was reliant up on a wheelchair, but at the time of the collision had transferred to a seat for people with disabilities. His wheelchair 'was sent flying' on impact. All the passengers described the collision as an 'enormous crash' and being propelled forward. A mother and daughter sitting opposite each other were thrown together causing the mother some bleeding from the mouth. Four of the passengers recalled the train doors being closed at the time of the collision and five recalled that the train had not started moving.

The initial report of the collision was made to Metrol, by station staff on the adjacent platform at 0829:38.

On impact the driver of train 6369 was jolted forward and he braced himself with his hand to prevent falling out of his seat. In the train mirror, the driver reported that he could see smoke and dust at the rear of his train. During interviews the driver recalled immediately pressing the 'emergency' button on the train radio set, to alert Metrol, to the accident. The emergency button should have given his radio call priority over all routine calls at Metrol. However, he received no confirmation that his call had been received as a priority and he tried again holding the emergency button down for some seconds. He then pressed the 'normal' button, which logged the call.

The driver of train 6369 then opened the train doors, put on his safety vest, secured the driver's cabin and walked towards the rear of the train checking the carriages. All passengers had left the train.

At 0829:46 the area controller at Metrol responded to the radio call from driver of train 6369. At 0830:50 , the NXB Field Operations Manager, based at Footscray, who had been leaving the platform at the time of the collision, reported the collision by phone to the Northern area controller, and gave instructions to stop trains on the Werribee line until further notice.

The driver of train 6369, together with the Field Operations Manager gave first aid to the driver of train 6371. At 0837, the driver of train 6371 used his mobile phone to call his wife and tell her of his accident.

1.4 Injuries

The driver of train 6371 suffered damage to his left arm and extensive bruising.

Two passengers in train 6369 suffered minor injuries and were admitted to hospital. Both passengers were released after observation.

1.5 Damage

1.5.1 Damage to Trains 6369 and 6371

Both trains[6] 6369 and 6371 were two-unit, six car trains. Each unit is made up of two motor cars (M) containing the driver's cab and electric motors and passenger space, with a passenger 'trailer' car (T) between them. Train 6369 had a lead unit of three cars [432 M, 1066 T and 431 M] and a rear unit of three cars [503 M, 1102 T and 504 M]. Train 6371 had a lead unit of three cars [333M, 1017 T and 334 M] and a rear unit of three cars [305 M, 1003 T and 306 M].

6 A train is a single unit of rolling stock, or two or more units coupled together, at least one of which is a locomotive or other self propelled unit.

FIGURE 4:
Collapsed as designed Scharfenberg coupler

The cars are equipped with Scharfenberg couplers. To help protect the carriages from structural damage in abnormal heavy impacts and collisions these couplers include a shock absorption device. That device consists of a preloaded collapsible tube and a drift with a design absorption capacity of 225000 Joules. On both trains the deformation tubes collapsed as designed. After any such accident both the tubes and couplers are replaced.

At the time of impact, train 6369 was just departing Platform No. 4 at Footscray with the doors closed and the brakes released and was propelled forward by the impact. The couplers between the lead car [333 M] of train 6371 and last car [504 M] of train 6369 locked.

After the initial impact, the couplings between the cars in the rear unit of train 6369 snapped when subjected to tension loading. This action broke the train brake pipe discharging air pressure, which automatically applied full emergency brakes on all cars in train 6369.

The lead unit of train 6369 sustained little damage. After the collision, this unit was operable and was used to haul the damaged rear units and train 6371 to the Newport Workshops. National Express undertook a post-accident examination of the lead unit. Repairs consisted of the replacement of all couplers and the replacement of one life-expired resistor assembly. The unit was returned to service on 12 June 2001.

The rear unit of train 6371 also sustained little damage. It was still serviceable after the collision and was used to aid in the removal of the damaged units. That unit received a post-accident examination and had couplers exchanged before undertaking brake tests. The tests were conducted to determine the status of the brake system on the unit at the time of the collision. Following those tests numerous routine maintenance servicing procedures were undertaken on the unit. Apart from the exchange of couplers, the only other accident-related damage identified during the maintenance procedures was to an air conditioning unit and the air system. The unit was returned to service on 10 July 2001.

FIGURE 5:
334 M impacted into 1017T Platform side view

The trailing unit of train 6369 [504 M] sustained significant damage. Apart from damage at the point of impact between cars 333 M and 504 M, the couplings between the cars within the unit broke under tension load. Damage occurred to the bogies and to equipment around the couplers, airlines, cable etc. In addition, some impact damage occurred to the ends of the car. That unit remains out of service awaiting repair.

The lead unit of train 6371 [333 M] sustained the most damage. There was damage at the point of impact of cars 333 M and 504 M. The rear of leading motor car 333 M was lifted into the air about 600 mm causing 1017 T to under-run it, resulting in significant end damage to both cars. The rear of car 1017 T was also underrun by car 334 M causing significant structural damage, including the failure of the anti-collision posts on 334 M at the pantograph end of the car and damage to bogies (eg torsion bars), couplings and associated equipment. During the recovery operation, the chaining together of vehicles that could not be coupled resulted in further damage. At the time of writing this report, that unit remains out of service.

1.5.2 Crashworthiness of trains

Apart from damage, the trains were examined for their crashworthiness,

As a result of the failure of the anti-collision posts on 334 M there was significant encroachment into the adjacent passenger space within the car. Collision posts are designed to prevent one carriage telescoping into another and into the passenger space.

FIGURE 6:
Left Hand and right hand collision post failures car 334 M

FIGURE 7:
Left Hand and right hand collision post failures car 334 M

In the driver cabins of cars 333 M and 504 M some items broke loose as a result of the impact. The restraint systems holding these items failed, including:

- the wheelchair ramp in cars 333 M, 305 M,
- the inspectors seat in 504 M,
- a fire extinguisher in 504 M,
- the ceiling light above the driver's seat in 333 M.

Under the franchise agreement with the Victorian Government, NXB is required to refurbish their 98 Com Eng trains. The program commenced in October 2000 and the first four units were placed in service in March 2001. None of the units involved in this incident had been refurbished.

NXB has engaged a consultant to examine the two damaged units. It is expected that lessons learnt or problems identified from this incident may be incorporated into the refurbishing program.

1.5.3 Damage to Infrastructure

The collision caused one wheel on the No. 2 bogie of the leading car, [333 M] of train 6371 to derail. The derailment was indicated by the marks of the wheel flange on the railhead, starting 2.055 m from the eastern end of the platform. When the wheels 'dropped in', the Pandrol rail fastenings and sleepers were then struck by the derailed wheels. The track was damaged for about 13 m (19 sleepers).

About 19 concrete sleepers showed some superficial damage. No sleepers required replacement. However, all damaged rail fastenings required replacement.

1.6 Train crew details

The driver of train 6371 had started his morning shift at 0516 and had driven a number of services on other NXB lines.

	Driver 6371	Driver 6369
Gender	Male	Male
Classification	Driver/ Driver Trainer	Driver
Medical Status	Medical expired	Medically fit
Continuation training	Current	Current
Time on duty	3 hours 12 minutes	

1.7 Train information

Both trains were Com Eng type suburban multiple unit electric trains. These trains were built by Com Eng (Victoria) Pty Limited at Dandenong. One hundred and twenty six three-car units were delivered for service between 1981 and 1989.

Each train was made up of two three-car units with an overall length of 142.4 m. Both trains were operated as driver only trains, referred to as single person operated trains (see section 2.2). At the time of the collision there were about 20 passengers on board train 6369, although the exact number is unknown. Following the accident, some passengers left the area before the police or rail staff were able to record personal details. Train 6271 was not carrying passengers.

The recent maintenance history of the four units involved in the accident was made available to the investigation team. Those records indicated that the units had been inspected and maintained in accordance with NXB's procedures.

Train 6371 was inspected by an independent consultant to check the condition of the braking system. The unit was subjected to a full series of brake tests, including the standard running performance test. In addition, the adjustment of the foot pilot valve equipment in 333 M was also checked.

The report on those tests advised that all the brake modes on the rear unit of train 6371 [334 M] operated correctly. In addition, an inter-unit continuity test confirmed that all brake modes were continuous through the end couplers.

Due to accident damage, in particular to electrical cables and wiring, the standard brake tests were unable to be conducted on the leading unit of train 6371 [334 M]. A separate series of tests was conducted which consisted of a 333 M control governor bypass circuit check, a unit continuity test of main reservoir and brake pipe systems, a service and emergency air brake test from the cab of 334 M and a check of the 333 M trip valve. In addition, independent bench tests were conducted on the driver's brake valve from 333 M and the electro-pneumatic brake (7-step) relay valve from all three cars.

The test of the pilot valve in the lead car [333 M] of train 6371, found that the foot pilot valve was within the required sensor clearance of 0.5mm to 1.0mm. The foot load required to operate the foot valve is dependant on the spring set up which is determined by the unit manufacturer.

The consultant's report concluded that on 5 June prior to the accident train 6371 was:

> in an acceptable operating condition, capable of meeting the standard brake performance requirements for a Com Eng suburban train.

1.8 Track and other infrastructure

1.8.1 Track

The 2 km of track between South Kensington and Footscray consists of four lines, two up and two down lines. The southern lines are the 'Through Suburban' lines to Newport. The track is typical of the Melbourne suburban network and has a gauge of 1600 mm. On the track approaching the station, the welded rails are supported on wooden sleepers using base plates and dog spike fastenings. Through Footscray No. 4 platform, concrete sleepers with Pandrol fasteners are installed. The nominal sleeper spacing for both concrete and timber sleepers is 685 mm.

Following the removal of the damaged trains at about 2030, the track was examined between Hopkins Street overbridge and the Newport end of Footscray platform. The

track was inspected for accident damage, gauge, alignment and for any track condition that may have contributed to the accident. The track was found to be within the required tolerances. The track infrastructure was not considered to be a contributing factor to the accident.

FIGURE 8.
The cutting approaching signal W 223

1.8.2 Electrical infrastructure

Melbourne suburban electric train services are powered by a 1500 Volt direct current (DC) overhead system. The overhead wires are supported by structures at intervals of about 70 m to 90 m. The contact wire height is nominally between 5.2m and 5.6m above rail level.

During the accident, the rear end of the first two cars [333 M and 1017 T] in train 6371, lifted about 600 mm and could have contacted the overhead wiring. However, the Electrical Control Room [Electrol] 'event list' for the day showed no record of a DC circuit breaker opening.

Electrol was advised at 1030 that there had been no damage to the overhead equipment and that overhead power was not required to be switched off. The electrical overhead equipment was not considered to be a contributing factor to this accident.

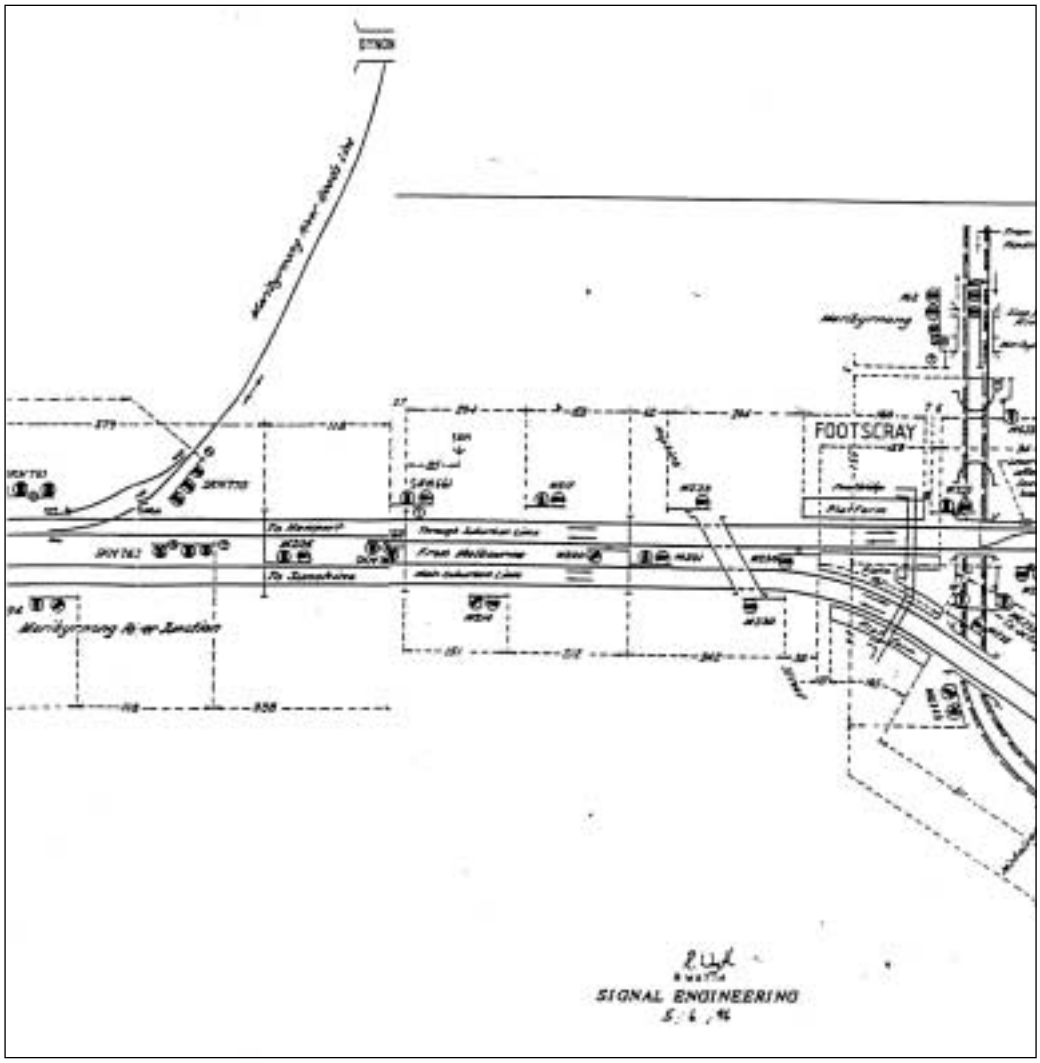
1.8.3 Signalling infrastructure

On the through suburban line to Newport, between the South Kensington Station and Footscray Station, there are seven fixed signals, one 'home' signal[7] (signal SKN 765) and six automatic (permissive)[8] signals. After leaving South Kensington, trains cross the Maribyrnong River bridge after which there is a 50 km/h speed limit for a short 370 m radius curve and the junction for the Maribyrnong River Goods Line. Once clear of the junction the maximum line speed, assuming normal running signals, is 80 km/h. Down trains on Werribee and Williamstown services arrive at No. 4 platform, Footscray.

---

7 Home Signal .Signals controlled by a signalman.
8 Permissive signals. Signals that operate automatically on track circuits.

FIGURE 9:
Schematic of track and signal layout east of Footscray station



The distance from the west bank of the Maribyrnong River to Footscray Station is about 1150 m. There are four sets of permissive signals on the down, through-suburban line: identified as SKN751; SKN661; W217; and W223. The signal at the western end of No. 4 platform Footscray is W235. The distances between the relevant signals are:

Signals	Interval
SKN 761 to SKN 661	497 m
SKN 661 to W 217	231 m
W 217 to W223	221 m
W 223 to W235	377 m

The distance between signal W223 to the rear carriage of a two-unit train at Footscray No. 4 Platform was about 230 m.

Following removal of the train from the accident site at 2030 on 5 June, an independent consultant and members of the investigation team inspected the track and witnessed testing of the signalling system. The train-stop arms at signals W 217 and W223 were gauged in the stop position and found to be operating to specification. All the track circuits were within specification. But the circuits operating

signals W 217 and W223 were not as designed. Due to vandalism those two circuits operated as a single rail system. However this system operated the signals within specification.

The evidence is that the signal circuitry and the train-stop arms were working properly at the time of the train collision.

1.9 Train control

Recorded data indicated that train 6371 passed signal SKN 661 while it was showing a yellow-over-green aspect. That signal required the driver to reduce to medium speed, 40 km/h, by the next signal, signal W 217. Signal W 217 was showing red-over-yellow aspect. The Book of Rules and Operating Procedures, 1994 (Section 2-16, Rule 13, clause (e)) provides that 'the driver may proceed at medium speed (40 km/h) and must be prepared to stop at the next signal'. The next signal, W223 was at stop, showing red-over- red.

After leaving South Kensington, both trains passed out of the direct control of the City Suburban rail control centre, Metrol. In Metrol, the passage of each train was passed from the direct signal control to the Northern area controller who set the points for trains on the western rail corridor. All the signals in this area were permissive and the controller could only monitor the progress of the two Williamstown trains by observing which section of track was occupied on the Northern area control panel.

Following the initial reports of the collision trains were stopped on the Werribee line. At 0835:40, the Field Operations Manager at Footscray Station advised that trains could use the 'up' line, but with caution.

1.10 Environmental factors

The accident occurred in fine weather, with clear visibility and a dry track. At the time of the collision the sun had an azimuth of 52 degrees and an elevation of about 9½ degrees. The sun would not have been in the driver's eyes at any stage and there is no suggestion that it made the signals on approach to Footscray Station hard to see.

The weather conditions at the time are not considered to be a contributing factor to the accident.

1.11 Medical and toxicology

The driver of train 6371 was taking a course of prescribed medication to assist in a psychiatric medical condition. The evidence available suggested that the driver adhered to his prescribed medication regime. The driver stated he retired to bed early on the night of 4 June in preparation for leaving the house for work at 0400 on 5 June.

At 1030 on 5 June, two hours after the accident, the driver of train 6371 provided a blood sample for a series of alcohol and drug tests. No alcohol, opiates, Sympathomimetic Amines, Benzodiazepines, Cannabinoids, Barbiturates, Cocaine or methadone were detected by the tests.

2 ORGANISATIONAL CONTROL

2.1 Introduction

Victoria's former publicly owned transport utilities had been subject to a policy of privatisation. The then Victorian Government commenced the privatisation of public transport with the bus operations. National Express (NX) took over the franchises of most of the government bus operations on 27 December 1993. The Public Transport Corporation (PTC) operated the Metropolitan train service as a public utility until 1999.

The Spencer Street to Newport railway opened on 17 January 1859, connecting to an existing line from Newport to Williamstown and Geelong. The current Footscray Station was opened in 1900. The Melbourne/Williamstown line was electrified in August 1920. Automatic three-position electric signalling between South Kensington and Yarraville was introduced in 1927. In November 1976, two additional tracks were added between South Kensington and Footscray making a four-track line, which were the 'Through Suburban' lines to Newport and the 'Main Suburban' line to St Albans. That project included elimination of Footscray as a junction station and provided the South Kensington-Footscray section with four-aspect speed signalling.

In April 1997 the Victorian Government took the decision to privatise the Victorian rail and tram systems. Interested parties were invited to submit expressions of interest in 1998 and NX started a commercial evaluation of the franchise, lodging an expression of interest in January 1999. Between January 1999 and the close of the tender process in May 1999, the PTC opened a 'data room', through which potential tenderers could access information on the status of infrastructure, rolling stock, safety records and other operational information. There was also a system by which tenderers could pose questions to PTC on specific issues.

The preferred tenderers were announced on 26 June 1999. NX was the preferred tenderer for Bayside Trains, V/Line Passenger and Swanston Trams.

The NX franchise operations, including Bayside Trains, started on 28 August 1999.

The 'due diligence' process, safeguarding NX interests was very short. NX stated that it was not possible to gain a proper assessment of the work culture and some other operational issues during that short period. NX stated that responses from PTC to some of those specific inquiries were found to be inaccurate.

However, NX was confident, in view of the known profile of the PTC train managers, that the fundamental operational structure was sound.

On 29 August 1999, the company operating Bayside Trains was formally taken over by National Express (Bayside Trains) Pty. (NXB) operate about 6200 train services and carry about 5.2 million passengers per week with a fleet of 77, six-car trains, supplemented by a diesel powered service between Frankston and Stony Point.

As part of a standard franchise agreement, train companies are required to maintain train schedules within certain parameters. There are monetary penalties for not meeting the standards. The efficient running of the trains therefore relies on serviceable trains, efficient infrastructure and an adequate supply of drivers.

2.2 Shift and fatigue management

NXB operated a two-shift roster, morning and afternoon. Drivers were assigned duty on a rotating roster, which took into account hours worked. Drivers were at liberty to swap rosters, coordinated through the roster office, following set procedures. Driver swaps are monitored by the NXB staff responsible for the roster.

2.3 Single person operated trains[9]

In 1988, detailed and in-depth consideration was given to operating the Victorian rail network as a driver-only operated train system, or 'single-person operated train' (SPOT) system. This was not a revolutionary concept. There was an international precedent for such an operation with, at that time, over 50 rail networks in 26 countries being operated as SPOT trains. The concept was initially examined by international consultants, London Transport International Consultancy, and by Transmark. Those consultancies confirmed the viability of the suburban train system being converted to a SPOT system, but the scheme was not introduced at that time.

The idea was revisited in 1992 with a view to introducing SPOT in 1993. In 1992, a project management team was set up to study the implementation of SPOT across the Victorian rail network. The study included a risk analysis of SPOT operations and visits to Western Australia and South Australia, where single-operator suburban trains had been adopted in Perth (1954) and Adelaide (1991). Analyses undertaken by Viner Robinson Jarman Pty Ltd included a study of the reduction of risk associated with modifications to the radio communications network of country and metropolitan trains and a study of the vigilance control on board country trains. The two analyses were submitted in September 1992.

On 6 January 1993, the Victorian Government announced that SPOT would be trialed with an anticipated introduction across the network in 1993. An internal memorandum noted:

> As a safety requirement for single person operation, it is essential that the main railway line be protected by train stops, which are devices interconnected to the signalling system that will apply the brakes of a suburban train should it overrun the signal at stop. Consequentially all suburban lines with the exception of Williamstown, Upfield, Greensborough to Hurstbridge – Pakenham to Warragul would be capable of accommodating single person operated trains.

The basis of the introduction of SPOT trains was that the new system should not be any less safe than the existing, two-person system.

The electric train service has its origins in the electric tram. A driver and a guard have operated electric trains since their inception. The driver was responsible for the safe driving of the train, while the guard was responsible for passenger security and safety, the closing of train doors and maintaining the timetable.

As the guard played a very minor role in train driving and monitoring, being primarily confined to the occasional scrutiny of signals through a periscope and application of a hand brake if necessary, the major modifications to the trains and driver duty focused on passenger safety. The modifications allowed a driver to monitor and close doors at a station, provided enhanced surveillance of passenger cars, provided radio communications with the train control centre and provided other measures to enhance

---

9 Single Person Operated Trains are also referred to as Driver Only Operated trains

passenger safety. In some limited lengths of track, not already fitted with train-stops, these were fitted before SPOT trains were allowed to operate on that portion of track.

One of the modifications involved the introduction of a foot control for the pilot valve (deadman's handle). The foot control provided drivers with the option of using either a hand or foot to control the pilot valve. It enabled hands-free operation of the pilot valve to allow the driver to control the train, operate the radio and other controls related to the single-person operated train.

As noted in a 1987 paper by Transmark UK Ltd, held on the Public Transport Corporation files:

> Any D.O.O. scheme for passenger trains must provide adequately for:
>
> (e) action to be taken in the event of the driver becoming incapacitated.

The introduction of SPOT trains, with the modifications to drivers' controls and driver retraining, was assessed as not reducing train safety. The system had relied on, and continued to rely on: trained, fit drivers; a speed signalling system; 'train-stops'; and the pilot valve system.

2.4 Signals and trainstops

The signal system adopted by the Victorian rail industry is based on the US Rhea-Rudd speed-based system. Signals are separated by distances that allow train drivers adequate time to stop, provided that the speed at which the train is travelling is consistent with the permitted track speed.

In areas of automatic signalling the passage of trains creates a 'ripple' effect and trains are protected by a series of signals in the preceding sections to alert or stop drivers of any following train to maintain the required safe separation.

A signal will automatically turn to stop, shown by a red-over-red aspect, when a train passes. Once the train has cleared the overlap section, which is provided as a buffer, the signal before the current red signal will revert to a reduced speed signal, warning any following train that the next signal is at stop. The signal before the 'warning signal' may show line speed, if a 'three aspect' signal; or a warning to reduce to medium speed, a prescribed speed (in this case 40km/h) at the next signal if a 'four aspect signal'. The signal colour combination will depend on whether the signal is a 'three aspect' or a 'four aspect' signal.

Three aspect		**Four aspect**	
Green/red	Line Speed	Green/red	Line speed
Yellow/red	Normal speed & warning next signal at stop	Yellow/green	Reduce to medium speed by next signal
		Red/yellow	Medium speed and warning next signal at stop
Red/red	Stop	Red/red	Stop

Those signals operate in conjunction with a train-stop mechanism. A lever adjacent to the signals at the track side is positioned parallel to the track and lies horizontally for all but a 'stop' signal. When the signal is on 'stop', the lever is raised so that a corresponding lever on the air brake system of a train contacts the lever if it has not

stopped at the signal, activating the emergency train brakes, slowing the train and bring it to a halt.

An audit of all signals in the NXB Metropolitan area was undertaken on 13 February 2001 and identified the marker light at signal W223 as being out of focus. That deficiency was rectified soon after the inspection and was not considered a factor in the collision between train 6371 and 6369.

With train 6369 stopped at Footscray station and clear of the overlap section for signal W223, the settings at the preceding signals should have been:

Signal	Aspect	Meaning
SKN 761	Green over red	Line speed
SKN 661	Yellow over green	Reduced to medium speed, 40 km/h by next signal
W217	Red over yellow	Medium speed 40 km/h and warning next signal at stop
W223	Red over Red	Stop

A two-unit train driven at the cautionary speed of 40 km/h would require about 75 m to stop under emergency braking conditions, given good track and weather conditions. If a train is not driven at the cautionary speed, but at full line speed, the stopping distance is much greater. In the case of the suburban line between the Maribyrnong River Goods Line Junction and Footscray the line speed is 80 km/h. A train contacting a train-stop arm at 80 km/h would require 275 m to 300 m in which to stop, the actual distance being subject to weather and line condition.

FIGURE 10:
Trainstop lever on motor car

The distance from signal W223 to the rear of a stationary two-unit train at No. 4 Platform Footscray Station is about 225 m. Therefore, the design distance of the overlap did not equate to a safety margin, a distance that the train stop would bring the train to a halt from line speed, should the driver become incapacitated or otherwise lose control.

2.5 Signals passed at danger (SPAD) occurrences

Recorded data indicated that train 6371 passed signal W223 while it was showing stop. Such an occurrence is known as a 'signal passed at danger' (SPAD).

The signalling system, the pilot valve (foot or hand) and driver alertness are the three main defences against rail collisions. SPAD occurrences are a key safety concern in rail operations worldwide and such instances are recorded and analysed in Victoria.

SPADS may occur during the following situations:

- Departing a platform (leaving before the signal permits);
- Leaving a siding;
- On line, in a section of track;
- Arriving at a station;
- Leaving a loop.

SPAD occurrences may be classified in terms of severity and NXB use the following categories:

1. Overrun 0-25 m, no damage;
2. Overrun 26-200 m no damage[10];
3. Overrun greater than 200 m, no damage;
4. Track damage, no casualties;
5. Derailment, no collision, no casualties;
6. Collision (with or without derailment), no casualties;
7. Injuries to passengers or employees with no fatalities; and
8. Fatalities to passengers or employees.

A frequent cause of SPAD is for the signal to be restored to the danger configuration as a train approaches, providing the driver with limited time to react.

An analysis and summary of SPAD occurrences in the NXB Network was undertaken for the period 1 January 1996 to 31 December 1999. During that period there were 61 occurrences, of which:

- 39 per cent involved trains departing a platform;
- 33 per cent involved trains in section; and
- 15 per cent involved trains passing an arrival signal.

The report's executive summary notes:

> The signalling system in the Bayside Trains area, as engineered, will not stop an electric train passing a signal 'at danger'. It provides only an indication to a driver after the train's air is released in bringing the train to a stand. The number of SPADS is therefore largely dependent on the train driver's concentration. The positioning of signals with automatic train stops will only reduce the likelihood of serious consequences resulting from a signal passed 'at danger' by electric trains.

A SPAD report covering the NXB operations for the period 1 January 2000 to 31 May 2001 showed that 107 SPAD had been reported. Two of the 107 SPAD resulted in an overrun of more than 200 m, and none had involved injuries to either passengers

---

10 200 m is the standard length of overlap to allow for misjudgment in train braking.

or employees. Ninety seven of the reported SPAD resulted from signals reverting to danger as the train approached, giving the driver insufficient time to react. The majority of cases of signals reverting to danger resulted from technical system faults while the track section ahead was clear. In submission, NXB stated that while for their purposes such an event was classified as a SPAD, in some jurisdictions they were not counted.

Since 1996 no SPAD had been recorded on the line between South Kensington and Footscray. Drivers' reports suggest the curved approach to Footscray on the Through Suburban line requires particular vigilance, given the short sighting distances to signals W217 and particularly W223. Such signals are often described as 'hidden signals'. The drivers confirmed that given the current pattern of services on the Newport line, the signals for most services from South Kensington were normally at green.

The signal 'headway' is the distance between trains under normal operating conditions and track speed. For non-express trains, the minimum signal headway in the South Kensington-Footscray section is reported as two minutes while Footscray-Newport is 2.5 minutes.

At Footscray, the scheduled interval between suburban trains is typically 8 or 12 minutes during peak hours while off peak it is 20 minutes. The 26 Geelong and Warrnambool weekday passenger trains, as well as the empty car movements, are scheduled to operate in the gaps between the suburban services. Detailed consideration was given to the working timetable and advice was sought on typical station stop times for V/Line trains stopping at Footscray. Allowing for typical minor service variations, the information and advice supported the drivers' observation that it is usual for scheduled in-service suburban trains to receive a green signal indication when operating between South Kensington and Footscray.

The expected signal indications to a driver of a non-stop empty car train following a scheduled service differ significantly from those for in-service trains. Non-stop trains, if driven at line speed, will catch up to the regularly stopping in-service train ahead. Typically, the driver of a non-stop empty car train would receive restricted signal indications on the approach to Footscray.

2.6 Accreditation and audit

The Victorian Rail system operates on the principle of 'co-regulation'. The state regulatory body, the Department of Infrastructure (DoI), accredits rail operators based on the regulator's approval of a company's Safety Management System. The SMS is contained in the NXB Management Safety Manual (MSM). The NXB MSM is a general safety policy manual which is supported by other more detailed operational documents covering the various areas of operation which include engineering, maintenance and train operation.

NXB is an accredited operator and is audited for compliance with the Management Safety Manual and other safety procedure documentation supporting that manual.

Audits assess compliance with an approved or accredited SMS or standard. The audit, as a defence against an accident, is only effective as far as the standard or procedure is effective in itself. Hence, an audit of the existing and long-standing signalling system would only measure compliance with its design. It would not identify unsafe conditions within the signalling system. Similarly, an audit of the medical standards would measure compliance against the PTC Medical Standards, but would not identify any shortcomings in the standards themselves.

NXB as a train operator and track provider, is an essentially vertically structured organisation. NXB have its own workshops and maintenance regime. Under provisions of the Transport Safety Act 1983 (Victoria), there is a requirement that accredited operators should be audited at least on a yearly basis, with the provision of special audits and 'unannounced' compliance inspections.

An audit of September 2000 expressed:

> concern at the state of instability that continues due to the protracted delay in the review of the system and the company reorganisation… Concern is also expressed at the lack of risk assessment undertaken relating to changes to the organisation's rail safety activity management and proces'.

The auditor's remarks concluded:

> Despite the above, the audit team found there was a good level of compliance by staff in addressing the rail safety requirement which was considered to be as a result of continuation of the practice from the previous corporation's management system.

Given the size of the NX operation and a number of managerial structural changes that affect the Management Safety Manual provisions, the company has been audited at six-monthly intervals.

One aspect of the audit dealt with the company's adherence to the Public Transport Medical Standards. The eyesight testing of drivers and the identifying of drivers requiring to operate using glasses was noted by the auditors as 'not yet addressed'.

An audit of 15-17 May 2001 noted that 19 drivers were overdue for their routine medical examination, recognising that a limited number of drivers had been on long-term sick leave. The audit report noted:

> In regard to responsibility for ensuring operations staff have current medical status CSMs (Customer Service Managers) believe that this is a 'Head Office' responsibility. Further the MSM (Management Safety Manual) does not specify the responsibility of functional managers in medical safety issues.

NXB had written 'Guidelines for Bayside Train Operational Personnel Medical Examinations' (BTNRIP – 05), which outlined the process of medical examinations and record management, including audit process, in regard to NXB Operational personnel. The controlled document was last revised in January 1999 and reviewed in November 2000. The guidelines outline the duties of line managers, the employee and others in the medical examination process. The guidelines require an employee to attend at a PTC nominated medical practitioner within four weeks of the due date of examination and detail the steps to be followed in making the appointment.

The guidelines provide that an employee who fails to attend will be withdrawn from normal duties as if medically unfit.

The driver of train 6371 was some six months overdue for his medical examination. The company's monitoring system had identified the driver as being overdue for each month since January 2001. However, the guidelines had resulted in neither the driver's attendance for a medical, nor the suspension of driver from duty. Nor were the guidelines effective in ensuring someone was responsible for monitoring the situation to ensure it was rectified.

2.7 Driver medicals

Train drivers come under the category 'A' requirements of the PTC 'Medical Examination Guidelines'. At the initial examination a driver is subject to an ECG. The requirement for a Periodic Physical and Vision examination includes a full medical history as well as urinalysis and height/weight index. Under those guidelines drivers are required to undergo a medical examination every four years until they are 39 years of age, then at two-yearly intervals between the ages of 40 and 49, thereafter annually until retirement. From the age of 40 drivers are subject to an ECG at each medical.

Drivers of single-person operated trains (SPOT) are not required to meet medical standards that are more rigorous than trains with two drivers or multiple crews (driver and conductor). In May 1993, the Public Transport Union expressed concern at the different standards apparently being applied to SPOT drivers at certain depots. The PTC replied in June 1993 that no additional medical standards were required for drivers associated with the SPOT project.

NX took over Bayside in August 1999. Subsequent reorganisation of the NX corporate structure, including the Human Resources area during December 2000, resulted in some confusion regarding the medical status of some drivers. In particular, interviews with various company personnel indicated that there had been a substantial loss of human resources expertise and corporate knowledge within the organisation pertaining to the management of medical records. Consequently, the medical status of drivers was not effectively addressed or managed for an indeterminate period.

From December 2000, a list of drivers due and overdue for medical examination was produced and sent to line managers each month. Despite the guidelines BTHRIP-05, there was confusion as to how the drivers were informed that they should attend a medical examination. This confusion was also shared at management level as identified in the audit reports of September 2000 and May 2001.

The driver of train 6371 was one of ten drivers whose overdue status had extended for three or more months. The driver of train 6371 was six months overdue for his medical at the time of the accident.

2.8 Train 6371 driver history

2.8.1 Background

The driver of train 6371 was a 44 year old male. He had worked within the rail industry for about 22 years. He had worked as a shunter, a suburban train guard and became a suburban electric train driver in 1985. In June 1995, he was appointed Locomotive Driver SPO Metropolitan, an on-the-job driver trainer. He was regarded by his peers as a good, safe and conscientious driver. In January 1998, the Crew Manager noted of his performance:

> Always satisfactory, very punctual and reliable, rarely comes under adverse notice… Is currently a relief OJT [on the job trainer] and has ability to progress to Principal Driver.

At interview another former train manager supported this assessment.

He was regularly assessed as a driver and, in a separate process, was assessed highly as a trainer. His driving had had been audited eight times between January 1995 and April 2000 and he had been interviewed routinely by the crew manager. He had undertaken eleven periodic training courses since May 1997. In all aspects of his work he was assessed as 'satisfactory' and was reported as a driver that assured passenger comfort.

He did have, however, an extensive sick leave record, with frequent absences from work, particularly since 1995.

2.8.2 Personal medical history

The driver of train 6371 was medically examined in accordance with the PTC Medical Examination Guidelines as an employee of the PTC. He was medically examined in 1984 as a guard and in 1985 when taking up duties as a driver. Thereafter, he was examined in 1986, 1988, 1992, 1996 and on 2 December 1998, at the age of 41½. At each examination he was assessed as fit for normal driving duties. His 1998 medical form indicated that his next medical was due in 2001, with no month specified. However, based on the fact that he was 41 at the 1998 medical, the NX medical data base confirmed that his next examination should have been in December 2000. The driver was not notified of the requirement to attend for a routine medical until December 2000.

The driver suffered from some medical problems and, at least over recent months, a significant level of absenteeism. A letter of early 2000 noted on his personal file that in the fifteen years between 1985 and January 2000, the driver had made 15 WorkCover claims, nine of these since 1996, of which seven were for stress.

A propensity to stress and anxiety was identified when he was a guard in 1984. He suffered headaches, sleeplessness and nightmares. However, after treatment over two months he was much improved. In 1985 the consulting doctor felt at 'this stage' there was no reason to prevent him 'progressing as a loco driver'. The remark was qualified by a recommendation that he should be reviewed after one year. An examination in 1985 also passed him fit for one year, however, the next record of medical examination by a doctor under the State Transport Authority is in July 1988, when he was also passed as fit.

No records of medical fitness were available for review by the investigation team for the period between May 1988 and September 1991.

On 11 September 1991, while returning from work by motorbike, he was involved in a collision with a car. He suffered head injuries, as a result of which he was rendered unconscious. He also suffered damage to his right shoulder and back. He spent some eight days in hospital. After leaving hospital he convalesced at home on sick leave for eight weeks as a direct result of the accident. He resumed work on 4 November and driving duties on 19 December 1991.

There was no follow-up or comprehensive neurological assessment undertaken at that time, or within a reasonable period after the motor cycle accident.

His physical injuries related to his ability to lift his right arm above the horizontal. He was examined under the PTC medical guidelines in June 1992. The examinations noted the injuries to three ribs, his clavicle and deltoid muscles but that he had returned to work and had been driving since 19 December 1991 and suffered no problems.

This was despite the fact that some 39 WorkCover reports had been raised, relating to neck pains and axillary nerve injury, between his resumption of work in December 1991 and the examination in June 1992.

A further report of December 1992 also passed the driver as fit and noted the next medical as being due in 1996. This examination had been conducted after a further six WorkCover forms, relating to similar symptoms, had been completed.

However, he suffered chronic sleep disturbance, recurring pain in his right shoulder and back pain. The sleep disorder took the form of long periods of sleep, during which he exhibited violent movements and verbalising. He would awake without feeling refreshed by the sleep. Apart from physical restrictions on his arm movement for which he sought and received physiotherapy, he was able to continue train driving. He seemed to have made a reasonable recovery in terms of his arm movement. He was, however, having recurring headaches and physical discomfort in his back and shoulders.

On 8 June 1995 the driver was involved in a rail accident, when a car collided with the train he was driving at a level crossing. As part of a driver's duty, he was required to stop and make the train safe and then attend the occupants of the car and render any help, pending the arrival of emergency and support services. The car was destroyed, but the single occupant survived unhurt. The following day the driver reported another incident, a 'near-miss' involving some track maintenance personnel.

In September 1995, the driver was assessed by a psychiatrist in support of a workers compensation action. The examination identified ongoing nightmares and anxiety. In diagnosing chronic post-traumatic stress disorder of a moderate degree the doctor noted that his headaches and certain other symptoms, including impaired concentration, which was consistent with post-concussive injury. The psychiatrist gave an opinion, which included the words:

> … To his credit, and despite his nervous symptoms, he has been able to continue work as a train driver despite the stresses associated with that job, although I doubt if he will remain at work in that capacity indefinitely.

In February 1996, he was referred by his general practitioner to a neurologist and he also attended six appointments with a psychiatrist and six with a psychologist. He also underwent a CT scan. It was as a result of these medical referrals that some brain damage was diagnosed, resulting from the 1991 motorcycle accident.

On 15 May 1996 the driver was driving a train that struck a man and his dog crossing the railway. It was later established by the Coroner that the man was partially blind and hard of hearing. Although the driver had sounded his whistle, it was not possible to avoid the accident.

In September 1996 the routine periodic medical examination again assessed the driver as fit. The PTC Driver Manager in September 1996 noted that the driver 'has some brain damage from (his) accident'. No WorkCover records, or sickness records, were sighted by the investigation covering the period November 1992 and June 1995. However, from 8 June 1995 until 1 July 1996 six WorkCover reports had been completed for claims relating to stress, anxiety and back injury.

Shortly after this examination, his own general practitioner referred the driver to Bethesda Hospital for evaluation. For a period of some months he received remedial treatment for his physical and psychological symptoms.

In February 1997, the driver was referred to the Director of the Neuropsychiatry Unit of the Royal Melbourne Hospital. He was diagnosed as suffering a depressive state possibly triggered by the 1991 accident, compounded by the accidents of 1995 and 1996. In July 2000, the driver was also referred to a specialist in sleep disorder. The driver was prescribed a course of medication to address both his psychological symptoms and his associated sleep disorder.

The consulting neuro-psychiatrist advised the investigation that it was his view that any physical concussive injury was not a factor in the accident. However, the post-

traumatic stress, depression and sleep disorder were factors with the potential to affect his driving performance.

In 1998, two consultant neuro-psychiatrists gave apparently opposing views. One on 27 October 1998, in assessing the driver for workers compensation, recognised that the driver had:

> … partial permanent psychiatric incapacity but not to the point of being unable to carry out normal duties as a train driver.

Less than six weeks later his own neuro-psychiatrist expressed an opinion that he should be suspended from driving duties. In late December 1998, the consulting neuro-psychiatrist concluded a letter to the Crew Manager of MetRail:

> With the more intense symptomatology that [the driver] has been describing it is my opinion that he should be relieved of driving duties and I would recommend a period of re-deployment of three months with subsequent review. He will continue on his regular medication in the meantime and he will be reviewed on a regular basis.

At a subsequent meeting in February 1999, with the Train Crew Manager of MetRail to discuss the driver's WorkCover claims the manager noted:

> Also reviewed a letter dated 22/12/98 from [consulting neuro-psychiatrist], which advised that he [the driver] should be withdrawn from driving and given alternative duties.
>
> I indicated to … [the drive] that if I were to initiate this letter I would have to withdraw him from driving on medical grounds and that his future suitability in grade would have to be assessed.
>
> It is my opinion that due to his work history, that he would not be suitable to return to that position due to physical and mental duress driving trains has on him.

The record of the interview contained a note reminding the Manager to consult the driver's neuro-psychiatrist. At interview, although he could not recall doing so, the manager was confident he had done so as the driver continued on roster. The neuro-psychiatrist, however, indicated that no contact was made with anybody from the rail company.

Between his medical in September 1996 and 1 January 2000, some 38 Workers Compensation forms were completed, with 25 of these relating to consultations at specialist consultations, 18 of those 25 claims related to neck or back complaints.

Following these workers compensation claims, the driver was referred to the company's contract chief medical officer in January 2000. The file examined by the investigation relating to this examination contained the driver's medical history notes, which included;

- a letter from the occupational medical officer of 1991;
- two letters from 1991 from orthopaedic surgeons; and
- a psychiatric assessment completed in 1994.

The more recent psychiatric assessments were not contained in the file.

The driver was examined and passed fit for all duties. The doctor noted, however, that although fit at present, the driver 'may run into trouble in the future'.

From the time of the January 2000 medical referral (this was not an examination under the PTC Medical Examination Guidelines) to the time of the accident at Footscray on 5 June, further injury/sickness claims were made. From the NXB database it was established that four claim numbers had been made against the NXB

insurer during that period. A further seven claims (WorkCover Certificates of Capacity for time off) for headache or headache/depression were made against the PTC insurer.

At the time of the accident, and for at least 3 years prior to the accident, the driver is now known to have been suffering with the following medical conditions for which he had been treated with on-going medication:

- Depression;
- Anxiety State;
- Chronic Sleep Disorder;
- Intermittent features of Post Traumatic Stress Disorder (PTSD);
- Intermittent episodes of mild paranoia;
- History of recurrent self-mutilation.

At the time of the accident, the investigation determined that the driver was taking the following medications;

- Efexor (Venlafaxine hydrochloride) –Antidepressant (Central Nervous System)
- Permax (Pergolide Mesylate) – Movement Disorders (Central Nervous System)
- Epilim (Sodium Valproate) – Anticonvulsant and sleep disorder (Central Nervous System)

Since early 1997, he has been continuously on medication of one sort or another without break. In addition to the medications cited above, at various times he has been taking the following;

- Risperdal (Risperidone) – Antipsychotic (Central Nervous System)
- Madopar (Benserazide hydrochloride; levodopa) – Movement Disorders (Central Nervous System)
- Rivotril (Clonazepam) – Anticonvulsant and sleep disorder (Central Nervous System)
- Tegretol (Carbamazepine) – Anticonvulsant and sleep disorder (Central Nervous System).

At all times, the medication dosage changes were made with minimal dosage increases and the driver was monitored for any element of sedation. The Clonazepam, Carbamazepine, and Pergolide were all introduced following identification of the sleep disorder. Epilim was recommended as a less sedating drug and discussed with the consultant sleep physician. Drug changes were often made during periods when the driver was on leave. Carbamazepine was introduced during such a period of leave. Following a review of the sleep disorder Clonazepam was substituted for Carbamazepine. The Clonazepam produced the effect of irritability in the driver and was withdrawn and replaced with Pergolide. Madopar had also been withdrawn due to adverse effects on the driver's mood.

The expert opinion of the transport medical consultant is that, with the possible exception of Efexor (and then only under the strictest of medical supervision), none of the other medications that he had been taking are considered compatible with the safe operation of a public transport vehicle. In addition, most of these medications, apart from adverse central nervous system effects, can cause vision disturbance.

2.8 Staffing and recruitment

NXB employs about 350 drivers. Interviews with NXB personnel revealed that in the period before the accident the company was short of drivers.

Some personnel attributed the shortage to the difficult of attracting men and women to an industry whose profile is not sufficiently attractive.

NXB management maintained that the problem was due to increasing the pool of drivers available to NXB following the privatisation of the Victorian rail network in August 1999 and the creation of the two metropolitan rail companies of Bayside Trains and Connex Trains Melbourne Pty Ltd. Training drivers involves 68 weeks from recruitment to completion of training.

3 EMERGENCY RESPONSE

The time of the collision was estimated to be 0828:22. That time was derived from train control records, particularly the position of train system (POTS). The time of the collision, as taken from video surveillance footage at Footscray Station, was discounted as the equipment was shown to have time errors of between four and six minutes, depending on the video tape viewed. The Police estimated the time of the collision as 0829:15, based on corrected video times. However, as the initial reports were channelled through the train control centre and the times recorded in their records relate to the POTS time base, the response timings are best assessed based on the collision occurring at 0828:22.

The initial notification of the accident was given by Footscray Station staff on duty on platform No. 2/3 to the Train Control Centre at 0829:38 and a few seconds later the Northern Train Controller also received a report by radio. That report was followed by a mobile phone call from the NXB Field Operations Manager, based at Footscray, who was adjacent to platform No. 4 at the time of the collision and reported the accident by mobile phone. He ordered all trains on the Werribee line to stop until further notice. The immediate danger related to other trains approaching Footscray platforms No. 3 and No. 4. The Metrol Centre initiated its emergency plan. The plan included alerting the Emergency Services and NXB management.

There was, however, no direction to turn off the power to the overhead 1500 volt supply.

At 0832:38 the northern train controller contacted the emergency services and advised the ambulance service of the best approach to the platform. At 0832:58, the following train on the Werribee Line was terminated at North Melbourne.

At Footscray, the initial few minutes were confused. By the time the emergency services had arrived, about half the passengers had left the station and made alternative travel arrangements. Half the passengers left without being asked for their name or contact details.

In the head office, management staff implemented an emergency response plan. That plan required management of the immediate emergency, making alternative travel resources available and the informing the travelling public of the alternative arrangements.

From the six responses to the passenger questionnaire issued to the ten passengers known to have been on train 6369, four recalled being told to leave the train (three from car 1 and one from car 4), one passenger in car 1 and the passenger from car 5 recalled leaving of their own initiative. Two of the respondents recalled being offered medical assistance, the other four stated they were not. Of the persons who were not offered medical assistance, one requested it, the other five respondents did not seek medical assistance. Only one of the six reported that they were offered alternative travel, though the wheelchair passenger requested a taxi. Five of the six reported that they could easily identify rail staff, all could easily identify the police, fire service and ambulance Staff.

4 ANALYSIS

4.1 Introduction

The accident occurred as the result of an unsafe, albeit inadvertent and involuntary, act in that the driver of train 6371 passed signal W223 at danger.

Signal W223 is 204 m from the eastern end of No. 4 Platform, Footscray Station. Train No. 6371 passed signal W223 at or near full line speed, resulting in the collision at about 0828:22. Safeguards (defences) in the rail system are designed to prevent such accidents or minimise the consequences.

Defences relevant to this incident included:

- driver training, skill, procedures and aptitude;
- driver fitness and health;
- train design;
- the pilot valve;
- track design;
- the signalling system;
- the train stop system and overlap allowance; and
- auditing, both internal and external, of safety systems.

The driver of train 6371 was experienced and was one of ten 'on-the-job' trainers. Following the accident he stated that he could not recall driving or sighting any signals, or any actions from the time he left South Kensington to the time of the collision. His failure to recall the signals or any other part of the track between 0826 and 0828:22 (South Kensington to Footscray) could be explained by the driver:

- being affected by prescription medicine, self administered medicine, illicit drugs or alcohol;
- daydreaming or being distracted for a period of two minutes;
- falling asleep, or otherwise losing situational awareness; and/or
- being unwell or medically unfit to drive.

Testing for alcohol and drugs immediately after the accident registered a zero reading. Impairment through the influence of alcohol or the intentional abuse of drugs can be discounted as a factor contributing to the accident. The issue of the possible influence of prescription medication is dealt with under the issues of the driver's health (see section 4.3).

The possibility that the driver was distracted is not remarkable. The operation was routine. The Footscray to Williamstown usage is less intense than other parts of the metropolitan rail system and passenger trains to Newport normally operate under a signal regime of 'clear normal speed' signals. All suburban passenger trains stop at Footscray. A driver operating on 'automatic' mode may have forgotten the fact that the train was an 'express' and reverted to the more normal passenger train-driving mode. He may have driven with the intention of slowing the train to stop at Footscray without taking note of signal W 217 or W223.

The driver's mobile phone record was examined to establish whether or not he was distracted while making a phone call. The records show that he made a 90 second call at 0818, between Flinders Street and Spencer Street. The next call, to his wife, was made after the accident at 0833. There is no evidence available relating to any calls to the phone. In the absence of such evidence the investigation accepts that the driver was not distracted by a phone call.

The probable contributing factor in terms of the driver's performance relates to his medical condition. The driver had a history of a serious head injury and continuing treatment for stress, insomnia and chronic pain. There is a high probability that the driver did not observe or react to the signals between 0826 and 0828:22 as a direct consequence of on-going medical conditions resulting in a disassociated state, sleep onset, mental blackout or memory loss.

Investigation of the medical factors central and peripheral to this accident have been obtained as a result of medical interview with a neuro-psychiatric specialist involved in the management of the driver, and the company medical officer for NXB. It was not possible to obtain all of the relevant medical correspondence between the driver's two treating specialists due to time constraints and some reluctance by the specialists to release them.

The investigation team concluded that the driver, at the time of the accident and for an unspecified period prior to the accident (certainly dating back to February 1997), was medically unfit to drive a train.

The investigation team's view of the driver's medical status is based on medical reports reviewed by the investigating team's medical specialist in transport medicine and discussions with his treating medical specialist (neuro-psychiatrist) and the company medical officer.

Since the beginning of 1997, and possibly earlier, the driver had been prescribed a significant number of medications by his treating medical specialists, to treat those conditions that appear to have their genesis in the 1991 road accident. Almost all of these prescribed medications are associated with significant short and long-term side-effects, which are considered incompatible with safe operation as a train driver. His full medication history cannot be determined accurately without complete access to all the medical records held by his treating specialists.

At the time of the accident, it is probable that his performance was impaired by his medical conditions and the likely interactions/side-effects of his medications. There is no way of ascertaining beyond question that this was the case, however, given that he was still under active management by a neuro-psychiatrist for mood disturbance, and a sleep disorder specialist, the likelihood of impairment remains high.

The precise nature of the impairment cannot be determined, however, it is possible that some or all of the following contributed to significant degradation of his situational awareness and possible motor retardation in the event of an emergency situation:

- Alertness and vigilance;
- Concentration;
- Arousal state (sleep and wakefulness);
- Cognitive function; and
- Reaction time.

Given the medication he was taking, the early start to his working day on the morning of the accident and history of chronically disturbed sleep, the most likely event was that he fell asleep at the controls.

4.2 Shift roster

The Interdynamics Pty Ltd computer program, FAID 330E, was used by the investigation to analyse the driver's work hours from 2 May to the time of the accident on 5 June. The FAID program gave a maximum fatigue score of 68.2 at 0700 (a reflection of circadian rhythm) and at 0820 his score had improved to 54.4. Based on his work roster, the hours would not, in themselves, have induced undue fatigue.

The NXB work roster was not a factor in this incident.

4.3 Personal medical fitness

There was a significant and dangerous lack of coordination in relation to critical medical records for the driver of train 6371, at least from the time of his road accident in 1991. In submission, NXB noted that they did not have access to any driver's records that existed before 29 August 1999.

The driver was examined and passed fit for all duties in January 2000 (this was not an examination under the PTC *Medical Examination Guidelines)*. The doctor noted however, that although fit at present, the driver *may run into trouble in the future*.

From the time of the January 2000 medical referral to the time of the accident, there are records of further claims against personal injury insurers. The NXB records show four claims, one relating to the 1991 accident and three to physical injuries. Seven other claims (further WorkCover Certificates of Capacity for time off) directed to the PTC insurer related to the original 1991 claim, and to which NXB was not a party, detail symptoms of headaches and depression.

The evidence that the driver had probably been unfit over a period of time to be in charge of a mass public transport vehicle, was available for at least two years. The fact that his motor cycle accident in 1991 involved head injuries should have singled him out as somebody at risk, a person requiring regular medical surveillance. This was particularly so after the incidents in 1995 and 1996 in light of his record of compensation claims and sick leave since that time.

There is clear evidence that his medical management by specialists in neuro-psychiatry and sleep disorders dating back to early 1997 was done in complete isolation from the company medical officer for NXB. There is also clear evidence that the NXB medical officer was completely unaware of the driver's medical and psychiatric problems until after the Footscray accident. Had he been aware of the health issues of this employee as far back as 1997, it is probable that the NXB medical officer would have disqualified the driver from driving a train and would have arranged and co-ordinated his ongoing medical care as a managed case within the company.

Other than a letter to the crew manager from the treating psychiatrist of 22 December 1998, the driver's medical management continued without any feedback to his employer. It is also apparent that the letter to the crew manager, containing vital medical details, was never passed to the company medical officer at any time. The consulting neuro-psychiatrist stated that he had no knowledge of the existence of the rail medical system or the existence of the NXB medical officer.

There is no evidence to indicate that the driver's treating specialists considered the nature of the driver's psychiatric or psychological disorders in the context of the potential risk to public safety by permitting his continued occupation as a train driver. Similarly, there is no evidence that these specialists considered the possible hazards to public safety by permitting the driver to continue driving a train whilst on a complex regime of mood-altering, anti-psychotic and anticonvulsant medications. The rationale for the prescribing of several of these medications is unclear in the absence of all the specialist reports to the investigating team.

There is no evidence that the driver disclosed, or was required to disclose, the nature and seriousness of his health status, or to declare his medication to his employer or company medical officer.

The evidence suggests that the driver's medical management and on-going health surveillance following a serious head injury in a motor-cycle accident in 1991, in the context of his employment as a train driver, has been inadequate. Furthermore, little or no consideration has ever been given to the possible deleterious neuro-psychiatric/ neuro-psychological consequences of this injury. The injury appears to have been trivialised by railway management in the course of time. In addition, the lack of communication and co-ordination between the employer, employee, company medical officer, authorised medical examiner, general practitioner and treating specialists/practitioners has been responsible for the driver's continued employment despite the fact that he has been medically unfit for train driving for years. Further to this, his medical certification lapsed and he still continued to drive.

The driver's accident and subsequent medical history covered a period of significant change in the rail industry, initially SPOT trains and latterly privatisation. As of 29 August 1999, all driver's personnel files were kept by the Public Transport Commission, hence the driver's documented history was not available to NX. From 29 August 1999 to 6 June 2001, although he had been absent for a number of days through sickness, the driver had completed only two WorkCover claims, one for a minor eye injury and one relating to recurring problems associated with his 1991 injuries.

The driver was reluctant to stop driving. Suspension or reclassification would have significantly and adversely affected his salary and standard of living. In any case he was proud of his driving ability and did not consider that his condition posed a danger.

There is an argument for medical self-assessment/disclosure by drivers, in the interest of the travelling public. The onus, however, must be on either the employer and/or the regulatory authority to provide and manage a medical examination and monitoring system that reduces to a level that is low as practicable, the risk of allowing an unfit driver to operate.

It is probable that the driver's medication would have had an adverse impact on his ability to concentrate and maintain wakefulness.

It was apparent that the medical screening of train drivers had been inadequate for some time, and predated the privatisation by some years. There was no system under the prevailing medical standards to consolidate and correlate the physical and psychological profile of the driver so as to make an informed assessment of his fitness to drive. Incomplete records have been provided to the medical practitioners charged with the driver's medical assessment. While it must be accepted that there is an issue of individual privacy, it must also be accepted that there is also an issue of public safety in a mass transport system.

The consequences for a company that knowingly permitted a driver who is unfit or overdue to undergo a medical examination, to continue to operate a train could be potentially catastrophic. However, drivers are valuable assets in a rail company and take years to train. Given the need to have a driver in the cab to maintain services and ensure the company's viability, NXB apparently elected to allow drivers to operate trains, who were significantly overdue for medical examination. There were two issues that may have influenced that practice: the need to meet on-time performance thresholds; and the shortage of drivers, from whatever cause. Any risk that a driver may be unfit was seen as offset by defences such as train-stops and pilot valves to prevent train collisions. In this accident, however, those defences were inadequate.

There were serious shortcomings in the oversight of driver medical standards. There is a strong case for clear and unequivocal medical standards administered by a third disinterested party, together with specific and appropriate limited periods of grace.

Passenger trains are a form of mass public transport. Medical standards and monitoring should be commensurate with the significant responsibilities associated with driving public transport vehicles.

4.4 Medical examinations

A review of the PTC *Medical Guidelines For Authorised Practitioners* July 1997 indicates that there are no provisions in those guidelines that require 'disclosure' by an employee or treating practitioner, of any medical condition or medication(s) likely to interfere with an employee's performance. In addition, there are no guidelines in that publication for psychological or psychiatric disorders or disease and the potential hazards associated with medications likely to be used in the treatment of those conditions.

The legal status of this publication is unclear, but there is no evidence that it is backed by any legal instrument, making it 'advisory only' at best. It is considered inadequate in the context of a regulatory framework that is supposed to recognise public safety as its core concern.

The more recent Draft *National Medical Guidelines For Rail Organisations* of June 2000, is a considerable improvement, however according to the disclaimer:

> The document is not intended for implementation in its draft form and no reliance should be placed on the accuracy or appropriateness of its contents …

The role of the company medical officer, contracted on a fee-for-service arrangement by NXB for two days each week, has become blurred by conflicting responsibilities. His prime function is to conduct occupational SafeWorking medical examinations of NX employees. In addition however, he is required to positively check all SafeWorking medicals received from authorised medical practitioners from the rest of the State, to ensure that they have been issued in accordance with prescribed procedures. This aspect of his job is perceived as regulatory, akin to his earlier responsibilities when he was the Chief Medical Officer for the PTC from 1993. Given the limited time available to him each week within NXB, it seems unlikely that he can adequately maintain thorough oversight of in-coming medicals, perform his own duties and take a pro-active role in the development of medical standards and other occupational health and safety issues affecting railway operations. He is also required to participate in the case management of more complex medical problems involving employees.

This arrangement places the medical officer in potential conflict-of-interest situations in the event that he may be required to disqualify employees, when the company is eager to retain them because of the shortage of drivers or other key personnel. Given

that the company is his employer, he could be pressured to make medical decisions in the interests of his employer rather than public safety. He is expected to be a medical advocate for employees with serious health problems, which could warrant disqualification, but at the same time, an advocate for public safety within the transportation system. Added to this is the possibility that management has its own agenda with regards certain employees. This creates an impossible situation for a medical officer who is required to perform a regulatory function within a commercial operation and where there are severe financial penalties against his employer if the lack of fit employees leads to performance benchmarks not being met.

There are no indications that any medical audit of authorised medical examiners has been undertaken, even though such audits are a requirement of NXB guideline BTHRIP-05.

The Department of Infrastructure noted that under the current legislation the Victorian Accreditation Authority officers are not authorised to audit medical process to the depth that has been identified as required and existing legislation will require amendment. Also the Department submitted that the Australian Standard, AS 4292 Railway Safety Management, is deficient on many of the required processes particularly on the ongoing monitoring of staff medical conditions and needs to be amended accordingly.

Medical standards, higher medical review of contested decisions, auditing and oversight of the process of SafeWorking medicals, should be independent of commercial operators. The responsibilities for command and control in the existing system are unclear, and this has contributed to the situation involving the driver of train 6371.

4.5 Train control

The train control system covering the Footscray area worked as designed.

The train controller for the Northern section did not have sufficient indication or time to prevent the collision.

The issue of whether or not the emergency radio call, apparently initiated by the driver of train 6369, worked as designed is not clear. There is a history, however, of areas of unreliable communication in the train system radio network. Some drivers carry moblie phones as these are seen as more reliable.

4.6 Signalling system and trainstops

The efficient operation of the network depends upon minimum train separation consistent with safety. The safety and separation of trains is controlled by the signalling system, which allows trains in adjacent track sections[11], but does not allow trains to occupy the same block section of track. Therefore short block sections allows more intense use of the network. The trainstop system, and the 'overlap'[12], reduces the risk of a train occupying the same track section as another train.

The signalling system and train stop system operated as designed. However, those two inter-related, critical defences did not prevent the collision.

---

11 For the purposes of this report a track section is taken to be the length of track between two sequential signals.

12 Overlap, in this report an overlap refers to a length of track on the departure side of a signal which must be clear before a train can be signalled to pass the previous signal, in order to provide a safety margin.

The driver did not respond to the signal aspects at signals SKN551, W217 and W223, as discussed above. The trainstop, did operate but failed to stop the train within the allowed safety margin, or overlap.

The worst case scenario in establishing an overall safety margin, based on an automatic trainstop, is the distance required to bring a train to a halt at maximum speed, plus an allowance for adverse track conditions.

Given constant deceleration under emergency braking of –0.83 m/s^2, the distance required to bring a six-car suburban electric train to a halt from full line speed (80 km/h) is between 275 m and 300 m (320 m with a safety allowance for track/environmental conditions).

The distance between signal W 223 and the rear of a six-car train standing at Footscray No. 4 Platform is about 221.5 m. The safety-margin for train operations appears to be predicated on a driver obeying all signals except the stop signal and driving through the signal at the prescribed reduced speed of 40 km/h. It does not take into account a driver who has been incapacitated for some reason and has not reacted to a series of signals.

There are signalling systems that, together with trainstops, regulate the train's speed consistent with the signal aspect. Such a system is used in the underground rail system in the Melbourne Metropolitan area, in Sydney and other areas of Australia, whereby a train exceeding the designated speed between any two signals will activate a trainstop, regardless of the aspect of the signal.

4.7 Pilot valve – hand and foot (Deadman's Handle)

Suburban trains are equipped with a pilot valve, which should apply the train brakes automatically if a driver fails to maintain a set position on the pilot valve handle.

Alternative systems, such as vigilance controls, may prove to be more problematic in a metropolitan rail system, given the density of traffic, the time gap between trains and the workload of train drivers.

Drivers on suburban trains are required to maintain a certain pressure on a pilot valve, often referred to as the 'deadman' devices. The system is predicated on the principle that any release or increase in pressure on the pilot valve handle will apply the train brakes and stop the train within an established safety margin. With the introduction of single-person operated trains and because of the extra functions a driver was required to undertake, a foot pilot valve was introduced in addition to the hand pilot valve. At any given time while running a drivers must maintain pressure on either the foot or hand pilot valve control.

Many drivers have adapted to the foot control in preference to the hand control. The driver of train 6371 was one such driver.

The Viner Robinson Jarman Pty Ltd 'Report on Vigilance Control' (September 1992) for the PTC formed an addendum to the risk analysis conducted for the SPOT project. It must be stressed that this report was in relation to country trains and not the suburban network. There are, however, some salient points which can be taken as applying to suburban trains.

In discussing the pilot valve system the report states that they can be easily circumvented, either deliberately or inadvertently. In foot control operation the report notes:

> Foot controls can be circumvented by the driver placing a bag or his foot partly on the moulding and partly over the pedal, in the latter case keeping the pedal in the correct position, even if the driver became incapacitated.

The report examined anthropometric data contained in 'Occupational Biomechanics', Chaffin and Anderson (1984) relating to estimated pedal forces produced by the weight of the driver's thigh, lower leg and foot. The weight produced for the male population varied between 5.4 kg for 5 percentile male, 7.2 kg for the 50 percentile male and 9.5 kg for the 95 percentile male. Based on NSW Tangara train pilot valve pedals, where the minimum force required was about 6.5 kg and the maximum about 11 kg, the report states:

> It can be seen from this analysis that a significant proportion of the driving population would be capable of providing the appropriate pressure by 'dead' weight of their lower limbs. It is therefore conceivable that the weight of the lower limbs of a dead or incapacitated driver could activate the deadman's pedal.

Examination of the driver's cab of train 6371 on 5 June, found was no evidence that the pilot valve had been intentionally circumvented. Given the design of the foot pedal system there is a strong possibility that the driver was able to maintain adequate foot pressure, although not consciously doing so.

4.8 Train crashworthiness

The collision post was struck about 500 mm above the floor by the leading trailer car T 1017. The impact bent the post as a cantilever before the connection with the floor failed. From direct observation it seems that corrosion was not a major issue affecting the post structure. Further investigation is needed to determine the reasons for this failure, assess if other vehicles may present a similar risk and determine what action may be required.

Apart from concerns over the foot pilot valve outlined elsewhere and the issue of the collision post, no defects in the trains were found that could have contributed to the accident.

4.9 Emergency response

Without any direct and complete knowledge of the situation, the risk of electrocution or other damage could not be discounted. The overhead power supply should have been isolated immediately and not restored until a positive report that it was safe to do so.

Other than the issue of the maintenance of the overhead power supply and the initial, short-term confusion at Footscray Station, the general response to the accident was effective.

5 CONCLUSIONS

5.1 Findings

1. The driver of train 6371 passed signal W223 at danger at 0828:07 at a speed of about 77 km/h.
2. Train 6371 collided with the rear of train 6369, which was stopped at platform No. 4 Footscray Station at 0828:22, at a speed of about 30 km/h.
3. The driver of train 6369 had released the brakes of the train thus mitigating the full impact of the empty train.
4. The performance of the driver of train 6371 was probably impaired by his medical condition.
5. The driver of train 6371 was in his fourth hour of duty.
6. The driver of train 6371 was five months overdue his Public Transport Corporation Class A medical examination.
7. It is probable that the medication taken by the driver of train 6371 would have had an adverse impact on his ability to concentrate and maintain wakefulness.
8. The driver of train 6371 was medically unfit to drive by reason of ongoing latent medical.
9. The system of medical examination of drivers is flawed.
10. The continuity of driver's records, including medical records, was interrupted by the privatisation process.
11. The train controller for the Northern section did not have sufficient indication or time to prevent the collision.
12. The signalling system and trainstop operated as designed.
13. The track 'overlap' is not an adequate 'safety-margin' and a train travelling in excess of 65 km/h cannot be expected to come to a stop within the standard overlap distance of 200 m.
14. The only defence against an incapacitated driver is the pilot valve, which cannot be relied upon, given design flaws, particularly in the foot operated pilot valve.
15. In general the rolling stock showed good collision resistance, though portable items were displaced.
16. The anti-collision posts at the No. 2 end of 334M failed. 13. In the driver's cabins, the restraint systems holding several fixtures in place failed.
17. Train maintenance was not a factor in this incident.
18. Driver training and re-training was not a factor in this incident.
19. After the collision there was an initial lack of coordination by NX staff at Footscray Station.
20. The overhead power supply was not isolated.
21. The NXB emergency management plan was implemented and operational within 15 minutes of the collision.

22. The response of the emergency services was effective and commensurate with the accident.

5.2 Significant Factors

1. The driver of train 6371 was unfit to drive on 5 June 2001.
2. The medical standards and medical procedures accepted under the Victorian rail accreditation system are flawed and unsuitable for a public transport industry.
3. The privatisation process led to a lack of continuity in record keeping and management knowledge.
4. The signalling and trainstop system on the Victorian Metropolitan Rail Network is not capable of maintaining safe separation of trains in the event of a driver becoming incapacitated.
5. The pilot valve, particularly the foot pilot valve will not necessarily activate if a driver is in some form of disassociated state.
6. The anti-collision post on car 334 M failed.

6 RECOMMENDED SAFETY ACTIONS AND SAFETY ACTIONS INITIATED

6.1 Recommended Safety Actions

1. Medical standards should be reviewed and amended to:
    - better monitor drivers' health and ensure a full past history and current medication regime is taken;
    - include an appropriate assessment of the current physiological and psychiatric status of all drivers to ensure operators have all relevant information on which to base an informed decision on driver fitness;
    - provide a system to monitor self medication of over-the-counter and non prescription medication;
    - include a system to identify drivers 'at potential risk', with provision for monitoring ongoing fitness;
    - ensure that medical examination periods are strictly adhered to and drivers suspended if not holding current medical license;
    - include assessment of psychological and psychiatric fitness;
    - require drivers to produce proof of medical fitness at any time;
    - create an audit system that will allow confirmation of compliance with such standards.
2. The medical examination procedures should be reviewed to ensure no perception of any conflict of interest may be present in future medical fitness system and whether such examinations should be conducted by a panel of doctors appointed by, and responsible, to the Accreditation Authority.
3. Australian Standard, AS 4292 should be reviewed in respect of the monitoring of the health and fitness of rail safety staff.
4. The signalling system and overlap should be reviewed with a view to ensuring trains passing a signal at danger are stopped within a safe distance. In sections before a station this distance should ensure a train is brought to a halt before a possible collision with another train stopped at the station.
5. The anti-collision posts on motor cars on Com Eng trains should be investigated to identify any deficiency in their design.
6. Rail accident response plans should be reviewed to provide procedures to ensure immediate safety of the track infrastructure, training for station staff at manned stations in immediate response procedures and rapid deployment of staff at unmanned stations.
7. The use of hand and foot pilot valves should be reviewed, given their limitations, to determine whether the system can be made more effective or whether an alternative, equivalent system might make a better safeguard.
8. The train system radio network should be reassessed for radio reliability.

6.2 Safety Actions already initiated

Following the collision of 5 June 2001 the Department of Infrastructure and NXB initiated a number of safety actions.

Department of Infrastructure:

The Parliament is considering a draft legislative proposal from the Department of Infrastructure covering the use of prescription and over-the-counter drugs by rail safety staff.

NXB initiated 19 safety actions in response to the collision at Footscray:

a) All train driver medicals were brought up to date and staff who have outdated medicals are not rostered for safe working duties,

b) A risk assessment of all four aspect signalling areas in the Bayside Network are subject to a desktop risk assessment.

c) Drivers sign-on procedures are being updated.

d) A review of applicable legislation relating to the holding of personal data has been commissioned, with a view to ensure that appropriate data is held.

e) A revised policy relating to return to work after sick leave has been implemented.

f) A policy covering the use of prescription drugs by safe working personnel has been drafted.

g) A review of the supervision and management of train drivers has been completed and discussions with Unions on its implementation are under way.

h) The protocols regarding the development of driver rosters have been reviewed.

i) Driver continuation/refresher training will include a dedicated 'safety day', pending industrial agreement.

j) The Metrol procedures have been reviewed and the NX Emergency Response Plan updated and reissued.

k) In addition to (j) above a protocol has been established as part of the NX Corporate Crisis Management Plan to ensure that adequate representation is present at an emergency site.

l) Legal advice is being sought to ensure that NX emergency response procedures adequately cover the preservation of the site requirements and site access.

m) Interim procedures have been established to undertake appropriate on site liaison with Emergency Service Personnel. Staff emergency response kits and training for front line staff is being developed, to ensure a more timely response, which includes the identification of passengers.

n) A review of the effectiveness of train vigilance devices has been initiated.

o) An initial damage assessment of the crashed vehicles has been completed and a proposal has been sought for a full damage tolerance assessment.

p) A database project has been initiated to ensure a more effective incident recommendation tracing system has been implemented.

q) Procedures for testing blood alcohol levels in line with proposed legislation.

r) The existing policy and procedures for counselling staff involved in serious incidents is under final stages of review.

s) NX is seeking to amend the Victorian Rail 'Book of Rules' in relation to the wording of rules relating to Home and Automatic Signal Indication, medium speed warnings.

7 SUBMISSIONS

Draft reports were provided to eight individuals or organisations who were judged to be an 'interested party'. Three responses were received and where appropriate the final report has been amended to reflect the submissions.

7.1 The Department of Infrastructure

The Department of Infrastructure made a number of comments and observations on the draft report issued to interested parties. The comments and observations have largely been incorporated into the text of the report. The Department's comment of 3 October on medical fitness is produced below.

> It is not considered appropriate that an independent medical review panel responsible to the Accreditation Authority should monitor and review medical cases. This process needs to be managed by the individual companies who have the risk and also need to have ownership of the outcomes. With changes to the medical standards recommended in this report, together with the above suggestions, it is considered that the STSB will, with the appropriately qualified auditors, be able to audit all the necessary processes required to ensure ongoing compliance with all parts of the medical standards including the management of ongoing medical conditions. Because of the foregoing the safety action should be modified accordingly.

7.2 National Express Group Australia (Bayside Trains) Pty Ltd.

NXB made a number of comments and observations based on the draft report issued to interested parties.. The critical issues raised by NXB on 4 October are reproduced below for clarity.

> **Infrastructure**
>
> The report provides a brief description at section 2.3 and analysis at section 4.6 regarding the design parameters governing the signalling system layout. It is clear that tghe system is not fail safe and I note your recommendation 4 regarding further investigation. We consider that speed proving signalling could be a significant option in improving system safety. Whilst there is a mention in section 4.6 regarding systems that regulate speed, it appears that a more detailed description of such systems would be beneficial.
>
> In regard to the recommendation, a detailed risk assessment of the critical aspects associated with 4 aspect signalling system locations has commenced for the National Express component of the network and is being undertaken by SKM. You may wish to note that SKM engineers have commented that Footscray is one of the safer 4 aspect signal locations.
>
> **Staffing and Recruitment**
>
> Section 2.9 makes some comment regarding the recruitment of drivers. It is not the National Express position that recruitment is difficult. Indeed, whenever we have sourced drivers, there is a good response. The issues in increasing the pool generally relate to the time taken to train drivers, 68 weeks from recruitment, and the resources available to provide training. National Express has a number of drivers under training at this time and will continue to do so into the future to ensure that new staff are available to replace those drivers leaving the industry as natural attrition.
>
> On matter not seemingly given much attention in the report relates to the recruitment at the time of franchise. As you are aware, National Express does not have access to the medical and personal records of staff for the period pre dating August 1999. Accordingly, the comments in section 4.3 that concern matters prior to August 1999 should be explicit in that regard.

SPAD

Section 2.5 provides some explanation concerning SPAD. On page 23 and 24 there is comment regarding the factors that caused SPAD and, in particular, a comment about a number of caused by signals reverting to danger as the train approached. We suggest that this section be expanded in more detail. The reasons as to why a signal will revert vary, but the majority concern a technical fault in the system. In these cases, there is really no danger at all as the track section ahead of the approaching train has been clearly identified as being clear. It is interesting to note that in many jurisdictions, a 'technical SPAD is not considered a reportable occurrence. Accordingly, in order that a lay reader does not become unduly alarmed, it is suggested that some narrative to this effect be included.

Medical Fitness

Section 4.3 provides some analysis regarding medical fitness. Your narrative in earlier sections, 2.7 and 2.8, correctly identifies that National Express imported the pre existing Management Systems. Accordingly, the comments at page 37, that NX elected to allow drivers to continue to operate trains appears to be out of context. The issue is one of context and wording in this matter, however, we think it important. In Bayside Trains document BTHRIP-05, dated 19.01.99, titled –'Guidelines for Bayside Trains Operational Personnel Medical Examinations', clearly sets out the requirements regarding staff overdue for their medical being withdrawn from safe working duties.

APPENDIX

INVESTIGATION OF

BRAKE EQUIPMENT INTEGRITY OF AGGRESSOR TRAIN

5TH JUNE 2001

Prepared for :
Dept of Infrastructure,
Safety and Technical Services Branch
By: Graham J. Vallance
FIE Aust CP Eng

Introduction

At the request of Mr K. Butler, Manager, Accreditation Audit Systems, Safety and Technical Services Branch of the Department of Infrastructure, an engineering investigation was conducted on the 'Aggressor' train involved in the collision at Footscray on the 5th June 2001.

The purpose of the investigation was to determine the integrity and operating condition of the brake systems and individual items of brake equipment fitted to the train.

The leading unit of the 'Receiver' train was also to be inspected to ensure that no brake faults were in evidence which may have delayed its departure prior to impact.

Background

On the 5th June 2001, a 6 car 'Comeng' train (333 M-1017T-334 M, 305 M-1003T-306 M) collided with the rear of a 6-car 'Comeng' train (432 M-1066T-431 M, 503M-1102T-504 M) which was stationary at the Down Footscray platform but with brakes released and about to depart.

The lead vehicle of the Aggressor train was 333 M, and the car, which took the initial impact on the 'Receiver' train, was 504 M.

Following the incident, the two trains were made safe to propel and were removed to 1-road Car-sidings at Newport Workshops. The leading unit of the receiver train (432 M-1066T-431 M) was removed from its trailing unit and placed in the lifting road at Bayside Train maintenance depot at Newport Workshops.

Prior to removal for repair and return to traffic, the trailing aggressor unit required a roadworthiness inspection and examination to determine the condition of its brake systems.

Similarly, prior to any further movement or disturbance of the brake systems of the leading aggressor unit cars, it was required that the continuity of the brake air systems was tested.

Receiver cars

Leading Unit: 432 M-1066T-431 M

It was requested that the leading 3-car unit was checked for brake equipment function after damaged couplers and a broken resistance grid were replaced and prior to the cars being returned to traffic. As 432 M was the leading car of the 'Receiver' unit, the condition of the brake was checked to ensure there was no fault which may have delayed departure of the train.

When tested, the brake equipment functioned normally in all braking modes.

A fault was found in the operation of the Brake Pipe test switch of 431M. The fault was consistent with the Scharfenberg coupler 'Uncouple' Switch not indicating true coupler condition. As this fault would not have affected the train at the time of the incident, it was repaired and the cars declared fit to return to service.

Trailing Unit: 503 M-1102T-504 M

As this unit was only the trailing unit in the 'Receiver' train and accordingly was under the control of the driver in 432 M, it was considered that there was nothing to gain by testing the brake equipment on this unit.

Aggressor cars

Trailing Unit: 305 M-1003T-30 6M (1-road Car-sidings, Npt)

Inspection

On Friday 8th June 2001, I attended Newport shops with Mr. A. Mackay, Transport Safety Investigator of Australian Transport Safety Bureau, and Mr L Tan, Professional Engineer of Bayside Trains, to conduct a brake integrity inspection and tests on the trains involved in the collision.

As the leading unit of the 'Receiver' train was not ready for inspection at the time of our arrival, we proceeded out to the car-sidings to inspect and test the trailing unit of the 'Aggressor' train and to conduct an inspection of the other cars involved.

The trailing aggressor unit was a tread-braked train with the lead car 305 M at the Williamstown end of the unit.

The cars were initially inspected to determine their physical condition with regard to safety, prior to connecting air and overhead power.

305 M

The front of the car 305 M, which had been coupled to 334 M, had suffered damage to the Scharfenberg coupler. The coupler (which houses the electrical and pneumatic inter-car connections), had suffered significant compression causing the failure of the sacrificial 'deformation tube. The electrical cables, which are wired between the car body and the coupler, had not been damaged so that electrical inter-car testing is possible.

Internally, the driving compartment was undamaged except for dislodgment of the wheelchair ramp, probably from the impact.

A check was made to ensure the Main Reservoir pipe and Brake Pipe isolating cocks from the coupler to the car-body were operable and in the closed position.

Inspection below the car revealed that the Brake and other running equipment appeared to be undisturbed.

The Scharfenberg semi-permanent coupling had suffered irreversible distortion to the deformation tubes but electrical and pneumatic connections were undamaged.

1003T

The trailer car appeared undamaged. Deformation tubes at each end of the car appeared undisturbed as the distortion appears to have occurred to the motor car coupler tubes.

Brake equipment appeared undisturbed and undamaged.

306 M

The car appeared to be undamaged other than some distortion of the deformation tube of the semi-permanent coupler.

Static Test

305 M

Prior to raising pantographs on the train to be tested, an inspection was carried out to identify any obvious faults. The train appeared to be in reasonable condition with no apparent damage other than the Scharfenberg tubes. The pantographs were raised individually to check the integrity of each Motor-Alternator circuitry.

From the cab of car 305 M the Main reservoir pipe was observed to charge to the standard 750 kPa. The air brake was then cut in at the driver's brake valve isolating cock.

The brake pipe charged up to the correct pressure of 550 kPa.

The air brake system was then tested, first in Automatic Air mode, stepping the handle from the off to the full service position, then moving the handle to Emergency. The Automatic Air and Emergency brakes performed in accordance with normal operating parameters.

The Electro-Pneumatic (EP) brake was switched in and tested in each step applying and releasing. The brake performed correctly.

For each brake mode, the train brake-cylinders were inspected to ensure each car responded correctly.

The brake systems were tested to ensure that changeover from one mode to another occurred correctly.

The train was then briefly powered from that car and responded correctly.

The Rheostatic brake could not be tested in the stationary position, however the Earth Fault Relay was inspected and had not tripped.

The brake was applied and isolated in preparation for testing from car 306M.

306 M

The above procedure for 305m was repeated in car 306 M. The brake equipment responded correctly.

The tests conducted were in accordance with the specified brake maintenance test procedures. The brake systems operated in accordance with the specified performance limits set for normal train operation.

Following the inspection and tests the train was declared acceptable to be transferred to Bayside's train maintenance depot for replacement of the damaged components in readiness for a brake performance/acceptance test under running conditions.

Prior to the commencement of repairs, pressure transducers were installed in the brake cylinders and the brake operated to ensure the brake cylinder pressure gauges in the driving cabs were within working tolerances and to ensure pressures recorded in the car sidings were correct. All pressures checked to within 10 kPa and are therefore considered acceptable.

Running Test

Following replacement of the damaged couplers and a detailed Driver's Preparation inspection the unit was declared acceptable for a series of standard running brake performance tests which were conducted on the designated brake test section of the Newport-Werribee line on 12th June2001.

The results of the tests confirmed that the all modes of the brakes of this unit were operating correctly.

Inter-unit Continuity Test

On return to No. 3 road car sidings at Newport, car 305 M of the unit was coupled to car 530 M of the unit 530 M-1115T-552 M to test the function of the electrical inter-car connectors of the Scharfenberg coupler.

Brake function of 305-306 M was tested for Electro-Pneumatic, Automatic Air and Emergency brake modes by examining brake cylinder pressures and response in each mode, firstly while being controlled from 552 M and then from 306 M.

These tests confirmed that all brake modes were continuous through the coupler connections.

Leading Unit: 333 M-1017T-334 M

An inspection of the leading unit was conducted in No 1-road Car-Sidings at Newport Workshops, to determine the general condition of the cars and to determine if the continuity of the Main Reservoir pipe, Brake Pipe and Electro-Pneumatic brake wiring throughout the length of the 3-car unit could be temporarily restored for the purpose of carrying out function testing on the cars.

Inspection

General

Substantial impact damage had occurred to the front of the car 333 M resulting in broken brackets, windows, fibreglass front and the destruction of the Scharfenberg coupler and its electrical and pneumatic connections.

Beneath the car the only damage evident was to the compressor mount which was slightly bent downwards. It would appear that the compressor has bounced at the time of impact (a contact mark from the bracket can be seen on the compressor body). The bent bracket is consistent with a vertical downward impact, as the compressor has fallen back into place after the collision.

Inside the drivers cab, considerable structural damage was obvious, with the window broken, the collision posts and the equipment cabinet having been pushed backwards at the top, the centre of the floor is 'dished' downwards as a result of draft pocket damage, and the driver's console has been forced backwards.

The Trailer car (1017T) and trailing Motor car (334 M) had suffered body damage and complete destruction of their couplers including damaged or cut electrical cables.

Inspection of the electrical cables revealed the damage to be too extensive to enable reconnection of the control circuits along the train and hence testing of the continuity of the Electro-Pneumatic brake could not be undertaken.

Further, as the cut and broken cables included the 3-phase cables it was considered too dangerous to attempt to power-up 334M to obtain air from the on-board compressor.

333 M

Control Governor Bypass Circuit

The Control Governor Bypass circuit was installed as part of the Single Person Operation Train (SPOT) project.

The purpose of the circuit is to allow the driver, without external assistance, to continue to operate the train in the event that an irrepairable leak occurs during operation, in the pneumatic Trip circuit or the Hand/Foot Pilot-Valve circuit. Failure of this circuit to hold pressure results in the control governor shutting off, thus cutting off all power and totally disabling the train.

A by-pass cock mounted below the driver's cab activates the control governor by-pass circuit. The cock has a red handle to assist in observation of its position.

In the normal running condition, the handle is parallel to the cock body and th side of the train. In the by-pass position the handle is perpendicular to the cock body and the side of the train.

When the by-pass circuit is activated the driver is required to press an impulse-response button every 30 seconds or less, otherwise an Emergency brake application will occur.

When examined at Newport there was no sign of the by-pass having been activated.

Driver's Brake Valve Handle

The console supporting the Driver's Brake valve had been damaged in the accident such that the Brake handle could not be returned to the Running and Release position.

Due to the number of 'tripped' control circuit-breakers it is not possible to determine what mode of brake was being used at the time, however the normal brake mode should have been the Rheostatic Brake with Emergency available.

Further examination of the handle reveals an impact mark on the bottom of the handle and a scuffmark consistent with the handle having been forced forward as the distortion occurred.

By aligning the handle with the impact mark it would appear that the handle may have been in the 3rd notch position at the time of impact and have been forced to the 4th notch position. Had the driver pushed the handle into the Emergency position, the impact mark would not have been created. This would indicate that the driver had only made a partial application of the Rheostatic brake which would have been replaced by an emergency application when the trip lever struck the signal trip stop.

The Brake-valve handle and cover-plate were removed and despatched to ATSB, Canberra for further investigation.

Continuity Test

On Tuesday 12th June, Mr Tan and I conducted a continuity test on the Main Reservoir and Brake Pipe systems of 333 M-1017T-334 M in the car-sidings at Newport.

The procedure involved connection of a Main Reservoir air supply from an adjacent Hitachi train to the coupler of 334M, to pressurise the main Reservoir pipe along the train and ensure that air pressure registered on the Duplex gauge in the cab of 333 M. Air leakage detected in each car was examined to ensure the leak had occurred as a result of the incident.

Significant leaks were found in the main reservoir system from bogie air bag supply pipes and as a result of distortion of the levelling-valve arms and their mounting brackets which had obviously been damaged in the collision.

Another leak was detected in 333 M, in the electrical control cabinet beside the driver's position. This leak could not be stopped, but it was not sufficiently bad to prevent correct charging of the Main Reservoir supply.

Once the Main Reservoir continuity had been confirmed, the Driver's Brake Valve Isolating Cock was cut in at the 334M end and Brake Pipe was charged to 550kPa.

This confirmed that continuity of the Brake Pipe was also correct.

All cars were therefore confirmed as having clear and continuous Main Reservoir pipe and Brake pipe.

Air Brake Test

Following the continuity test, a test was conducted on the Automatic Air Brake and Emergency Brake of 333 M-1017T-334 M from 334 M.

With the Main Reservoir system charged and the Brake pipe fully charged, the Service air brake was applied from minimum brake pipe reduction (minimum service application), in gradual steps to Full Service Application with brake cylinder pressure checked at each end of the unit. The brake was released and the brake pipe recharged. An Emergency application was then made and checked at both ends.

In each case, brake performance complied with standard pressures for this mode of brake. (Full equalised application pressure of 275-280 kPa).

The air brake was then applied and isolated (cut-out)in 334M and cut-in at the 333 M end.

Brake pipe was observed to fully charge (550kPa). The service air brake was applied from minimum to Full Service and brake cylinder pressures checked.

An Emergency application was made and the pressure was confirmed at both ends of the unit as 275-280 kPa.

These tests confirmed that the Service mode and Emergency mode of the Air Brake system were functioning correctly.

Trip Valve: 333 M

With the driver's brake valve still cut-in at the 333 M end, the trip valve on the leading Aggressor car in the collision 333 M, was then tested in the normal manner required when a driver is preparing his train and when the trip valve is tested during routine maintenance exams.

The trip was set and the brake pipe fully charged to 550 kPa.

The trip was then struck and the brake pipe fully exhausted and continued to exhaust until the driver's brake valve handle was placed in the emergency position and then returned to Off at which point it reset. This is normal operation.

The test was repeated several times with impacts on the trip lever varied to replicate slow to fast trains speeds and hence increasing impact loads.

The result on each occasion was a correct dumping of brake-pipe air with no sign of resetting.

Accordingly it can be stated that the valve was in an acceptable operating condition and would have performed correctly during the Driver's preparation checks and in operation.

Trip gauge

During the process of testing the operation of the trip, the height of the trip lever above rail height and its distance from the rail head were tested with the appropriate calibrated trip lever setting gauge.

This is a calibrated Go/No-Go gauge which is laid across the rail and projects out to the correct position of the lever relative to the centreline of the rail. The gauge is slotted so that the lever should pass over the lower limit setting but must not pass over the upper limit. Failure either way requires resetting the trip height by moving the assembly up or down on the serrated adjustable mounting face on the axle box.

In this case the trip lever was found to be within allowable limits so that contact with properly adjusted, raised trip-stops would be assured. The trip was therefore confirmed as being fully operative and correctly adjusted.

Components test: (Westinghouse Brake Australia).

Test Requirements

Following discussions with Mr Mackay, Mr K. Butler and Mr G Perry, it was agreed that the following components should be removed from the cars, as indicated below, to be tested on the appropriate brake equipment test racks by Westinghouse Brake Australia and a report on the condition of each valve be obtained:

Car 333 M
Driver's Brake Valve
Electro-Pneumatic Brake Relay Valve (7-step Relay)
Cars 334M and 1017T,
EP Valve (7-step Relay valve)

In addition, Mr Mackay has requested that the trip lever from 333 M be removed and sent to ATSB Canberra for further tests.

Test Results

The results of the tests conducted by Westinghouse Brake Australia were received from Mr. G. Perry, on his return from overseas, on 8th Aug. A copy is attached.

The test report indicates that although there were slight variations with regard to bench test specifications in the respective valves, the variations would not have adversely affected the brake operation.

Recommendations

It was recommended that all of the remaining quarantined units be released to Bayside trains as soon as possible for repairs to avoid unnecessary delays in returning the units to traffic.

It was understood that release was conditional upon Bayside trains providing the ATSB with a report of all damage and repair costs and intended actions to be taken to prevent further incidents of items breaking loose as a result of impact.(ie: Wheelchair ramps, light fittings, fire extinguishers).

Conclusion

Prior to moving the train on the day of the incident, the driver would have conducted a continuity and function test of the brake systems and would have reported any detected defects.

From inspections and tests subsequently conducted on the train following the accident, Brake-Pipe and Main Reservoir pipe continuity were found to be unimpaired and all brake modes of the train, especially in the Emergency brake, were found to be operating correctly.

The brake systems on the aggressor train involved in the Footscray incident on 5th June 2001 were in an acceptable operating condition, capable of meeting the standard brake performance requirements for a 'Comeng' suburban train.

www.atsb.gov.au

1800 621 372

ISBN 1 877071 01 3

Footscray.11.01