



Australian Government

Australian Transport Safety Bureau



ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Rail Occurrence Investigation 2004/004
Final

Signal FS66 Passed at Danger, Freight Train 8868

Fisherman Islands, Queensland
20 September 2004



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Abstract

Train 8868 was nearing the end of its journey from Rockhampton to the Brisbane port of Fisherman Islands when it passed signal FS66 showing a stop aspect. The passing of this signal at stop circumvented the initial phase of the level crossing protection and the train passed through the Pritchard Road level crossing before the boom gates were in the horizontal position.

The driver probably experienced a micro-sleep event approaching the signal and there was no secondary protection measures to guard against such an error in a single driver operation.

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THE AUSTRALIAN TRANSPORT SAFETY BUREAU

This report is the result of an independent investigation carried out by the Australian Transport Safety Bureau (ATSB). The ATSB is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. The ATSB's objective is safe transport. It seeks to achieve this through: independent investigation of transport accidents and other safety occurrences; safety data research and analysis; and safety communication and education.

The ATSB operates within a defined legal framework and undertakes investigations and analysis of safety data without fear or favour. Investigations, including the publication of reports as a result of investigations, are authorised by the Executive Director of the ATSB in accordance with the *Transport Safety Investigation Act 2003* (TSI Act).

Readers are advised that ATSB investigations are for the sole purpose of enhancing transport safety. Consequently, Bureau reports are confined to matters of safety significance and may be misleading if used for other purposes. Reports released under the TSI Act are not admissible in any civil or criminal proceedings.

As the ATSB believes that safety information is of greatest value if it is passed on for the use of others, readers are encouraged to copy or reprint this report for further distribution, acknowledging the ATSB as the source.

EXECUTIVE SUMMARY

At 0738:06¹ on 20 September 2004 train 8868 passed signal FS66 when it was displaying a stop aspect. Train 8868 was a freight train from central Queensland bound for Fisherman Islands and was crewed by a driver who had signed on at Maryborough at 0050 the same day. Signal FS66 is about five kilometres from Fisherman Islands and about 100 metres from a busy road crossing at Pritchard Road.

Train 8868 reached Lytton Junction at about 0736 and was routed onto the Fisherman Islands branch line for the final section of the journey. The driver recalls passing through this junction and setting one of the train radios to the Fisherman Islands local control channel. He thinks he then fell asleep, as he remembers little until sensing that the train was travelling too slowly. The driver then applied full power until about 15 metres from signal FS66, by which time the train was travelling at 49 km/h. Being momentarily unaware of where he was, applying full power, noticing the cars on the level crossing before realising (when 15 metres away) that the signal was red, indicate only a partial state of arousal. A service rate reduction² of the brake pipe failed to stop the train from passing the signal and proceeding through the Pritchard Road crossing. Because of the rate of reduction and because the brake pipe pressure reduced to 229 kPa, well below the 350 kPa equalised pressure of a full service application, it is concluded that the brake handle was placed in the 'handle out' position and not in the emergency position. The 'handle out' position is the notch immediately before the emergency position.

As train 8868 passed signal FS66 the protection cycle for the level crossing was only partially complete and the boom barriers were not horizontal. Train 8868 stopped about 175 metres beyond signal FS66 and 74 metres beyond the level crossing.

The emergency response to passing FS66 on a red signal was initiated by the driver, who radioed the Mayne train control centre to tell them what had happened. The Mayne train controllers had no indication of what aspect signal FS66 was displaying, or whether the SPAD³ had occurred, as this signal was controlled by the area coordinator at Fisherman Islands. The area controller at Fisherman Islands did receive a SPAD alarm at his workstation but had not responded to it by the time the Mayne train controller called. Train 8868 remained across the level crossing for nearly 40 minutes until a relief driver arrived and moved the train.

The investigation found that the driver of train 8868 was probably experiencing microsleep episodes on the approach to signal FS66 and that this was the principal contributing factor in this incident. The investigation was unable to determine if this fatigue was 'personally induced' or 'task induced'.

The investigation also found that the interface procedures between the Mayne train control centre and Fisherman Islands local control in combination with the

1 0738:06 – Eastern standard time synchronised as described at section 2 of this report.

2 Service rate reduction – brake-pipe air vented to atmosphere at a controlled rate to apply consistent propagation throughout the length of the train.

3 SPAD – An acronym common to the rail industry that stands for 'Signal Passed at Danger'.

structure of the Fisherman Islands area coordinator/station officer's role have the potential to inhibit emergency response. Additionally, the lack of certain track and train secondary protection devices was considered to be an absent defence.

Safety actions recommended as a result of this investigation include the drafting of a fatigue management standard/policy, evaluation of secondary wayside safety devices, emergency procedure amendments, interface procedure amendments, training in these procedures and a review of attendance at the Fisherman Islands area coordinator/station officer workstation.

INTRODUCTION

Following the passing of a signal at danger on the Defined Interstate Rail Network (DIRN) by train 8868 at 0738:06 on Monday 20 September 2004, the Australian Transport Safety Bureau (ATSB) initiated an investigation into the contributing factors to this incident under the *Transport Safety Investigation Act 2003*.

Train 8868 was nearing the end of its journey from Rockhampton to the Brisbane port of Fisherman Islands when the incident occurred. The potential existed for a collision with road traffic traversing the Pritchard Road level crossing in advance of signal FS66 because the passing of this signal at stop circumvented the initial phase of the level crossing protection. This meant that the flashing lights had been illuminated for 11 seconds but the boom barriers had only just begun to lower when train 8868 proceeded through the level crossing.

This investigation sought to encompass an examination of all factors that contributed to the incident. The investigation methodology included an analysis of locomotive, signal and track data, relevant safety management systems, the actions of individuals and human factor issues.

The ATSB acknowledges the cooperation of all who participated and assisted in this investigation.

1 NARRATIVE

1.1 Overview

Train 8868 was operated by Queensland Rail's (QR) Coal and Freight Services Group (now known as QR National) and track access was provided by QR Network Access Group. Train 8868 had a maximum speed of 100 km/h, was 470.5 metres long, weighed 794 tonnes and was hauled by locomotives 2390 and 2346.

Train 8868 was being operated as a Driver Only Operation (DOO), which means that the driver was the sole crew member.

1.1.1 Location

Lytton Junction is the junction of the Fisherman Islands line and the Cleveland suburban line. Signal FS66 is located about 1.5 kilometres from Lytton Junction on the final section of the Defined Interstate Rail Network (DIRN) to the Brisbane port of Fisherman Islands. The line between Lytton Junction and Fisherman Islands is single bi-directional dual narrow (1067 mm) and standard (1435 mm) gauge. The passage of trains is controlled by the application of safety management standards and procedures in combination with colour light signalling.

Signal LJ2 at Lytton Junction governs entry to the Fisherman Islands line and is controlled by the Mayne train control centre. Signal FS66 is controlled locally by the Fisherman Islands area coordinator and is the interface point at which control of Up⁴ trains is handed over from the Mayne train control centre to Fisherman Islands local control. Signals LJ2 and FS66 are three-aspect incandescent colour light signals.

Between signals LJ2 and FS66 is the repeat signal⁵ FS66P. This signal is located 350 metres in advance of signal FS66 and displays a yellow aspect if signal FS66 is at red or a green aspect if signal FS66 is at proceed (yellow or green aspect). The sighting distance of signal FS66P is 1027 metres and the sighting distance of signal FS66 is 193 metres, the track curving to the right between these two signals. This curve is rated for a maximum speed of 60 km/h. There were no obstacles that hindered the observation of these signals within these distances.

Pritchard Road level crossing is located 101 metres beyond signal FS66 and is an active level crossing consisting of signage, flashing lights and boom barriers. Pritchard Road is a major thoroughfare for road traffic from the bayside areas to the Fisherman Islands port and industrial facilities. At the time of the incident the traffic flow on Prichard Road was described as moderate to heavy.

4 Up trains – trains travelling towards Fisherman Islands.

5 Repeat signal – intended to give advance warning of the aspect displayed in the next signal. Generally placed where signalling layout does not provide adequate scope for advance warning and/or where signal sighting distance is marginal.

FIGURE 1: Aerial photograph of Fisherman Islands precinct



FIGURE 2: Signal LJ2 at Lytton Junction and, around the corner, entering the Fisherman Islands branch line



1.1.2 The incident

The driver signed on for duty at 0050 and Train 8868 departed Maryborough West⁶ at 0135 on Monday 20 September 2004. The train then ran non stop to Beerwah⁷ crossing loop where an opposing train was crossed. Train 8868 then continued to Brisbane and Lytton Junction via Corinda⁸ and Yeerongpilly⁹, stopping five times to allow a train in advance to clear the section. From Yeerongpilly, the Mayne train controller routed train 8868 to the Fisherman Islands branch line via the dual gauge DIRN. The last signal controlled by the Mayne train controller on this route is LJ2 at Lytton Junction.

The driver of train 8868 had signed on at 0050, which was 12 hours after completing his previous shift. At about 0630 the driver asked the service delivery supervisor (see 1.2.2) what sort of a run he was going to get through to Fisherman Islands. The service delivery supervisor said arrival at Fisherman Islands would be around 0745. The driver then asked about the delay and commented that he was having trouble staying awake. However, the driver said (at interview) that he thought he could stay awake and that he had not asked for relief from duty.

At Lytton Junction the driver said he passed signal LJ2 displaying yellow (caution) and entered the Fisherman Islands branch line at the posted 25 km/h. Around this time he changed one of the radios from 'trackside' to channel 72, the Fisherman Islands local radio channel. The other radio was left on the Mayne train control centre channel 117. He thought he must have then fallen asleep for a short time after this because he remembered suddenly becoming aware that the train, which was now on a higher speed section of track, was going too slowly. He said he was momentarily unsure of where he was and applied full power. Upon rounding the right hand corner he recollected seeing a car going through the level crossing. He then noticed that the boom barriers were in the raised position and moments after, that the signal was at red. He then applied the train brake and came to a stop about 175 metres beyond signal FS66, which is about three locomotive lengths beyond the level crossing.

The driver of 8868 then contacted the Mayne train control centre and told a train controller that he had just gone past the signal before the level crossing at stop. The Mayne train controller confirmed with the driver that 8868 was stationary and asked how far the locomotive was past the signal. The driver replied 'about 150 metres'. The Mayne train controller then contacted the Fisherman Islands area coordinator and told him that 8868 appeared to have passed 'your signal' at stop. The area coordinator confirmed that a SPAD¹⁰ alarm had activated. The Mayne train controller told the area coordinator that he assumed the train was blocking Pritchard Road and that the train was to remain there until further notice.

6 Maryborough West – about 280 kilometres from Fisherman Islands.

7 Beerwah crossing loop – about 106 kilometres from Fisherman Islands.

8 Corinda – a southern suburb of Brisbane, about 30 kilometres from Fisherman Islands.

9 Yeerongpilly – southern suburb of Brisbane, about 25 kilometres from Fisherman Islands.

10 SPAD – An acronym common to the rail industry that stands for 'Signal Passed at Danger'.

The Fisherman Islands area coordinator said that he was sitting at the Universal Train Control (UTC) panel and noticed that train 8868 was approaching signal FS66. He then started setting the route for the passage of this train but, before the signal FS66 had cleared, 8868 had passed it while showing red. The area coordinator said that the SPAD alarm on his UTC panel activated at 0736 and that he intended to call the Mayne train control centre and tell him that a SPAD had occurred but the Mayne train controller called first. The area coordinator made no attempt to call the driver of train 8868 during the SPAD event to confirm whether the train had stopped.

1.1.3 Post incident

The driver of train 8868 remained on the locomotive until relieved by another driver at 0814. He was then taken to Fisherman Islands where he was breath tested by police officers at 0840 and interviewed by QR personnel. The breath test returned a negative result. Train 8868 remained stationary across the Pritchard Road level crossing from 0738:22 until 0818:20, a period of 39 minutes and 58 seconds.

There were no injuries or damage as a result of this incident.

1.1.4 Environmental factors

At 0736 on 20 September 2004, the weather at Brisbane Airport (about 6 km north-west of Pritchard Road crossing) was hazy with smoke from industrial or bush fires but visibility was greater than 10 kilometres. Air temperature was about 18 degrees Celsius.

The sun was bearing at about 77 degrees true at an altitude of about 27 degrees. The orientation of the line between signals FS66P and FS66 varies from about 010/190° true at the start of the 360-metre radius curve to about 066/246° true immediately prior to signal FS66.

1.2 Context of the occurrence

1.2.1 Personnel involved

The driver of train 8868 was a 42 year old male who was based at the Maryborough depot. This driver had extensive experience in train operations. He began as a trainee at Maryborough in 1981. Apart from the period August 1982 until November 1984, when he worked as a fireman (locomotive assistant) in Gladstone, he has been based in Maryborough for his railway career. In November 1990 he qualified as driver and in March 1993 he was appointed as locomotive driver. In May 2003 he qualified for the Park Road to Fisherman Islands route and had last driven over it in the Up direction about six months prior to this incident. He had, however, driven the route in the Down direction several times during this six-month period. His route and locomotive qualifications were current and he had been medically examined and passed fit for duty in June 2004. This driver had one previous SPAD, several years ago, but had no SPAD Worker Points¹¹ allocated at the time of this incident.

¹¹ SPAD Worker Points – an individual allocation of risk points to workers directly involved in SPADs.

The train controller on duty at the Mayne train control centre began his railway career in 1985 at Townsville as a shunter (railway operator) and became a train controller at the Mayne train control centre circa 1997. He had worked in that position since this time.

The area coordinator at Fisherman Islands had extensive experience in station and yard operations in general, having started service in 1964. He had been based at Fisherman Islands for about 10 years, five as assistant station master and five as area coordinator.

The service delivery supervisor's role is to coordinate and liaise with elements of the rail operation, including train controllers, customers and train crews in regard to the passage of trains. Coordinating relief of train crews is a component of their role.

1.2.2 Work environment

Train 8868 was crewed as DOO with the driver operating from the right side of the cabin of the lead locomotive, 2390. The 2300 class locomotives are rebuilds of older Clyde locomotives that were carried out on a progressive basis, commencing in 1997. Extensive modifications to the locomotive cabin were undertaken as a component of the rebuild program. Cabin size, air conditioning, in cab noise levels, placement of controls and driver visibility were some of the aspects where improvements were made. These locomotives have been accepted by QR management and unions as suited for DOO.

The train controller at the Mayne train control centre who was controlling the passage of train 8868 was positioned at UTC2 workstation within the centre's work area. This work area is configured as an open plan, affording easy verbal and visual communication with other train controllers and operational staff. In their area of control, train controllers also communicate directly to drivers by radio and monitor trains by visual display units (VDU's) that mimic positions of trains, signals and points 'in the field'.

The area controller who was controlling the passage of train 8868 from signal FS66 to the Fisherman Islands terminal was stationed at Fisherman Islands in the upper floor of the administration building. The work area was essentially a large office that, from time to time, housed operational staff of varying disciplines. The area controller had verbal and visual contact with trains in this area in the form of radio and VDUs that 'mimic' the position of train, signals and points 'in the field'. At times a person from the station officer's grade performed some of the operational tasks of the area coordinator.

The service delivery supervisor's office is located in the Brisbane central business district.

FIGURE 3: Fisherman Islands area coordinator's workstation



1.2.3 Track and train safety devices

The section of track between Lytton Junction and Fisherman Islands had no secondary protection devices such as Automatic Train Control (ATC), Automatic Train Protection (ATP), Automatic Warning System (AWS) or station protection magnets fitted to wayside infrastructure.

Locomotive 2390 was fitted with ATP but, in the absence of the wayside componentry, the role of the ATP was limited to preventing the maximum speed of the train being exceeded. However, the locomotive's Vigilance Control System (VCS) was functional, meaning that if the acknowledgement button was not depressed every 90 seconds, a visual and audible alarm would activate followed three seconds later by an application of the train brakes. The VCS is designed to assist in the verification of driver alertness only, and does not have the capacity to intervene in and/or monitor the operation of the train or the actions of the driver.

The track and safety devices of the section of track from Lytton Junction to Fisherman Islands met the requirements of QR standard *STD/0076/SWK'Safeworking Principles'*.

1.2.4 Signal positioning and illumination

Signals LJ2, FS66P and FS66 met the sighting and positioning requirements as detailed in QR *SAF/STD/0024/SIG Signal Positioning Principles*. Signal FS66, being situated just beyond a 60 km/h section of track, has a sighting distance of 193 metres, thereby exceeding the minimum 135 metres sighting distance set in *SAF/STD/0024/SIG*. According to this standard, repeat signal FS66P is not necessary.

At the time of the SPAD, one filament of the bulb illuminating the red aspect of signal FS66 was blown; however, the red aspect was still illuminated and, based on evidence, the defective filament is not considered to be a contributing factor in this incident.

2 ANALYSIS

Neither the condition of the track, nor the condition of the rollingstock are considered to be contributing factors to the SPAD. The key safety questions are:

- Was the safety of the road crossing compromised?
- Why did train 8868 pass signal FS66 when it was at stop?
- Why was the detection that signal FS66 had been passed at stop not acted on immediately?
- Should a train controller, who does not have control of signal FS66, have been contacted as a first response to an emergency situation?

Times were derived from three separate time sources relevant to this incident: the UTC data recorded at the Mayne train control centre, the UTC data recorded at Fisherman Islands and the ATP data recorded by the locomotive of train 8868. Given the primacy of the Mayne train control centre in terms of operational control of the Brisbane suburban system and that all telemetry control signals from the Mayne train control centre were recorded by the UTC system, the times recorded by the UTC at this centre were regarded as the standard for this investigation. This synchronisation results in 82 seconds being added to the times recorded by the UTC at Fisherman Islands and 88 seconds being added to the times recorded by the ATP of the locomotive of train 8868.

2.1 Actions of individuals and data examination

2.1.1 Driver 8868

A replay of audio communication between the driver and the service delivery supervisor confirmed the evidence at interview that a conversation regarding the anticipated path of train 8868 took place. Other evidence indicates this conversation took place at about 0630 when in the vicinity of Albion. At this time the train was some 46 kilometres from Fisherman Islands. With 1.25 hours to run, the driver expressed concern at the anticipated time it would take to reach Fisherman Islands (0745). It was at this time that he commented that he was having trouble staying awake and had hoped that he would be given a better run. His concern was not such that he asked for relief.

Signal data has also confirmed that signal LJ2 at Lytton Junction was displaying a yellow aspect to train 8868, as stated by the driver at interview. Importantly, the driver also said that this signal, in his experience, always displayed a yellow aspect (when cleared) and that he thought it was only a two position yellow/red aspect signal.

An analysis of the locomotive ATP data from Lytton Junction to Fisherman Islands records that train 8868 passed through Lytton Junction at about 0736 maintaining the correct speed of 25 km/h, with the brake-pipe fully charged (brakes released) and the power controller in the gate¹³ position. Immediately beyond the points at

¹³ Gate position – the intermediate position between idle and dynamic brake. In effect a 'barrier' that mitigates against transitioning between power and dynamic brake selections too quickly.

Lytton Junction there is a down grade of between 1 in 85 and 1 in 77 before the track becomes almost level. This sometimes necessitates a slight application of dynamic brake to hold the speed at 25 km/h until the rear of the train has cleared the junction points; the selection of the gate position implies that such action may have been anticipated. However, dynamic brake was not engaged and the power controller was moved from the gate position to idle at 0736:18 when the locomotive was 1040 metres from signal FS66 and travelling at 25 km/h.

Despite the driver believing that he fell asleep somewhere about this point, it is evident that the locomotive controls were operated several times between this time and when he reacted to his perception that the train was travelling too slowly. At 0736:50 the power controller was moved from idle to notch-one, 20 seconds later at 0737:10 to three notches, and 17 seconds later at 0737:27 to four notches. At this point the train was about to enter the right hand 360-metre radius curve and was yet to pass repeat signal FS66P. Signal FS66P was passed seven seconds later at 0737:34 with the power controller still in four notches and the speed of the train at 38 km/h.

Eight seconds later, at 0737:42, the driver placed the power controller in eight notches (full power) because he thought the train was travelling too slowly. At this time, train 8868 was travelling at 41 km/h and was 226 metres from signal FS66. Full power was maintained for about 177m past the point at which signal FS66 should have been sighted (193.5 m) with a red aspect. The time was now 0738:03 and the speed of train 49 km/h. At this point, at 15 metres from signal FS66, a service rate¹⁴ application of the train brake was made and brake pipe pressure reduced from 500 kPa¹⁵ to 324 kPa over the 19 seconds it took for the train to stop (at 0738:22). After stopping, brake pipe pressure continued to reduce to 229 kPa at the service rate for 21 seconds until the brake pipe started recharging.

FIGURE 4: Signal FS66P (left photograph), 360 metre radius curve, signal FS66 (right photograph)



14 Service rate reduction – brake-pipe air vented to atmosphere at a controlled rate to apply consistent propagation throughout the length of the train.

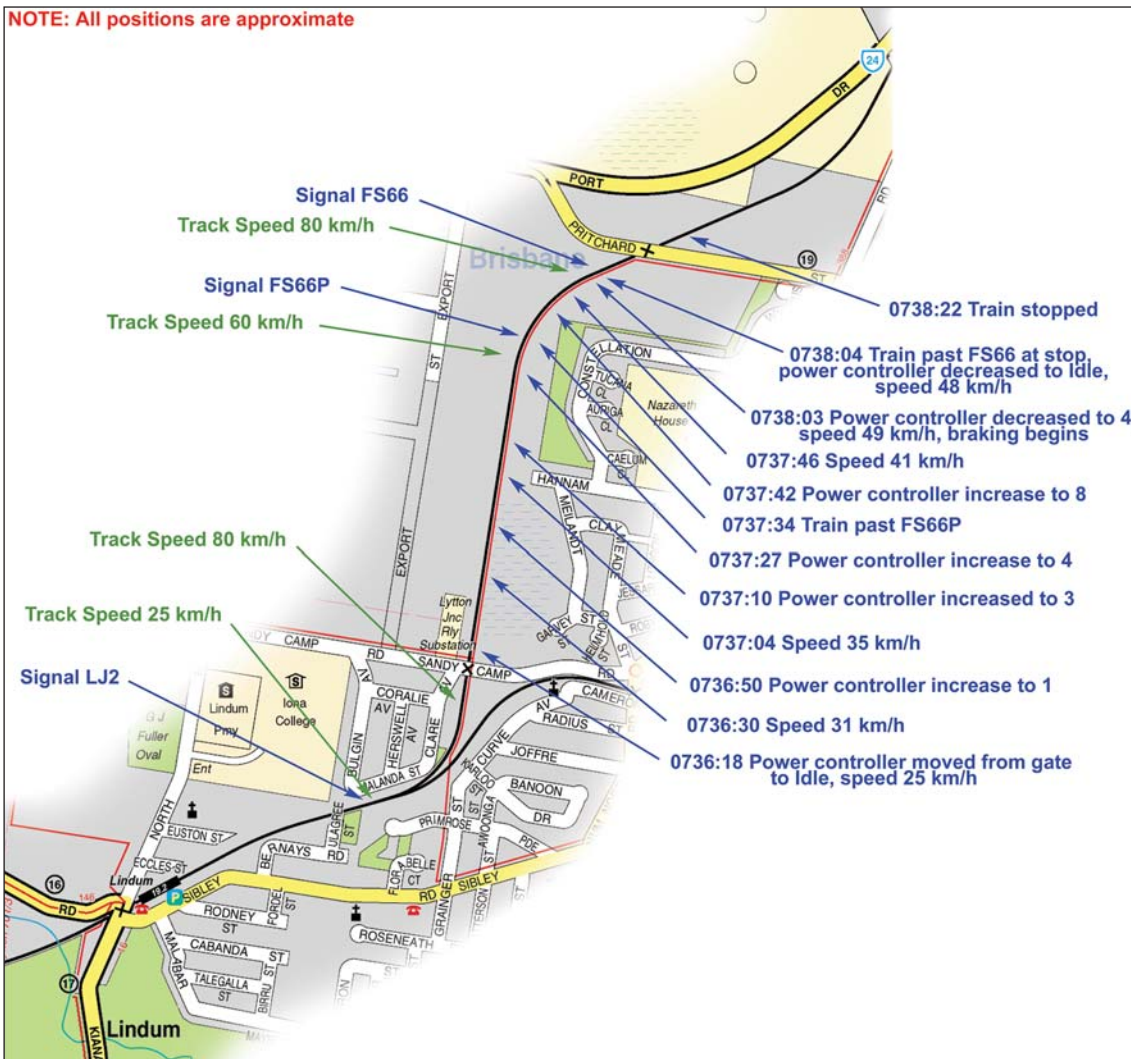
15 kPa – kilopascals.

Although the ATP data records the locomotive brake as being charged with air, the amount of air pressure is not recorded. At interview the driver said he made an emergency brake application and did not apply the locomotive brake, allowing it to apply automatically in conjunction with the train brake.

On the 2300 class locomotives, the VCS time cycle is not reset by the operation of the locomotive controls. This means that, in addition to the operation of the locomotive controls as described, that the VCS acknowledgment button must have been depressed by the driver when his arousal was in question.

The ATP data logger of locomotive 2390 did not record whether the headlight was illuminated or if the whistle was sounded as the Pritchard Road level crossing was approached. QR has indicated that the 2300 class locomotive data loggers were being modified to record the activation of the whistle but that this feature had not yet been applied to locomotive 2390. QR standard STD/0048/TEC Event Recorders stipulates that horn (whistle) and headlight operation are to be recorded by event recorders on all new locomotives after the date of implementation cited in this standard, 1 February 2002.

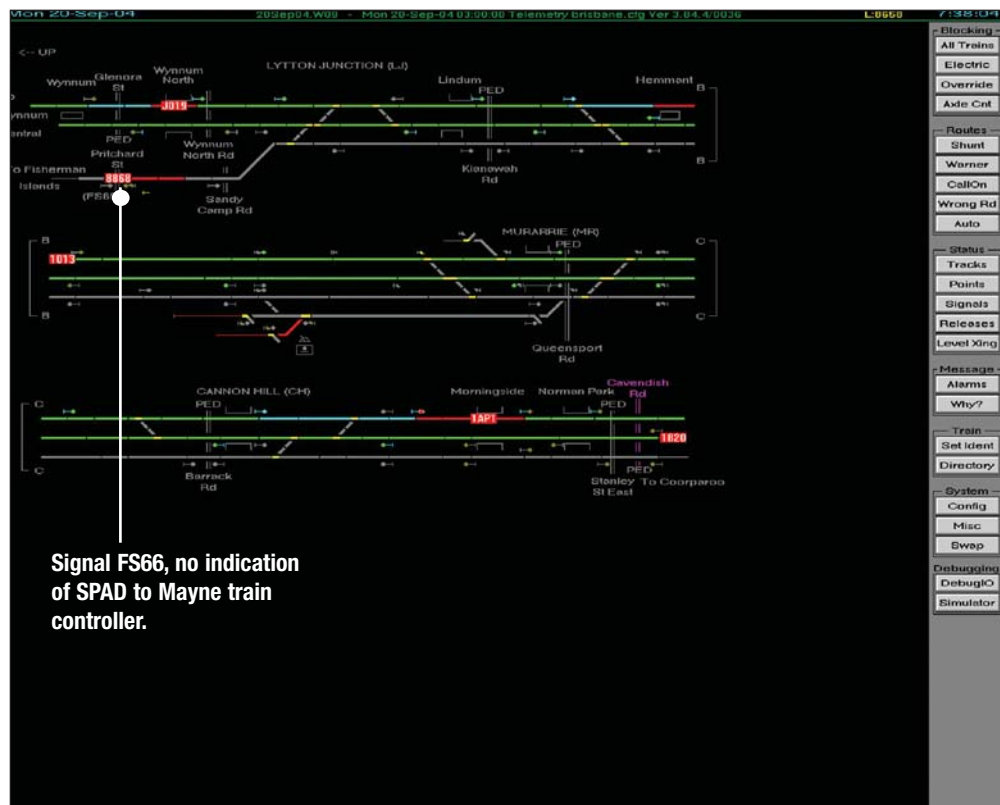
FIGURE 5: Overview of events, signal FS66 and Pritchard Road level crossing



2.1.2 Train controller, Mayne train control centre

The train controller of the UTC2 panel at the Mayne train control centre stated that he had not talked to the driver of train 8868 prior to the advice of the SPAD at signal FS66. The train controller confirmed that they have no indication of the aspect displayed in FS66 and that their role is to set the route as far as signal FS66 only. Once a train proceeds past this signal the Mayne train controller has no indication of where any train may be.

FIGURE 6: Mayne train controller's UTC screen at the time of the SPAD 0738:04



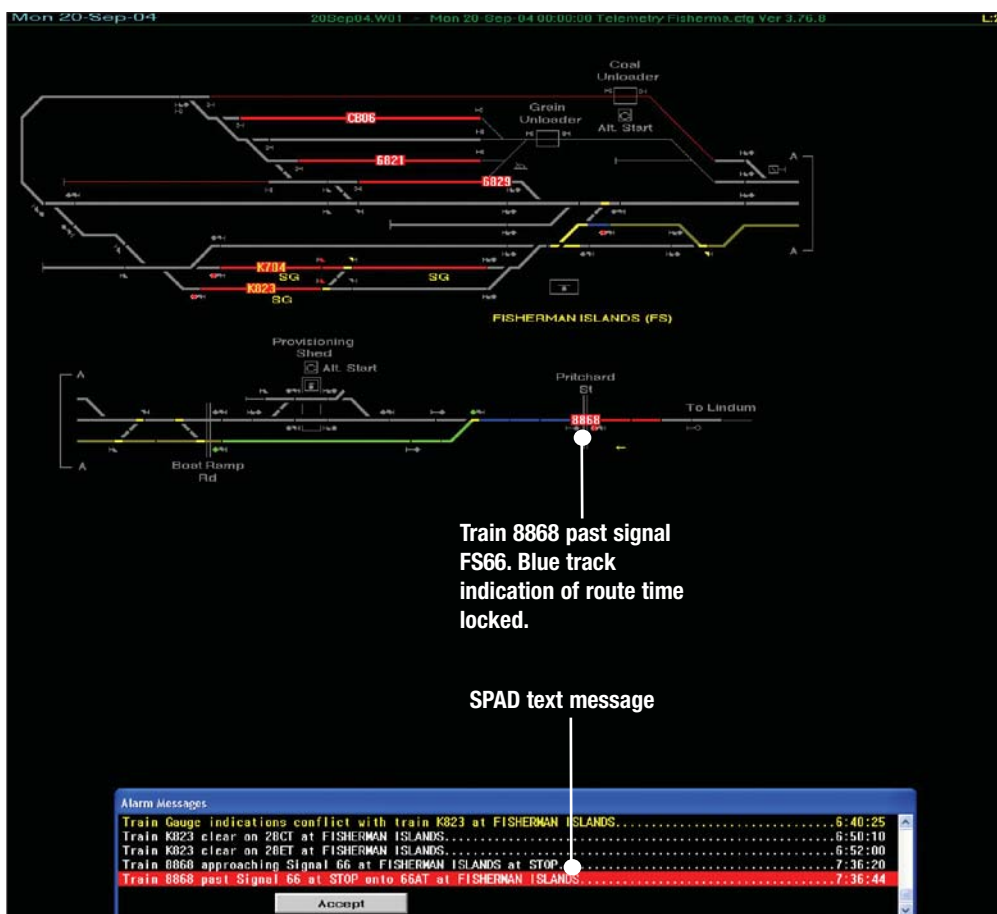
The Mayne train controller evidence was that, as far as he was aware, there is no interface procedure between the Mayne train control centre and Fisherman Islands for the handover of trains. He said that normal practice is for the Mayne train controller to call Fisherman Islands, although sometimes this is not possible because the area coordinator is not at the workstation. On other occasions the Fisherman Islands area coordinator will just accept the advice of an approaching train as it appears on his VDU screen without talking to the Mayne train controller. Equally, for Down trains from Fisherman Islands, sometimes the Fisherman Islands area coordinator will send a train to signal FS65 and, if there is no problem, the Mayne train controller will accept the train and without any conversation taking place.

2.1.3 Area coordinator, Fisherman Islands

An analysis of the UTC data from Fisherman Islands reveals that at 0737:48 the area coordinator started setting the route for train 8868 from signal FS66 into the Fisherman Islands terminal. This task was completed three seconds later at 0737:51. At 0738:04 the UTC data indicates that signal FS66 was passed in the stop position and two seconds later at 0738:06 a SPAD alarm activated at the Fisherman Islands

area coordinator's workstation. The message 'Train 8868 past Signal 66 at STOP onto 66AT at FISHERMAN ISLANDS' was then displayed on the VDU monitor. Ten seconds later, at 0738:16, the message was accepted and the SPAD alarm stopped.

FIGURE 7: Fisherman Islands UTC screen at 0738:06 (synchronised time) as SPAD alarm sounding



Pritchard Road level crossing is 101.3 metres beyond signal FS66. If signal FS66 is showing a proceed indication, the level crossing protection is 'called' upon the occupation of LJ2F track circuit. However, if signal FS66 is at red, the level crossing protection is not 'called' to operate. If the track circuit immediately beyond this signal is detected as being occupied the level crossing protection will operate regardless of the aspect displayed in signal FS66. Train 8868 occupied track circuit LJ2F at 0737:27.

The Fisherman Islands area coordinator was anticipating the approach of train 8868. After seeing the prompt on his VDU he started setting the route at 0737:51 from signal FS66 through to Fisherman Islands. This meant that the level crossing warning lights would have started flashing at 0738:00 and the boom barriers would have started to move from the vertical eight seconds later at 0738:08. Nominally, boom barriers take ten seconds to drop to the horizontal position. Train 8868 started crossing the Pritchard Road level crossing 0738:11, 11 seconds after the initiation of the warning lights and three seconds after the booms started to fall.

The light and gate closing sequence for level crossings is a nominal 25 seconds. Had the area coordinator delayed setting the route by just a few seconds, there would

have been a greater possibility of road vehicles being caught on the level crossing as the train passed through.

FIGURE 8: Pritchard Road level crossing



After the train came to a halt it was about one minute between when the driver told the Mayne train controller of the SPAD until the Mayne train controller told the Fisherman Islands area coordinator. This period is exclusive of the time between the SPAD and driver communication to the Mayne train controller and dwell times between individual transmissions. The Fisherman Islands area coordinator said he did not call the driver of 8868 during this period.

The Fisherman Islands area coordinator was aware that there was a procedure to be followed in the event of a SPAD. He said the procedure was that he would talk to the Mayne train controller as a first response.

In regard to interface arrangements with the Mayne train control centre, he said that most times the Mayne train controller will call and give advance notice of an Up train's arrival. The timing of this advance notice was said to vary between about 10 to 30 minutes or more. On other occasions though, no such call was made, or the call was unable to be answered due to the Fisherman Islands area coordinator or station officer being away from the workstation. Also, when the Mayne train controller sets a route for a Fisherman Islands bound train, a visual prompt appears on the Fisherman Islands area coordinator's VDU and an audible prompt should sound when the train is at Lindum Station. It was claimed, that sometimes this feature does not work.

The Fisherman Islands area coordinator said there have been instances where radio contact is not able to be made with trains in the Fisherman Islands precinct due to the locomotive radio not changing over or not having been changed over to the correct channel.

2.1.4 Summary

The driver of train 8868 had signed off at 1250 on Sunday 19 September, having completed a shift of seven hours 50 minutes. He signed on again 12 hours later at 0050 on Monday 20 September 2004 to work train 8868 from Maryborough to Brisbane. At interview he said he had got to sleep at about 1900 on the Sunday and had a 'staggered sleep awaking a couple of times before getting up at about 2330'. This would have amounted to, at best, four hours sleep before a night shift.

To seek to determine if the fatigue was roster induced, an analysis was undertaken using the Fatigue Audit InterDyne (FAID) computer program. This analysis encompassed the 14 shifts worked by the driver of train 8868 up to the rostered completion of duty on 20 September 2004. The result was a fatigue score of 68.7 which, according to this program, is regarded as a moderate score. Fatigue scores in the range of 80 to 100 are regarded as being high. Therefore, roster induced fatigue should not, of itself, have been a contributing factor in this driver's fatigued state.

There is little doubt that the locomotive driver was tired and that this was a contributing factor in train 8868 passing signal FS66 in the stop position on 20 September 2004. Whether this fatigue was personally induced by actions outside of work, or task induced, could not be determined.

The evidence, both at interview and in analysing driver actions, is that the driver was drowsy and, in all probability, in a state of low arousal or sleep before the SPAD at signal FS66. In this instance, the possibility of the driver having a series of microsleep episodes warrants consideration.

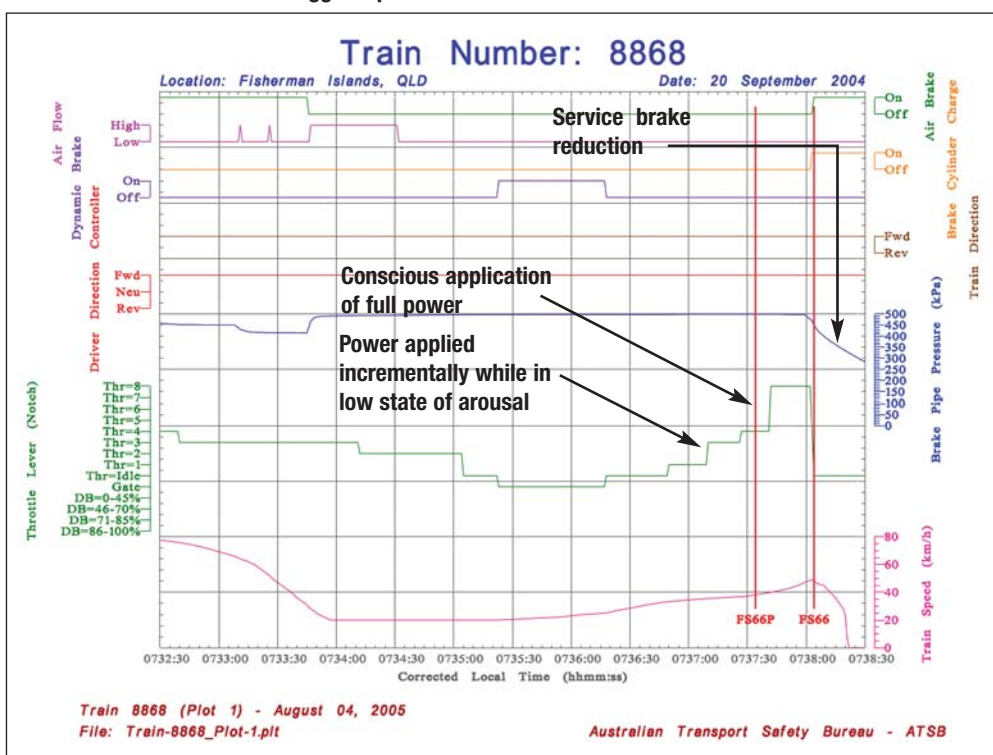
Microsleeps are short periods of sleep that last up to a few seconds. These episodes often occur when a person is fatigued and performing a routine task and are characterised by what is sometimes termed as 'brain shutoff'. During this state the eyes may remain open in a blank stare accompanied by 'head snapping' or momentary dozing. The actions of the driver in operating the locomotive controls and depressing the vigilance control acknowledgment button, passing a signal (FS66P) with no recollection or recognition prior to regaining a state of at least partial arousal, has the attributes of microsleep episodes.

In addition, the actions of the driver after he perceived the train was going too slowly are indicative of the level of fatigue associated with microsleeps. Being momentarily unaware of where he was, applying full power, noticing the cars on the level crossing prior to realising (when 15 metres away) that the signal was red, indicate, at best, only a partial state of arousal. Even when action was taken to stop the train, a service application of the brake was made in lieu of an emergency application. Because of the rate of reduction and because the brake pipe pressure reduced to 229 kPa, well below the 350 kPa equalised pressure of a full service application, it is concluded that the brake handle was placed in the 'handle out' position and not in the emergency position. The 'handle out' position is the notch immediately before the emergency position. An emergency brake application and

continuous sounding of the locomotive whistle in such a situation is mandated at section GS 4.4 (a) of the QR *General Operational Safety Manual STD/0036/SWK*. However, it is not known if the locomotive whistle was sounded (or if the headlight was illuminated) as this information is not recorded by the ATP data logger fitted to locomotive 2390.

There is also the possibility that habit patterns could have contributed to this incident. The distance between signal LJ2 and FS66 (about 1450 metres) could result in a driver normally driving to road speed rather than the aspect of signal LJ2, particularly as there is a repeat signal (FS66P) that is positioned to give advance indication of the aspect of signal FS66. The driver's perception that signal LJ2 only ever displayed a yellow proceed aspect and that he did not recall seeing the repeat signal could have influenced the driver's deliberate actions in applying full power when only 226 metres from signal FS66. The comments at interview that he '... woke and realised going too slow ... opened the throttle up ...' lend themselves to this possibility.

FIGURE 9: Locomotive data logger reproduction



The Mayne train controller had no control over, or knowledge of, the aspect displayed in signal FS66. The evidence is that the train controller and the driver of train 8868 did not talk to each other on the radio. The train controller set the route to the Fisherman Islands interface point (signal FS66) in a routine manner, advising the Fisherman Islands area coordinator in the process. Once advised of the SPAD, the Mayne train controller acted promptly and in accordance with the procedures in confirming with the driver that the train had stopped and that the signal was red. The Mayne train controller also sought information from the driver on the location

of the train. The Mayne train controller then contacted the Fisherman Islands area coordinator and enquired whether he had received a SPAD alarm.

The Fisherman Islands area coordinator should have played a major role in the post incident phase of this SPAD. He was however, relatively passive. At the time of the SPAD he was at the area coordinator's workstation and heard and accepted the SPAD alarm within 10 seconds. It has been established that at least one minute elapsed from when the SPAD occurred to when advice was forwarded to the Fisherman Islands area coordinator. During this period, no attempt was made by the Fisherman Islands area coordinator to contact the driver of train 8868 or the Mayne train controller. The investigation was unable to find a reason for this inaction.

It is possible that this incident could have had a much worse outcome, a collision with a car or bus on the Pritchard Road level crossing, train driver incapacitation, or an unabated continuation of train 8868 towards the Fisherman Islands terminal are all possibilities. Indeed, evidence that the driver applied the brakes only 15 metres from signal FS66 shows how close the driver was to not seeing this signal at all and continuing.

2.2 Organisational factors

2.2.1 Fatigue management

QR has no standards or instructions in its safety management systems regarding the management of fatigue of its workforce. Industrial agreements stipulate minimum time intervals between shifts and maximum shift lengths but do not seek to 'manage' fatigue. QR is, however, working with the Australasian Railway Association (ARA) in drafting an Australian Code of Practice that will provide guidance in this area.

2.2.2 Interface procedures

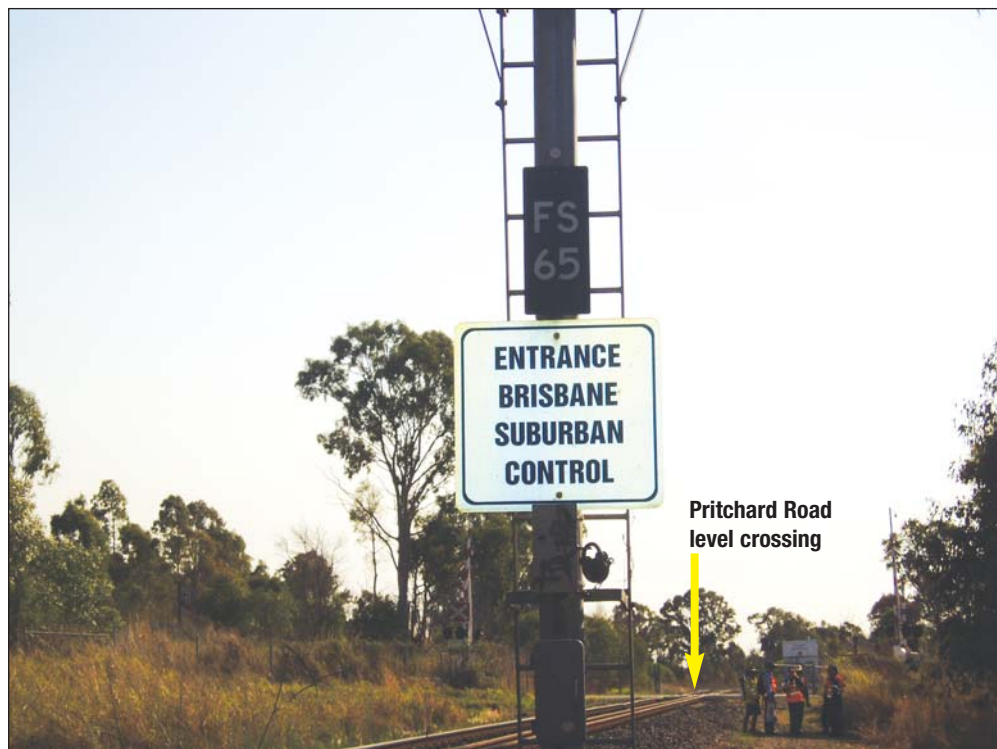
The interface arrangements for entering and exiting Fisherman Islands are contained in QR procedure *NAG-BI-1834 Procedures for Shunting, Entering and Exiting Fisherman Islands Yard*.

In general terms, this procedure requires the Mayne train controller to give advance notice (at least 40 minutes) of the anticipated arrival time of an Up train and that this advice shall be acknowledged by the Fisherman Islands area coordinator. The area coordinator should then liaise with local staff as to the placement of the train. When the Up train departs Pritchard Road level crossing, the Fisherman Islands area coordinator should provide follow-up (supplementary) advice to local staff indicating the train's imminent arrival. The Fisherman Islands area coordinator should clear the applicable signals from FS66 to the Fisherman Islands terminal. The driver of an arriving train is required to be available for radio contact with local staff on channel 72. A sign affixed to the signal post of FS66 reads: 'Change Radio 2 to Channel 72'.

Down train movements are handed over from Fisherman Islands local control to the Mayne train control centre at signal FS65, which is situated some 200 metres from signal FS66 on the opposite (Fisherman Islands) side of the Pritchard Road

level crossing. For departing (Down) trains the procedure is similar to that for arriving (Up) trains, except that the train controller at Mayne gives permission for train departures from Fisherman Islands. Although signal FS65 is controlled by the Fisherman Islands area coordinator, the signal will not clear to proceed unless the Mayne train controller operates an 'acceptance function'. This is an added measure to ensure that a Down train is not permitted to leave Fisherman Islands terminal and enter suburban traffic unless the Mayne train control centre is ready to accept it. Procedure NAG-BI-1834 requires drivers of Down trains to be available for contact with the Fisherman Islands area coordinator until departure. As shown in figure 10, a sign is affixed to signal FS65 that reads: 'Entrance Brisbane Suburban Control'.

FIGURE 10: Signal FS65, Interface for Down trains



2.2.3 Aspect displayed in signal LJ2

The proceed aspect displayed in signal LJ2 (yellow or green) is determined by whether the Fisherman Islands area coordinator/station officer sets the route beyond signal FS66 prior to the arrival of an approaching train at signal LJ2. Should the route beyond signal FS66 not be set (FS66 at red) a yellow aspect will be presented in signal LJ2. Should the route beyond signal FS66 be set (FS66 at yellow or green) a green aspect will be presented in signal LJ2.

Signal data over a three-week period in 2002 indicated that signal LJ2 presented a proceed aspect to approaching trains about 97 per cent of the time. Other data and anecdotal evidence indicate that a green proceed aspect in signal LJ2 was often presented to approaching trains.

2.2.4 Role of Fisherman Islands area coordinator

The role of the Fisherman Islands area controller is varied. Tasks such as operational planning, local coordination, planning and oversight of shunting tasks at the remote localities of Pinkenba and Doomben are carried out daily. These tasks (and others) require the Fisherman Islands area coordinator to vacate the workstation where the radio and VDUs are located at regular (frequent) intervals.

2.2.5 Emergency response procedures

The required actions of a driver of a QR train that is involved in a SPAD are set out in procedures *SAF/STD/0016/SWK Management of SPADs* and at sections 13.5.1 and 18.16.2 of *SPC/0022/WHS Operational Emergency Procedures*. Sections 13.5.1 and 18.16.2 read:

Traincrew actions

If for any reason, a train passes a signal showing a stop aspect without authority, or passes any other limit of safeworking authority:

- bring the train to a stop immediately in the first safe location
- warn trains or on-track vehicles in the vicinity
- tell the train controller immediately by making an emergency radio call
- identify the train to the train controller and give location and/or rail section
- secure the train against movement.

Note: If the signal or local safeworking system is managed by a person other than a train controller, (eg signaller or shunter), the emergency should be reported to the train controller who will advise the relevant operations manager responsible for the area.

The actions of a train controller are also set out in section 13.5.1 and they read:

If a prompt or alarm has been received that a train may have passed a signal at stop

- immediately call the driver on the radio using emergency radio procedures and tell the train driver to stop
- warn any train that may be in danger
- take any action necessary to protect trains and any workers working on the track
- ask train drivers of any trains in the vicinity to confirm their location
- report the emergency to the train control supervisor
- check relevant corridor plan, site plan and traffic plan for any necessary requirements and take action as necessary.

Similar wording is at section 4.1.1 and 4.1.3 of *SAF/STD/0016/SWK Management of SPADs*.

The driver of train 8868 and the Mayne train controller (once advised), acted in accordance with these instructions.

2.2.6 Previous incidents

QR records indicate that signal FS66 has been passed at red without authority on five other occasions since June 1997. All five SPADs were classified as category one¹⁶.

<i>Date</i>	<i>Details</i>
05/06/1997	Loaded coal train, driver unable to see signal aspect due to the glare of the sun.
30/04/1999	Driver of container train failed to control the speed of the train on the approach to FS66.
24/11/1999	Container train past FS66 by three metres, train surge and complacency of driver cited as contributing factors.
25/02/2002	Loaded grain train, driver said to have not been aware of exact location of signal and brake delay with relay type brakes.
08/09/2003	Container train past FS66 by about three metres. Some confusion evident by the driver as to whether FS66P was an approach ¹⁷ or repeat signal.

The investigation report undertaken by QR of the previous incident (8 September 2003) has been examined during this investigation. Of note is that on 8 September 2003 the driver of the train also called the Mayne train controller and was told that the signal was not under this controller's control and that he should call the Fisherman Islands area coordinator/station officer. The Fisherman Islands officer, having spoken with the driver, then incorrectly gave verbal authority for the train to proceed. Shortly after, the next signal, FS62, which is about 800 metres from FS66, was also passed at stop by this train. Again, incorrect verbal authority was given for the train to pass this signal. The details of the second SPAD were not disclosed during the initial stage of the investigation/interviews by those involved.

2.2.7 Summary

The issue of fatigue was raised by the driver of 8868 with the service delivery supervisor at about 0630 on the morning of the SPAD at FS66. The driver did not ask for relief; equally though, the service delivery supervisor did not delve further in an endeavour to ascertain to what extent the driver was fatigued. The absence of policy or standards on how fatigue is to be handled, particularly in an 'active' operational sense as opposed to a planning sense (work environment, task structure, rosters etc), could have contributed to the inaction of both the driver and the service delivery supervisor in this instance.

The interface arrangements in procedure *NAG-BI-1834 Procedures for Shunting, Entering and Exiting Fisherman Islands Yard* instruct the driver of Up trains to be on the correct channel for contact with the Fisherman Islands area coordinator/station officer. However, this procedure does not state the location at which Up trains are required to change to this radio channel. There is a sign affixed to the signal post of FS66 but this is not mentioned in the procedure. This procedure provides no

¹⁶ Category one SPADs – Defined in QR standard *SAF/STD/0016/SWK Management of SPADs* as being a signal overrun not exceeding 50 metres.

¹⁷ Approach signal – intended to give advanced warning of the aspect displayed in the next signal. Is placed at or in excess of braking distance to the next signal.

mechanism for ensuring that the train radio is indeed on the correct channel; for example, a radio check at a pre-determined point prior to signal FS66.

In regard to departing trains, procedure NAG-BI-1834 reads:

The driver of a train departing from Fisherman Islands Yard will be required to remain available for radio contact by the Area Coordinator/Station Officer until departure from Fisherman Islands where radio communications will be with the Network Controller on the channel nominated in Attachment 'A'.

This wording is unclear in regard to where the radio channel is to be changed: whether upon departure (physical movement), at the applicable starting signal, or departure from the Fisherman Islands yard (at signal FS65). Also, this procedure incorrectly refers to signals FS66 and FS65 as being dual-controlled and different radio channels are displayed in signage 'in the field'. The radio channel numbers displayed on the sign that is affixed to the signal post of signal FS66 are 2 and 72. The correct channels are Mayne train controller, 117 and the Fisherman Islands area coordinator/station officer 72.

In the event of a SPAD, the QR emergency response procedures *SAF/STD/0016/SWK Management of SPADS and SPC/0022/WHs Operational Emergency Procedures* require the driver to immediately contact the train controller. In this instance however, the train controller was not in control of the signal, as this was the responsibility of the area coordinator. In this respect the procedures do not take into account the particular interface between Mayne train control and local Fisherman Islands control. For example, the driver emergency response requirement means that the initial notification of the emergency situation is to someone who has no immediate control of the situation. The principal risks are that radio coverage to this person may not be available, additional time would be taken for the train controller to convey details of the emergency situation to the officer in charge, and there would be potential loss of accuracy during a three-way transmission.

In regard to a train controller's emergency response, the ability to carry out these requirements is not only hindered by these risks but moreover, in the absence of a SPAD alarm, it is predicated on notification being received from the driver or the Fisherman Islands area coordinator/station officer. In this instance, the driver was 15 metres from the signal when a brake application was made. This shows how close this SPAD was to being a signal missed altogether, thereby indicating that the radio message from the driver to the Mayne train controller would not have been made in the first place.

Even if notification of a SPAD is conveyed via the Mayne train controller to the Fisherman Islands area coordinator as required by the relevant procedures or SPAD alarm, the initiation of appropriate action is predicated on the area coordinator being at or near the workstation. Also, if the incoming train is on the wrong channel, it will not be in a position to receive or respond to emergency radio transmissions. The evidence is that this workstation is often unattended and that there have been instances of incoming trains being tuned to incorrect radio channels.

The dual gauge line between Lytton Junction and Fisherman Islands carries considerable traffic and is accessed by several operators. Being the interface point for Up trains as described, signal FS66 and the management thereof, are key elements in the safe passage of trains on this corridor. The evidence is that FS66 has been passed at stop without correct authority on five occasions prior to the SPAD that occurred on 20 September 2004 and is currently listed as a 'black-spot multi SPAD signal' by QR. The risk of a serious collision between a train and road vehicles as the result of a SPAD is increased by the proximity of the road crossing to signals FS66 and FS65.

It is evident that there are a number of absent defences at this interface. These absent defences are the lack of secondary track and train protection devices such as station protection magnets, AWS and ATC/ATP. Such safeguards provide additional risk mitigation against driver error, particularly when the train is being operated as driver only. Also, there is no guarantee of full-time attendance at the Fisherman Islands area coordinator's workstation and no guarantee of an incoming train being on the correct radio channel.

With the exception of the attendance of the area controller at the workstation, these absent defences played a role in the passing of signal FS66 by train 8868 on 20 September 2004. Likewise, the locomotive VCS, signals FS66P and FS66, level crossing protection on Pritchard Road and communication (procedural and inaction) were all failed defences.

3 CONCLUSIONS

3.1 Findings

- 3.1.1 The personnel involved in this incident were experienced and appropriately qualified in their respective duties.
- 3.1.2 The location and sighting distances of signals LJ2, FS66P and FS66 were in accordance with, and in fact exceeded, the requirements of *QR STD/0024/SWK Signal Sighting Principles*.
- 3.1.3 The driver of train 8868 applied the train brakes when 15 metres from signal FS66.
- 3.1.4 As calculated by Interdynamics Pty Ltd FAID computer program, the fatigue experienced by the driver was moderate and not roster-induced.
- 3.1.5 The setting of the route beyond signal FS66 by the area coordinator at Fisherman Islands meant that the Pritchard Road level crossing flashing lights had been operating for 11 seconds and the boom barriers had just started to lower.
- 3.1.6 The risk of a SPAD was increased by the absence of secondary track or train protection equipment and hence the consequential risk of a level crossing accident.
- 3.1.7 A SPAD alarm activated at the Fisherman Islands area coordinator's workstation at 0738:06, two seconds after signal FS66 was passed at stop by train 8868.
- 3.1.8 The SPAD alarm at Fisherman Islands had been accepted by the area coordinator by 0738:16, 10 seconds after the alarm initiated.
- 3.1.9 The driver's actions in contacting the Mayne train controller were in accordance with relevant procedures.
- 3.1.10 The Mayne train controller's emergency response was in accordance with relevant procedures.
- 3.1.11 There was a general lack of knowledge on the part of the Mayne train controller and the Fisherman Islands area coordinator in regard to interface procedures between the two operational centres.

3.2 Contributing factors

- 3.2.1 Moderate traction power was incrementally applied to the locomotives of train 8868 on the approach to signal FS66P and full traction power applied approaching signal FS66.
- 3.2.2 A service rate application of the train brakes (brake handle in 'handle out' position) was initiated 15 metres from signal FS66 at a speed of 49 km/h.
- 3.2.3 The driver of train 8868 had a maximum of four and a half hours sleep between shifts and was fatigued and probably experiencing microsleep episodes on the approach to signal FS66.

- 3.2.4 The driver's perception of travelling too slowly when approaching signal FS66 is an indication that he was attempting to drive at the track speed in lieu of the yellow (caution) aspect displayed in signal LJ2.
- 3.2.5 The locomotive vigilance control system was ineffective in maintaining the driver's vigilance.
- 3.2.6 There was an absence of secondary protection measures to guard against error in a single driver environment.

The following contributing factors are relevant to the emergency response phase of this incident.

- 3.2.7 Apart from the driver's radio call, the Mayne train controller received no indication that a SPAD had occurred at signal FS66.
- 3.2.8 In accordance with the relevant emergency response procedures, the driver of 8868 contacted the Mayne train controller and not the Fisherman Islands area coordinator, who had control of signal FS66, as a first response.
- 3.2.9 The Fisherman Islands area coordinator did not contact the driver of 8868 after receiving a SPAD alarm at his workstation.
- 3.2.10 The Fisherman Islands area coordinator did not contact the Mayne train controller after receiving a SPAD alarm at his workstation.

The following contributing factors are relevant to the interface arrangements that exist between the Mayne train control centre and Fisherman Islands local control.

- 3.2.11 The current interface procedures between Mayne train control and Fisherman Islands do not provide a robust procedure to ensure a guarantee that, at and beyond signal FS66, incoming trains will be on the Fisherman Islands local radio channel. This could render emergency radio transmissions ineffective.
- 3.2.12 The structure of the Fisherman Islands area coordinator's/station officer's role is such that the workstation where signals and train movements are monitored is often unattended. This could render emergency response requirements ineffective.
- 3.2.13 The current interface procedures between Mayne train control and Fisherman Islands are deficient with respect to certain facets of radio channel allocation and signal description, as noted in recommendation RR20050039 below.

4 RECOMMENDED SAFETY ACTIONS

As a result of its investigation, the ATSB makes the following recommendations with the intention of improving railway operational safety. Rather than provide prescriptive solutions, these recommendations are designed to provide guidance to interested parties on the issues that need to be considered. Recommendations are directed to those agencies that should be best placed to action the safety enhancements intended by the recommendations, and are not necessarily reflective of deficiencies within those agencies.

RR20050036

The ATSB recommends that QR compile a fatigue management policy/standard to guide managers and workers in how to manage fatigue in planning and operational situations. This policy/standard should also provide guidance on how to deal with reported instances of fatigue.

RR20050037

The ATSB recommends that QR evaluate the installation of wayside secondary protective/prompt device/s in advance of signal FS66. Such device is to be compatible with all operators. This recommendation is made in light of the position of FS66 and the number of SPADs that have occurred at this signal.

RR20050038

The ATSB recommends that QR amend the emergency response procedures applicable to Fisherman Islands to ensure that initial notification of a SPAD is sent to the officer who has control of the signal in question.

RR20050039

The ATSB recommends that QR amend the interface procedures between Mayne train control centre and Fisherman Islands with the intention of ensuring that all trains are contactable by the Fisherman Islands area controller/station officer when in signalled territory controlled by the Fisherman Islands area coordinator/station officer. Boundaries of signalled territory should be clearly defined and current discrepancies in regard to radio channels and signal control should also be amended.

RR20050040

The ATSB recommends that QR undertake training of all concerned in regard to emergency response and interface procedures between the Mayne train control centre and Fisherman Islands.

RR20050041

The ATSB recommends that QR examine methods of ensuring continued attendance by appropriately qualified employees at the Fisherman Islands area coordinator/station officer workstation.

RR20050042

The ATSB recommends that the Queensland Railway Safety Regulator actively monitor the actions initiated by QR in response to this investigation.

5 SUBMISSIONS

5.1 From QLD Department of Transport

Section 26, Division 2, and Part 4 of the *Transport Safety Investigation Act 2003*, enables the Executive Director to provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate, for the purposes of:

- a) allowing the person to make submissions to the Executive Director about the draft: or
- b) giving the person advance notice of the likely form of the published report.

Queensland Transport made a number of comments and observations on the draft report issued to directly involved parties. Some of these comments and observations have been incorporated into this report where they were supported by evidence or agreed by the investigation team.

**Signal FS66 Passed at Danger, Freight Train 8868
Fisherman Islands, 20 September 2004**

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