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Australian Transport Safety Bureau

Safeworking breach involving a Local Possession Authority

Revesby, New South Wales | 10 July 2013



Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2013-017
Final – 19 September 2014

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Addendum

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Safety summary

What happened

On 10 July 2013, a pre-planned and advertised Local Possession Authority (LPA) was implemented on the Up Main line between Revesby and Turrella.

Approximately 30 minutes after the LPA was implemented, passenger train 709C entered the limits of the possession area and immediately ran over railway track signals (detonators) and was brought to a stand. There were no injuries or damage.

Revesby Station



Source: OTSI

What the ATSB found

The ATSB's investigation found that an LPA was an appropriate method of authorising the work to be performed. However, a combination of individual actions and systemic issues contributed to the incident. Two Special Train Notices (STNs) were published, one highlighting the limits of the LPA (called the proforma) and the other advising of altered train running (or pathing) arrangements. When implementing the LPA, two Sydney Trains area controllers working the Revesby control panel incorrectly assumed the limits of the LPA were at the city end of Revesby (clear of 51 points) rather than the country end (clear of 55 points). As a result blocking facilities were applied at the wrong location. These actions were partly influenced by a deficiency in the train pathing STN, which routed city-bound trains via 51 points. A final amendment to the proforma STN, extending the possession limit to 55 points, was not accounted for in the pathing STN, resulting in the two STNs being incompatible and contrary to engineering and pathing requirements when implemented.

A number of Sydney Trains' procedures were examined to determine if any area of the planning, advertising and implementation of the LPA contributed to the incident. The ATSB found that the key parties involved in the implementation of the LPA did not come to a mutual understanding of the possession limits and other potential entry points or impact to train running arrangements. Documented procedures were not accurately followed and critical safety information was not confirmed by train control. The ATSB also found that there was an over-reliance on informal and verbal handover procedures amongst area controllers.

What's been done as a result

As a result of the incident, Sydney Trains implemented changes to STN production and validation processes. Sydney Trains also updated the signal box phone list and the Protection Officers Handbook which were published on their RailSafe website. Sydney Trains proposes to undertake targeted assurance in relation to adherence to safety critical communications protocols in LPAs in order to determine whether the non-compliances revealed in this investigation represent a systemic failure.

Safety message

In order to minimise errors prior to implementing LPAs, key parties should come to a mutual understanding of the possession limits and impact on train running, and ensure that altered train running (pathing) is compatible with the advertised possession limits. Rail operators should also recognise that handovers leading up to or during the implementation of an LPA increase exposure to the possibility of error and that this risk can be mitigated if train controllers, signallers and protection officers comply with documented procedures, protect all entry points and repeat back safety critical information.

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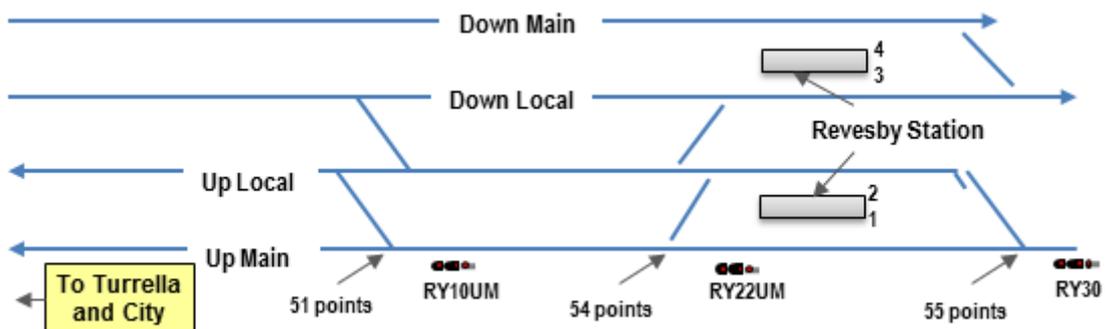
The occurrence

Events leading up to the occurrence

On Wednesday 10 July 2013, a train controller¹ signed on duty at the Rail Management Centre (RMC) at Central railway station Sydney at 0430² in preparation to work an extended shift on the Sydney Operations Control Illawarra Board. All tracks between Turrella and Revesby form part of the overall rail territory covered by this train control board.

At 0913 the train controller (TC) contacted two area controllers (ACs), both located at Sydenham signal complex, to discuss a possession³ which was due to commence at 0930. These ACs were on the Wollie Creek Panel (controlling the Turrella end of the possession) and Revesby Panel (controlling the Revesby end). The possession protection method to be used was Local Possession Authority (LPA), which is used to close a defined portion of track for a specified period. LPAs must be advertised in a Special Train Notice (STN)⁴ at least seven days in advance and two STNs were issued advertising the work – STN 1003-2013 (the ‘proforma’ STN which showed the possession ‘limits’ or boundaries) and STN 1004-2013 (which showed the train running/pathing). In anticipation of the possession going ahead at the appointed time, the train controller initially sought four assurances from the ACs – that they had a copy of the STN, they understood the limits of the LPA, that the section was clear of rail traffic and relevant blocking facilities⁵ were applied. The train controller received affirmation from both ACs and he then stated the limits of the possession as: ‘Up Main line Revesby clear of 55 crossover back to Turrella clear of 502 crossover’ (the track layout at Revesby is shown in Figure 1). For his part, the AC rostered on the Revesby Panel assumed the possession was clear of 51 points at Revesby, an assumption reinforced by his recollection of the pathing for up services in a previous possession configuration, and the pathing on STN 1004, which incorrectly pathed city-bound services via 51 points.

Figure 1: Diagram of configuration of track and signals at Revesby



Source: OTSI, not to scale and some details omitted

¹ With effect 1 July 2013 Sydney Trains became accredited as a rail operator under the Rail Safety National Law (NSW) whilst RailCorp continued to be the owner of the Metropolitan Rail Area network (MRA) including stations and rolling stock. All employees, roles and maintenance responsibilities for the MRA network referred to in this report are under the control of Sydney Trains.

² All times referred to in this report are Eastern Standard Time, Coordinated Universal Time (UTC) + 10 hours.

³ A possession is an arrangement whereby a section of line is closed to normal rail traffic to allow engineering staff to carry out works.

⁴ The Network Rules Glossary describes a ‘Special Train Notice (STN)’ as: ‘A published notice providing details of train operations or events that might affect train operations’.

⁵ Blocking facilities: a facility or device used by a competent worker to prevent either the unintended issue of an occupancy authority, or the operation of points or signalling equipment. (Rail Industry Safety and Standards Board (RISSB) - National Guideline Glossary of Railway Terminology).

In an effort to minimise the impact of two late running city-bound Southern Highlands passenger services, the train controller, possession protection officer (PPO) and rostered ACs agreed to delay the start of the possession and operate trains as normal via the Up Main line, until these two services had cleared Turrella.

Around 1000, the AC rostered on the Revesby Panel was relieved for a routine break and during a handover process, he informed the incoming relief AC that the possession would be expected to commence from 51 points once the two city-bound Southern Highlands passenger services had cleared Turrella. Similarly, the relief AC had the impression that the possession was clear of 51 points by his own recollection of the previous possession configuration and the pathing on STN 1004, a view which was further reinforced by the instructions from the rostered AC during handover. The train controller was not made aware that there had been a routine changeover of ACs on the Revesby Panel as there is no procedural requirement to do so.

By 1019 the last of the two late running services had cleared Turrella and the train controller recommenced implementing the LPA with the two ACs on the Wollie Creek and Revesby panels. The train controller assumed it was the same AC who was involved in the earlier discussions so after a short discussion reiterated only two assurances with the AC, receiving verbal affirmations that the section was clear of rail traffic and blocking facilities were applied. At the same time, in anticipation of the LPA going ahead, the relief AC on the Revesby Panel applied blocking facilities beyond 51 points to prevent direct entry to the Up Main line at Revesby and also at the intermediate points (512 points near Beverly Hills), an action which was to prevent trains being inadvertently pathed from the Up Local line, across 512 points onto the Up Main line.

At 1020, based on these affirmations of the ACs, the train controller declared the LPA in force and then contacted the possession protection officer (PPO) to confirm the possession arrangements. Shortly after, the PPO placed possession protection or railway track signals (consisting of a red flag and three detonators)⁶ at the Turrella end near 502 points and made arrangements for another protection officer (PO) to place railway track signals near 55 points. At this point, both the PPO and PO were unaware of the presence of a train, 707D, at Revesby, nor that the Up Main line between 55 points and 51 points was not protected when the PO began to place possession protection. At 1030, when the PO completed that task, he moved off the track and to a safe place. Whilst possession protection was placed to protect against unplanned entry of trains at each end of the possession area, the PPO had not taken into account the potential entry points via 512 points, nor 54 points⁷ at Revesby and no additional possession protection was placed in those areas.

Meanwhile, the relief AC on the Revesby panel had set up a signalling route for an approaching city-bound passenger service (707D) to travel past 55 points, along the Up Main line through Revesby No 1 platform and traverse 51 points (refer to Figures 1 and 4). The train crew of 707D, unaware of the possession that was now in force, carried out a routine stop at Revesby before departing at 1021. The train travelled across 51 points onto the adjacent Up Local line where it continued the journey towards the City without incident.

The occurrence

At 1045, the relief AC on the Revesby panel made preparations for the next city-bound passenger service (709C) and set up a similar route to that of 707D, that is a route past 55 points, along the Up Main line through Revesby and across 51 points (refer to Figures 1 and 5).

⁶ Detonators, or detonating signals - Impact explosive devices secured on top of the rail of the track to be protected, to attract the attention of train crews. (RISSB – National Guideline Glossary of Railway Terminology)

⁷ The ACs assumed the LPA commenced at 51 points and from this perspective 54 points were positioned outside the possession area and a blocking facility was not required.

At 1049, train 709C passed 55 points (the advertised limit of the possession) and entered the Up Main line. Shortly after, the train ran over and exploded three detonators. The driver immediately brought the train to a stand approximately 160 m from the country end of Revesby platforms.

Post occurrence

Following the incident the driver of train 709C contacted the relief AC and was initially advised to remain stationary pending further instructions. The relief AC contacted the train controller and shortly after arrangements were made for the train to be advanced into Revesby where it terminated on platform 1. Passengers were transferred to a waiting train on platform 2 to continue their journey towards the city.

In the meantime, the train controller initiated incident management procedures and shortly afterwards spoke to the PPO who confirmed that all members of his work crew were safe and that no work or equipment had been in place at Revesby between 55 and 51 points.

After discussion between the train controller and shift supervisor in Sydenham signal complex, the relief AC was placed under the immediate supervision of the shift supervisor until a replacement AC relieved him of his duties. Sometime later, the relief AC was relieved from duty and along with the rostered AC subjected to drug and alcohol testing, the results of which were assessed as negative. Before the two ACs ceased duty, it was determined by Sydney Trains that actions by other parties did not contribute to the occurrence, so no other person was subjected to post-incident drug or alcohol testing.

At 1101 the train controller contacted the PPO and requested that, because of this incident, he discontinue the work, clear all staff and equipment from the line, 'fulfil' the LPA and prepare to hand back the line for normal operations. By 1149, the PPO was able to satisfy this request and when he confirmed this with the train controller, he immediately 'fulfilled' the LPA.

Context

Incident location

The incident involving train 709C occurred on the Up Main line approximately 160 m on the approach to Revesby station which is located in the East Hills rail corridor approximately 20.885 km⁸ by rail south-west of Central railway station, Sydney (Figure 2).

Figure 2: Location of Revesby



Source: NatMap, Railways of Australia, Geoscience Australia

There were four platforms at Revesby station and the East Hills rail corridor contained two standard gauge Up and Down East Hills lines, diverging at Revesby into four standard gauge lines: the Up and Down Main lines, which predominantly carried high speed express passenger trains; and the Up and Down Local lines, which predominantly carried slower (all stops) passenger

⁸ All kilometrages are measured from the buffer stop at No. 1 platform at Central railway station, Sydney Terminal. The kilometrage shown for Revesby station is referenced from the Network Local Appendices (NLA) 510.

trains. The posted track speed for the Up Main line past 55 points and through Revesby station was 115 km/h.

Environmental conditions

The early hours of the morning were cool and cloudy with 1.2 mm of rainfall recorded in the 24 hours up to 0900. The overnight minimum temperature was 7.3 °C as recorded by the Bureau of Meteorology at Holsworthy, approximately 8 km from Revesby station.

It was determined that the environmental conditions did not contribute to the incident.

The Kingsgrove to Revesby Quadruplication (K2RQ) Project

The Kingsgrove to Revesby Quadruplication project involved the construction of two additional tracks between Kingsgrove and Revesby and associated bridge and station works required to allow for a physical separation of local (all stations) and express services operating on the East Hills line. It was anticipated that train service reliability would improve as delays to local services would not affect express services and vice versa. In addition, there would be increased capacity to run additional all stops and express services on all the East Hills lines including provision for future services for the proposed South West Rail Link (Glenfield to Leppington). The final phase of the project was commissioned during the weekend 13-15 April 2013.⁹ From an operational and timetable perspective, full use of the line was introduced with the timetable change on 20 October 2013.

As part of the K2RQ pre-commissioning phase, both ACs participated in a 'training brief' (a training course) in February 2013 which provided instructions in the correct use of new infrastructure between Kingsgrove and Revesby. The objective was to allow ACs to gain the necessary skills required to perform their duties with the new and altered signalling infrastructure including the new Revesby panel. Course material indicated that it was two hours in duration and consisted of: '...a 1 hour training session conducted by a Signaller Trainer and a 1 hour review on the 'live' workstation'. Participants were not assessed.

Development of the occurrence

The track inspection work

The track work being undertaken by the team involved taking measurements and inspecting the track at various locations between Turrella and Revesby. Track inspections of rail lines are undertaken periodically and those undertaken on the Up Main line were formally requested by an engineering 'bidder' by entering the possession scope into a possession management system called 'TRAK2'. The bid remained in that system and was approved by Sydney Trains Asset Management. This work was usually carried out quarterly under LPA arrangements and required advertisement on two related STNs.

The previous possession occurred on 17 April 2013 just two days following the final K2RQ commissioning. On this occasion, the scope was for an LPA of the Up Main line from Beverly Hills (clear of 512 crossover) to Turrella (clear of 502 crossover). This work was advertised on STNs 0748 – 2013 (the proforma) and 0749 – 2013 (the altered train running arrangements). For this possession configuration, pathing for city bound train services on STN 0749 was via 51 points at Revesby.

⁹ Details of the new and altered signalling infrastructure brought into use upon commissioning was advertised in RailCorp Weekly Notice 14-2013.

When the engineering 'bidder' submitted the next quarterly request for this work to be carried out (on 10 July 2013), the possession scope was again submitted and approved for the Up Main line from Beverly Hills (clear of 512 crossover) to Turrella (clear of 502 crossover). On 1 May 2013, the bidder requested the possession boundaries be modified and increased through to Revesby (clear of 55 crossover). This was the first time this increased possession boundary was requested post the K2RQ commissioning, nonetheless, this amendment to the original bid was approved and work began within Sydney Trains Train Planning unit on finalising the two related STNs.

Development, validation and distribution of the STNs

The Train Planning unit is responsible for the production, validation and distribution of STNs. This unit had access to the TRAK2 system and work on STNs would only commence once a possession bid was approved.

Within the Train Planning unit there was a review or validation process for all STNs and a range of documents were provided detailing the production, validation and distribution processes. There was a different process and different team members (many referred to as train planners) were assigned to the various STNs depending on the rail regions and whether they were developing the proforma or the plan for the altered train running arrangements.

The unit had a 'RailTable' system within which was a 'conflict' program called the Track Closure file which had the capability to identify what trains would be affected by a particular possession scope. That is, it checked for a conflict between the possession boundary and the trains which would be affected and require alteration. Various scenarios could be examined using the program. The need for further negotiation among bidders, Asset Management and the Train Planning unit could be identified by altering parameters including possession boundaries; times, routes and stopping patterns of trains; and other arrangements such as transferring passengers by bus to another station. For the LPA between Turrella and Revesby, the internal validation processes required the two teams to liaise and come to a mutual understanding of the possession scope and how this may impact on the train running arrangements.

Network management

The Up and Down Main lines and Up and Down Local lines between Turrella (8.565 km)¹⁰ and Revesby (20.885 km) form part of the Sydney Trains controlled Metropolitan Rail Area network (MRA). Sydney Trains was responsible for track maintenance, signalling, train control and incident management functions in this corridor.

Train movements in this area are controlled by a combination of automatic and controlled signals under RailCorp's¹¹ *Network Rule NSY 500 Rail Vehicle Detection System*. All signals and points are monitored remotely from the Sydenham signal complex. At the signal complex, area controllers (signallers) operate panels, each covering a defined portion of the total area controlled from Sydenham. The incident occurred in the area controlled from the Revesby panel.

This panel covers rail operations between Bardwell Park and Holsworthy and has signalling control over the rail territory on both the Up and Down Main lines and Up and Down Local lines (Bardwell Park to Revesby) and the Up and Down East Hills lines (Revesby to Holsworthy).

Network control and worksite protection

RailCorp's *Network Rule NWT 300 Planning Work in the Rail Corridor* requires work in the danger zone to be planned and to be carried out using one of five methods of worksite protection. The

¹⁰ The kilometrage shown for Turrella station is referenced from NLA 402.

¹¹ With effect 1 July 2013, RailCorp retained ownership of the MRA, Sydney Trains (metropolitan services) and NSW Trains (regional services) were formed. Both entities became accredited rail operators and inherited a number of staff, documents, systems, assets and responsibilities from RailCorp.

methods require varying levels of authority and competencies to implement and, despite their technical differences, all are underpinned by the following fundamental safety requirements:

- work cannot occur unless the workers have access to a safe place within the rail corridor that can be easily reached in a timely manner
- the level of safety must not be reduced to allow train and track vehicle movements, or because of a lack of trained workers
- effective communication must be maintained with network control officers
- worksites must have a protection officer whose other duties must not interfere with protection duties
- the protection officer must:
 - make a safety assessment before work commences
 - ensure work is conducted safely
 - keep a record of the protection arrangements.

Any person required to enter the Sydney Trains rail corridor to establish a worksite must be trained and assessed as competent as a protection officer. Network Rule NWT 300 states that: ‘a protection officer’s primary duty and responsibility is to keep the worksite and workers safe.’ Of the allowable worksite protection methods available to him as a protection officer level 4, the PPO had the necessary competencies to plan and implement an LPA. The PPO was also responsible for arranging additional possession protection to protect against unauthorised entry into the LPA limits between Turrella and Revesby.

The PPO provided a number of documents to support how he had planned and implemented the worksite protection. These documents mainly consisted of the STNs, the Worksite Protection Plan (WPP) and Pre-work Briefing (PWB). The majority of the WPP and PWB material was made up of drivers route knowledge diagrams (DRKDs) which the PPO relied on for confirming the position of points, signals, tracks and other rail infrastructure, but nonetheless were endorsed as ‘uncontrolled’, requiring validation and not suitable for this use. It was also noted that contact telephone numbers for the ACs on the Wollie Creek and Revesby Panels had been crossed out and other numbers added. The PPO indicated that he had not received an updated telephone list showing the new panel numbers post K2RQ Commissioning. These anomalies are factors that increased risk as they affected the quality of initial information available to the PPO during his planning phase and so some non-validated information was replicated in his Worksite Protection Plan and Pre-work Briefing material.

The procedures for the protection of track workers using LPA were prescribed under RailCorp *Network Rule NWT 302 – Local Possession Authority*. LPA was used to authorise the closure of a defined portion of track for a specified period to allow persons or vehicles to safely work in the danger zone¹² in that section of the track. An LPA can only be authorised and issued by a train controller and is issued exclusively to the possession protection officer. Unless advertised in a network local appendix (NLA) the intention to take an LPA must be advertised in a special train notice (STN) at least seven days in advance. Both STNs were issued more than seven days in advance. Further, NWT 300 states that LPAs are one of two preferred methods for working safely on track, the other being track occupancy authorities (TOAs). As the chosen method in this case, LPA was adequate for and compatible with the type of work to be performed.

In order to protect the limits of the LPA, the area controller placed one signal at stop (RY10UM) and then placed a blocking facility on the route and track ahead of that signal. The electronic blocking action is a further action to prevent the inadvertent changing of the signal.

¹² The danger zone is defined as everywhere within three metres horizontally from the nearest rail, and any distance above or below this three metres, unless a safe place exists or has been created. RailCorp General Rules NGE 200 version 2.0 21 August 2005.

Advanced Train Running Information Control System

The Advanced Train Running Information Control System (ATRICS) is used throughout much of the Sydney Trains network and has been in use at the Sydenham signal complex since 2002. It provides a diagrammatic display which allows controllers to interact directly with the rail network by controlling signals, points and other signalling equipment through a computer mouse. It is a non-vital¹³ centralised traffic control system which enables real time monitoring and control of the signals and points. The area controller's area of responsibility is displayed over multiple LCD monitors. The Revesby control panel is shown in Figure 3.

Figure 3: Sydenham signal complex – Revesby control panel



Source: OTSI

Area controllers have two main means available for manipulating signals and points for some other commands (such as placing blocks) on the network. The changes are made by:

- either clicking directly on the symbols representing the signalling equipment that controllers select from a number of commands located in a series of cascading menus (Anecdotal evidence indicates that this is the method preferred by area controllers.)
- or selecting from a drop down menu, controllers make a selection from the menu bar at the top of the screen, similar to the menus on Microsoft® packages.

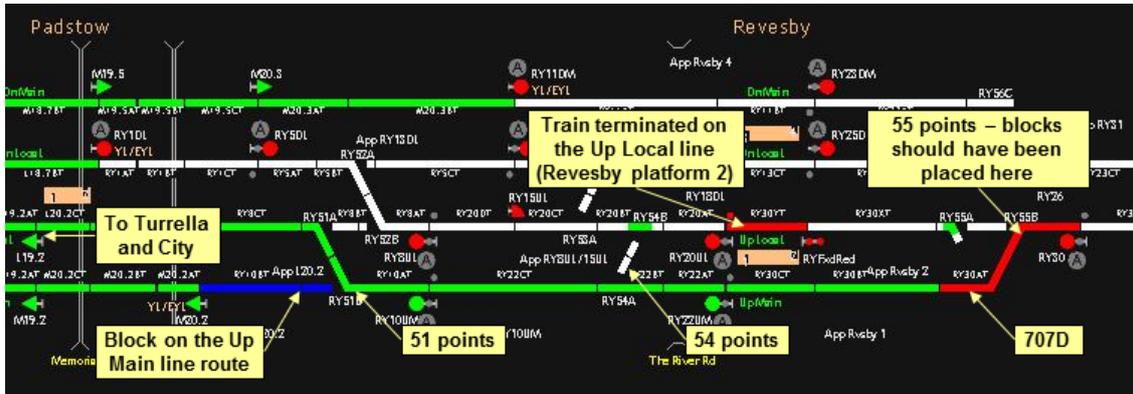
Area controllers issue work on track authorities and proceed authorities through their panel by interacting with the ATRICS screen using a computer mouse to open menus and select the relevant signal or set of points. Not all signals can be controlled by the area controller. On the ATRICS screen, automatic signals appear as triangles and controlled signals as circles (Figures 4

¹³ Non-vital: Signalling equipment and circuits are considered non-vital where failure to function correctly would not cause an unsafe outcome of the signalling system. Non-vital equipment and circuits do not affect the safe operation of the signalling system.

and 5). The status of tracks, signals and the presence of trains and blocking facilities are displayed in various colours.

The ATRICS system has a replay capability which investigators used to review the operation of the system and trains on the day of the incident. Figure 4 shows train 707D approaching Revesby station at 1020 when the LPA commenced and the blocked route protecting entry to the Up Main line beyond 51 points.

Figure 4: ATRICS replay at 1020, showing position of train 707D when LPA in force

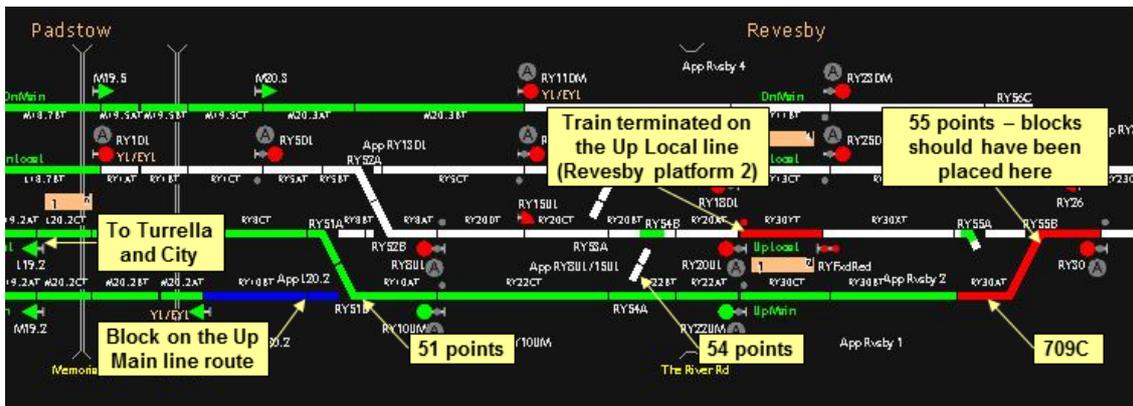


Source: Sydney Trains

Figure 4 shows that the area controller had set up routing for train 707D via the Up Main line back through 51 points so that the train could bypass a train that had terminated on the Up Local line (Revesby platform 2). This particular routing of 707D would not have been possible if blocks were placed according to STN 1003: that is, clear of 55 points and preventing entry to the Up Main line.

Figure 5 shows train 709C approaching Revesby station at 1049 and the same blocked route protecting entry to the Up Main line beyond 51 points.

Figure 5: ATRICS replay at 1049, showing train 709C when it struck LPA possession protection detonators



Source: Sydney Trains

Examination of the ATRICS replay revealed that when the area controller utilised a command in ATRICS to block the route/track, the track beyond 51 points, in the usual direction of travel, changed from white/green to blue, indicating a block on the route. The colour changes demonstrate there is recognition of physical changes to the track conditions at the software level.

The ATRICS can display the reason a block is in place, but not where the worksites, or additional protection are in place. It does not show a train’s kilometrage or exact location relative to signals or worksites. Hence the positions of the worksites and possession protection relative to the LPA limits, signals, points and platforms are not reflected on the Revesby panel.

Train Location System information

The Train Location System (TLS) is used extensively across the Sydney Trains and NSW Trains networks by both the Rail Management Centre (RMC) and some signal complexes, including ones that have ATRICS. It provides a graphical display of train locations and on time running information that assists in the planning and execution of the daily rail program. Unlike ATRICS, TLS does not indicate the state of points, signals, routes and blocking facilities.

Sydney Trains indicated that TLS is to be used as a guide only for 'on time running' and is not a recognised safety system. As such TLS cannot be utilised for verifying train location, or for informing safe working decisions. Prior to the application of safety related activity, train controllers are required to confirm the exact location of trains using other methods of communications such as via:

- interrogation of the ATRICS
- direct communication with the train crew using a mobile phone or radio such as MetroNet.

In this instance, the train controller relied on the relief AC's observation of ATRICS when seeking assurances about the location of trains. However, a check of the TLS prior to the implementation of the LPA would have identified 707D as within or approaching the possession area.

Area controllers' information

Employment and training records showed that the rostered area controller commenced training as a signaller/area controller in November 1999 and since April 2005 had been working in the Sydenham signalling complex. He was deemed fully qualified and was certified in all relevant systems of safe working. He was also deemed competent to operate various signalling control panels at the signalling complex, including the Revesby panel.

On 10 July 2013, the rostered area controller had signed on for duty at 0535 to commence an 8 hour shift on the Revesby panel. At approximately 1000 and after the scheduled start time of the LPA had been delayed, the area controller was relieved and replaced by another area controller (the relief area controller). The relief area controller had also signed on for duty at 0535 to commence an 8 hour shift providing relief breaks for area controllers throughout the signal box.

Employment and training records showed that the relief area controller commenced training as a signaller/area controller in June 2009 and since December 2011 had been working in the Sydenham signalling complex. He was deemed fully qualified and was certified in all relevant systems of safe working. He was also deemed competent to operate various signalling control panels at the signalling complex, including the Revesby panel.

Shortly after the incident, the rostered area controller was subjected to drug and alcohol testing which returned negative results. The relief area controller was supervised until he was in turn relieved and then subjected to drug and alcohol testing also returning negative results.

Train controller information

Employment and training records showed that the train controller commenced training as a train controller in September 1994 and since November 1994 had been working in train control, now referred to as the RMC. He was deemed fully qualified and was certified in all relevant systems of safe working. He was also deemed competent to operate various operations control boards at the RMC, including the Sydney Operations Control Illawarra Board. This board had operational control over the rail territory on the Up and Down East Hills lines (Mains and Locals between Sydenham and Glenfield (exclusive)), the Up and Down Bankstown lines (between Sydenham and Sefton), the Up and Down Illawarra lines (Mains and Locals) between Bondi Junction and Sutherland

(inclusive), the Up and Down Cronulla Branch lines (between Sutherland (inclusive) and Cronulla), the City Inner and the Up and Down Airport lines.

On 10 July 2013, the train controller had signed on for duty at 0430 to commence a 6 hour 38 minute shift on the Illawarra Board. Shortly after the incident, the train controller implemented the incident management procedures and requested an incident response officer (IRO) be dispatched to the signal box. On arrival the IRO supervised the drug and alcohol testing of the two area controllers.

Possession protection officer information

Employment and training records showed that the PPO commenced training in this role in March 2006 and since November 2009 had been qualified to work in roles requiring Worksite Protection Officer Level 4 competencies. He was deemed fully qualified and was certified in all relevant systems of safe working. He was also deemed competent to implement all forms of worksite protection and work in the PPO role when implementing LPAs.

On 10 July 2013, the PPO had signed on for duty at 0700 to commence an 8.5 hour shift which included planning and implementation of the LPA between Turrella and Revesby. Shortly after the LPA was implemented, the PPO was contacted by the train controller who confirmed the LPA was in force. As an additional control measure, the PPO then placed possession protection at the Turrella end and made arrangements for another protection officer (PO) to place possession protection at the Revesby end. These actions were to protect against unplanned entries of trains into the limits of the possession area and were effective in bringing 709C to a stand when it entered the possession. Although the relief AC had blocking facilities applied to 512 points at Beverly Hills, no possession protection had been considered by the PPO to protect against trains being routed from the Up Local line through 512 points at Beverly Hills to the Up Main line and into the limits of the LPA. Nor had he considered a similar risk scenario for 54 points at Revesby. Shortly after the incident, the PPO was requested by the train controller to discontinue the work, clear all staff and equipment from the line, fulfil the LPA and prepare to hand back the line for normal operations. By 1149, the PPO was able to satisfy this request and when he confirmed this with the train controller, he immediately fulfilled the LPA.

Rosters and fatigue

Factors that may have affected the performance of key personnel were considered for this incident. Fatigue is one area which is focussed on in investigations as it can have a range of influences on performance, such as decreased short-term memory, slowed reaction time, decreased work efficiency, reduced motivational drive, increased variability in work performance, and increased errors of omission.¹⁴

The work rosters for the train controller, area controllers and possession protection officer were examined for the fortnight prior to the incident. A software based fatigue management tool (FAID)¹⁵ was used by Sydney Trains to analyse the work rosters. Key personnel involved with this incident were interviewed about their sleep and work patterns, general well-being, how they were feeling leading up to the incident and the length of time on task. It was concluded from consideration of these factors that fatigue was unlikely to have affected the performance of the train controller, rostered area controller and possession protection officer at the time of the incident. It was found that at various other times, throughout the relief area controller's fortnightly

¹⁴ Battelle Memorial Institute, 1998, *An Overview of the scientific literature concerning fatigue, sleep, and the circadian cycle*, Report prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors, US Federal Aviation Administration.

¹⁵ FAID (Fatigue Audit InterDyne) is a commercially available computer program that derives a fatigue score based on hours worked or rostered. The FAID results were included amongst the working rosters provided by Sydney Trains.

duties, the models indicated that the relief area controller's fatigue levels were conducive to performance below a level that would be considered acceptable for safeworking operations. In particular, the elevated risk periods tended to coincide with successive overnight shifts and successive extended day shifts.

While considered useful for rail operators, bio-mathematical fatigue management tools have a number of documented limitations.¹⁶ In general, software based models do not have the capacity to predict fatigue or fatigue induced errors in all cases for all individuals and should only be considered within the context of a broader fatigue risk management system.

In this case, there was insufficient evidence to determine conclusively if the relief area controller was affected by fatigue at the time of the incident.

Related LPA occurrence and audit data

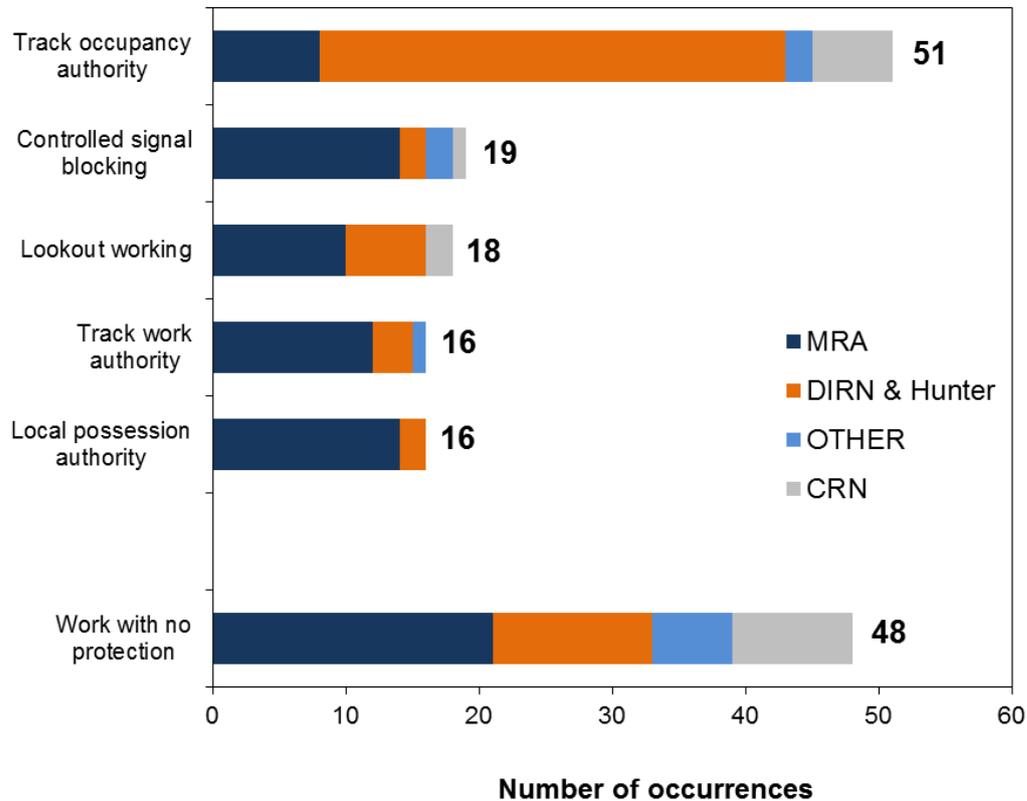
Sydney Trains was requested to provide information on any previous similar Sydney Trains/RailCorp incidents involving trains entering the limits of an LPA in the last five years and provided eight items. None of the provided information identified or addressed systemic issues and none of the reported incidents were directly comparable in nature to the incident currently under investigation.

Sydney Trains was also requested to provide details and results of any Sydney Trains/RailCorp compliance audits or inspections conducted in relation to Sydenham Box and the use of LPAs in the previous five years. Information provided showed that RailCorp had been completing compliance checklists of signal box procedures and 760 completed documents were supplied. The checklist included an LPA section to be completed when applicable. No records were provided for the period August 2012 to June 2013 (inclusive). Of the records provided, 54 included a completed LPA section (that is, an LPA was, or had recently been, in force) and none specifically targeted interactions between train controllers, area controllers and protection officers. Only one safety related issue with an LPA was identified (in July 2011) but no information, narrative or remedial action was recorded.

Prior to 2012-13, the Independent Transport Safety Regulator of NSW (ITSR) published an annual Rail Industry Safety Report which summarised safety performance and historical trends. Figure 6 shows the number of worksite protection irregularities (occurrence events) in 2011-12.

¹⁶ ITSR, 2010, *Transport Safety Alert 34 - Use of bio-mathematical models in managing risks of human fatigue in the workplace*. ITSR 2011, *Transport Safety Alert 35 - Use of bio-mathematical models of human fatigue*. Both available from the ONRSR website: www.onrsr.com.au

Figure 6: Worksite protection occurrence data on the NSW rail network, 2011-12

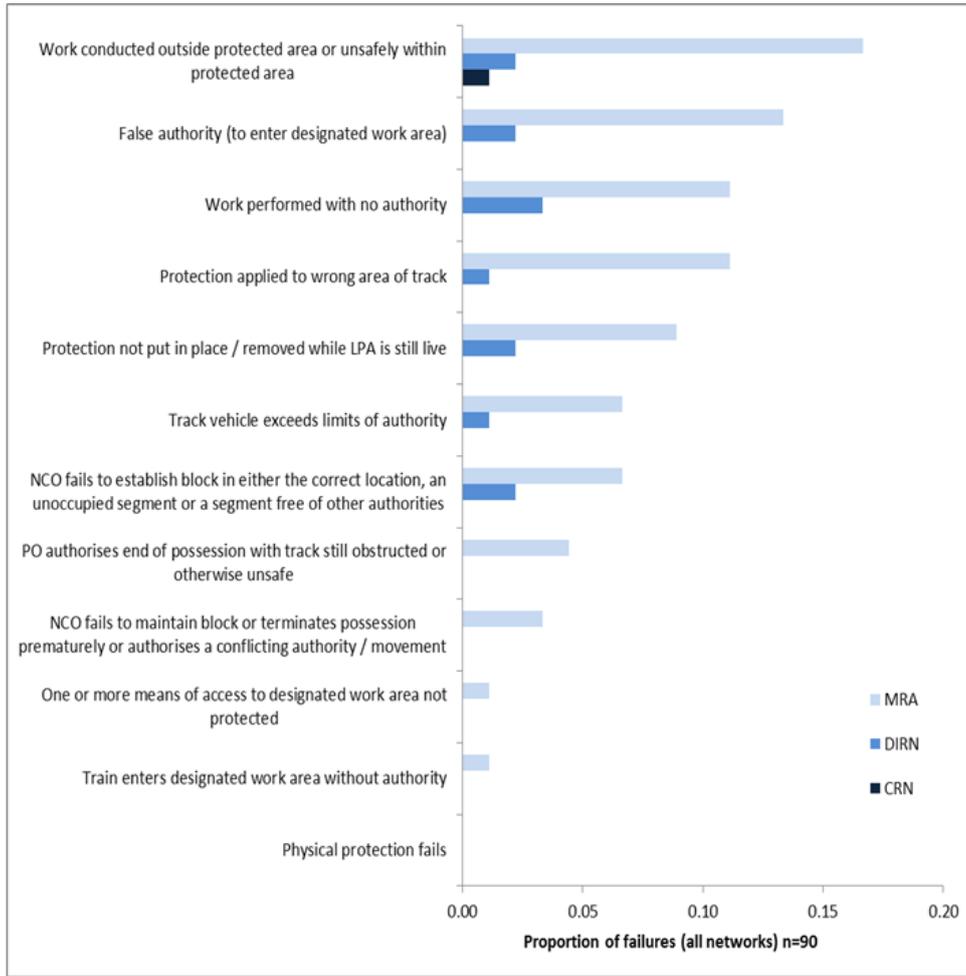


Source: ITSR Rail Industry Safety Report 2011-2012. (MRA – Metropolitan Rail Area, DIRN – Defined Interstate Rail Network, CRN – Country Regional Network)

In NSW in 2011-12, with the exception of track occupancy authority related occurrences, the number of LPA occurrences was similar to those experienced with other types of worksite protection. The proportion of LPA occurrences was comparable over the preceding four 12 month periods.

For analysis purposes, the ITSR classified LPA specific irregularities (failures) into 12 categories (Figure 7).

Figure 7: LPA occurrence data on the NSW rail network, 2007-08 to 2011-12¹⁷



Source: ITSR Rail Industry Safety Report 2011-2012. (MRA – Metropolitan Rail Area, DIRN – Defined Interstate Rail Network, CRN – Country regional Network)

The Revesby incident where 709C entered the limits of an LPA has been classified as: ‘NCO (Network Control Officer, in this case the area controller) failed to establish block in either the correct location, an unoccupied segment or a segment free of other authorities’. Despite the apparent predominance of this category of failure to the MRA network, it is not statistically significant as the differences between the failure types are low and relatively minor due to the small number of failures across a large number of categories.

The regulatory response to this data, including the LPA failures, was to continue to include all methods of worksite protection in their routine compliance audit program.

¹⁷ Data for the period 2012-2013 was requested but was not available. As from 20 January 2013 the ITSR became part of the national rail regulatory framework and the collation and validation of rail notification data became the responsibility of the Office of the National Rail Safety Regulator (ONRSR).

Safety analysis

An intrusion into a possession area, as in the case of passenger train 709C, is classified as a serious incident. Precursor events such as this can lead to derailments, collisions, injury or death.

The investigation into this occurrence at Revesby examined the use of various documents to plan and advertise the work to be carried out, as well as the actions of various parties with responsibilities for implementation of worksite protection. It was established that LPA was an appropriate form of worksite protection for the task to be performed, the ATRICS worked as designed and the actions of the train crews of 707D and 709C and the PO did not contribute to the occurrence. Consequently, the analysis focused on the factors that contributed to the incident including:

- use and implementation of LPA
- actions of the train controller, PPO and area controllers
- adequacy of communications
- handover procedures
- STN production and validation
- maintenance of operational documentation.

Implementation of LPA

Use of LPA as a method of worksite protection

The LPA was chosen as the preferred method to protect the work area and it was adequate for and compatible with the type of engineering work to be performed. LPAs had inherent advantages in safety and efficiency over the other methods of worksite protection. A key advantage was a long lead time approval process for LPA type possessions which was undertaken by Sydney Trains' asset management area. This allowed high levels of planning, coordination, resource allocation amongst the various divisions and engineering disciplines, and facilitated exploration to allow an optimal customer transport option. Issuing the STNs more than seven days in advance of the work to be carried out provided a greater opportunity for operations personnel to absorb the content and for downstream rail stakeholders, many who dealt direct with the customers, to plan for the possession at their local level. Overall, these processes aimed to find the right balance between communicating safety critical information, maximising efficiency of the possession period and minimising the overall impact to rail customers.

Whilst NWT 300 stated that LPAs and TOAs are the two preferred methods for working safely on track, there were key differences in the implementation of the two methods, including:

- TOAs are not advertised and have forms embedded with a checklist of assurances and mandatory items, such as to the requirement to read back (repeat) details; and
- LPAs have no forms, but rely on safety critical information (such as the limits and train pathing) being pre-validated and embedded on the STNs which in turn are to be distributed, received, communicated, read back and understood by downstream stakeholders.

Records provided by Sydney Trains show that on 1 May 2013 the bidder modified the possession boundary and by 3 May 2013 the amendment had been approved and work commenced on incorporating this into the draft proforma STN (STN 1003). The process required a train planner to re-run the conflict program based on the amended possession boundary. A breakdown in communicating the significance of the amended scope meant the train planner did not recognise the need to re-run a conflict program and so no other trains were identified as being affected. Based on feedback from the train planner to those working on the proforma, STN 1003 was

finalised and distributed on 19 June 2013. This STN showed the possession would be from 0930 to 1330 and for the possession boundaries to be from Turrella (clear of 502 crossover) through to Revesby (clear of 55 crossover). Meanwhile, work on STN 1004 continued based on the original possession scope (Turrella to Beverly Hills) and affected trains were pathed via 51 points at Revesby. Despite no longer being compatible with STN 1003, nor meeting the requirements for operations, or the bidder, STN 1004 was finalised and published on 26 June 2013.

When the final track configuration was commissioned and the bidder’s possession scope evolved from Beverly Hills to Revesby, these two triggers were not sufficient for other parties to treat the LPA other than routinely. Therefore, unknown errors or omissions which made it through the review and validations processes and into the final STNs had an increased potential to impact on the inherent levels of safety and efficiency of the LPA.

Comparison between LPA requirements and actual implementation

The ATSB examined the STN requirements and the actions of the train controller, area controllers and the possession protection officer in implementing the LPA against the stated requirements in the relevant network rules and procedures. The investigation found several instances where actual arrangements were not strictly in accordance with procedures and these are detailed in Table 1.

Table 1: Summary comparison between LPA requirements and actual implementation

Rule (R) or Procedure (P) Requirement	Actions/comments on actual implementation
(R) NWT 302. ‘Unless advertised in the Network Local Appendix the intention to take an LPA must be advertised in a Special Train Notice at least 7 days in advance’	The work was due to start on 10 July 2013 and both STNs met this requirement - STN 1003 was published on 19 June 2013 and STN 1004 on 26 June 2013. But the STNs were incompatible, did not meet the requirements of the possession bidder, were not viable operationally and impaired the inherent safety and efficiencies that LPAs have over other methods of worksite protection.
(R) NWT 302. ‘Train Controller must make sure that Signallers ¹⁸ responsible for the affected area, and the Possession Protection Officer, are aware of the protection arrangements’	The TC was the only party who sought and received affirmations that the ACs and PPO had copies of the STNs and understood the limits. The relief AC became preoccupied with the ongoing train running responsibilities from STN 1004 (via 51 points), even though 55 pts were mentioned by the train controller and documented on STN 1003.
(R) NWT 302. PPO must: ‘make sure that all points of entry into the portions of track within the LPA limits are protected against unauthorised rail traffic movements’	The PPO thought this meant his primary responsibility was to place possession protection at each end of the section. He did not consider other potential entry points such as 512 points at Beverly Hills and 54 points at Revesby and as he had no direct contact with the ACs, he assumed they put on blocking facilities wherever they were required. STNs do not specify intermediate entry points needing additional possession protection.
(R) NWT 302. The PPO must: ‘tell the Network Control Officer ¹⁹ the protection arrangements at the limits of the LPA’	Not done as there was no direct contact between the PPO and ACs. All key stakeholders involved with the implementation indicated this requirement is rarely complied with.

¹⁸ Within Sydney Trains, an area controller is a higher graded signaller. The term signaller covers all job titles which may be performing the duties for the area concerned. Area controllers are qualified workers who remotely monitor and control train movements in the Sydney Trains rail network from a large signal box or control centre.

¹⁹ The Network Control Officer is a Train Controller for an unattended location, a Signaller for an attended location, or a delegate carrying out some functions of a Train Controller or Signaller.

<p>(P) NPR 700. Procedure states PPO is to: 'Make sure that you and the affected Train Controller and Signallers have a copy of the Special Train Notice (STN)...'</p>	<p>There was no direct contact between the PPO and ACs. TC was the only party who sought and received affirmations that the ACs and PPO had copies of the STNs and understood the limits.</p>
<p>(P) NPR 700. Procedure states TC is to: 'Confirm the details of the LPA and protection arrangements with affected Signallers'.</p>	<p>TC felt that he complied by seeking four assurances; that is did they:</p> <ol style="list-style-type: none"> 1. have copies of STNs 2. understood the limits 3. confirm section clear 4. have blocks applied.
<p>(P) NPR 700. Procedure states PPO is to: 'Arrange to tell affected Signallers about the location of worksites in the possession'</p>	<p>The TC sought and received affirmation for all of these. The ACs placed blocking facilities at the commencement of LPA (STN 1003), but then had ongoing responsibilities for train running and pathing (STN 1004). LPA rule/procedure does not specify a requirement that TC is to confirm an understanding of the train running arrangements.</p>
<p>(P) NPR 700. Procedure states PPO is to: 'Arrange to tell affected Signallers about the location of worksites in the possession'</p>	<p>Not done as there was no direct contact between the PPO and ACs. All key stakeholders involved with the implementation indicated this requirement is rarely complied with.</p>
<p>(P) NPR 700. Procedure states TC is to: 'Make sure that any rail traffic not associated with the LPA is not authorised to move within the limits of the LPA...'</p>	<p>TC sought confirmation that the section was clear, when he asked: '...can we get some ah blocks and clearance please Up Main line Revesby to Turrella clear of 55 crossover back to and clear of 502 crossover would that section of track be clear of rail traffic at the moment'. The TC had access to the Train Location System (TLS) which showed the general location of trains, but it is not a recognised safety system that has been validated for use by those seeking safe working assurances. TC relied on AC affirmations that section clear based on the integrity of ATRICS.</p>
<p>(R) NGE 204. Key Principle under Network Communication, Confirmation of communication: 'The receiver must confirm the content of a message by repeating the message back to the sender, if the communication is about.....a work on track authority'</p>	<p>Very little information was formally repeated back by any party during the process of implementing the LPA. When implementing LPAs, the TC felt it was onerous under some circumstances to seek a repeat back of information, so he applied this to all LPAs. An opportunity exists to review rule non-conformance in relation to the implementation of LPAs.</p>
<p>(R) NGE 204. A 'warning' under Confirmation of communication: 'The receiver must not act on the communication until the sender confirms that the message has been repeated correctly'</p>	<p>Not done - see above.</p>

Source: OTSI, using various sources and evidential material

An analysis of the recorded voice communications found they were informal and conversational and not in accordance with network rules and procedures. Also, very little information was formally repeated back by any party during the process of implementing the LPA. The rules stating the standard for network communications and repeating messages back to sender were expected to apply equally across all related rules and procedures, including those for LPAs. Anecdotal evidence from the train controller and area controllers suggested that the requirement to repeat back was considered impractical when implementing more complex LPAs, many which involve multiple rail sections, conflicting routes, entry points, ACs and/or train controllers. This is one example where under certain circumstances an element in one rule made it impractical to implement with another rule. The train controller indicated that it was a common predicament

when implementing any LPA to be confronted by the conflict between a stated requirement to 'repeat back' and the practicality to comply for complex LPAs. As such, the train controller typically used the same approach for all LPAs, no matter how complex, in which he did not require the information to be repeated back.

There are no forms associated with the implementation of LPAs, so there is no provision for TCs and ACs to record critical information regarding the location and type of worksite and key assurances. In the absence of an LPA form, STNs serve a more crucial role for stakeholders as the only reference document embedded with critical information specific to the possession limits and ongoing train running requirements. It is crucial they complement one another and that key information is confirmed as being mutually understood by all parties, prior to implementation, which was not the case in this instance. This lack of communication played a part in causing the incident and it highlights a continuing problem.²⁰ Clear and unambiguous communication during the implementation of a work on track authority for protection for persons to enter the danger zone is essential. The responsibility, as outlined in the network rules, lies with both parties. Safety critical messages should be repeated back and understanding confirmed so that both parties are sure that the message is agreed upon.²¹

Given these anomalies, there is scope for certain safety critical information in the relevant LPA and communication rules to be cross referenced and to overcome the conflicts that exist between some rules and the capacity to comply under certain conditions.

In summary, the LPA was appropriate and advertised at least 7 days in advance. The implementation of an LPA does not require forms and has a greater reliance on STNs and following procedure. The inherent levels of safety and efficiency of the LPA were compromised by the inaccuracy of STN 1004 and where the relevant rules and procedures were not followed during implementation of the LPA by key stakeholders. A commonly held view that the repeat back provision was onerous under certain LPAs resulted in non-compliances with it..

Expectation and distraction

Area controllers

Research has established that individuals often fail to notice unexpected events, even ones that are important. When objects are designed for visual distinctiveness, they will be missed if they do not fit within an individual's expectations. Overcoming the powerfulness of expectancy is challenging, particularly because people will generally assume that, by looking in the right direction, unexpected objects and events will grab their attention.²²

Both area controllers said they expected the possession to be clear of 51 points based on their respective recollection of the previous possession configuration and the pathing on STN 1004. The relief area controller, having the same impression about the location of the possession at 51 points, had this further reinforced during handover from the rostered area controller. Their previous experience would be sufficient to influence their expectations of the possession limits to build an established mental model around 51 points, despite the mention of 55 points by the train controller which was heard but not comprehended by the ACs.

It is possible, given his expectation that the possession was clear of 51 points and that the rostered area controller had already gone through the assurances with the train controller, the relief AC relaxed more than he otherwise would have. With relaxing came reduced vigilance in the

²⁰ Recent reports where worksite protection communication issues feature can be found at the ATSB website (see Newbridge (2010), Jaurdi (2011), Bogan Gate (2011), Maitland (2011) and Hurlstone Park (2012)).

²¹ Refer to Network Rule NGE 204.

²² Chabris, C. & Simons, D. (2010). *The Invisible Gorilla and other ways our intuition deceives us*. Harper Collins: Hammersmith.

tasks of reading and comprehending the possession limits on STN 1003 and recognising when 55 points were actually mentioned by the train controller at a critical time during implementation.

A key point prior to LPA implementation was when the train controller made mention of 55 points but this was not emphasised and neither AC comprehended or reacted to the differences to the LPA limits. As a result the train controller and the ACs did not have a mutual understanding of the limits of the possession authority. A number of factors, either alone, or in combination, may have contributed to this situation where:

- the area controllers established a mental model of 51 points
- the train controller's assurances only required affirmation, rather than confirmation via read back
- there was not a significant difference in the sound of '55' compared to '51'
- there was no direct relationship between the advertised possession limit (at a set of points) and where the blocking facilities were actually applied (the route in advance of those points).

In this instance, as this LPA was not complex compared to larger possession configurations, it was possible that the train controller may have been able to establish a mutual understanding of the limits if he sought a repeat back of the information (a specific requirement under Network Rule NGE 204).

In summary, both area controllers expected the termination of down trains at Revesby station based on previous LPA works. The relief area controller was distracted by instructions for continuing train operations and overlooked details about the limits of the LPA.

Train controller

When the train controller first began to discuss the LPA and STN arrangements with the ACs it became apparent that two emerging issues would complicate implementation of the LPA. The first was that some down-direction services from the city were timetabled to terminate alongside Platform 2 at Revesby (on the Up Local line - Figure 1). Terminating down-direction services at Revesby would impact other up-direction services and there was some discussion if these could continue to East Hills to terminate. From the train controller's perspective, the two area controllers understood that if the requirement for terminating services on platform 2 remained, the only available alternative route for city-bound services around these was via 51 points. However, this was not expressed directly with the train controller and the opportunity to further explore this was lost because of concerns with the second emerging issue.

The second issue was that express 'Endeavour' passenger services (designated SN54 and SN56) had an operational requirement to be worked under 'block working'²³ conditions when pathed along the Up Local line. The focus of the train controller was on how this was not sufficiently catered for on STN 1004 as it had not adjusted timetables, departure times, or stopping patterns for other city-bound services which had to follow the 'Endeavour' trains from Revesby. As such, following trains would have to wait until the 'Endeavour' services had sufficiently cleared ahead before they could continue, during which time they would incur delays. The train controller reacted to this situation by calling the Train Planning area and leaving a message about the problem then generated an incident report in the Incident Information Management System (IIMS report No: 00037, dated 10 July 2013). Shortly after it became apparent that these two 'Endeavour' services were running late and this would have exacerbated the delays. At this point the train controller had to balance the need for the engineering work to go ahead against the likely delays to services,

²³ The instructions for Manual Block Working are referenced in Network Rule NSY 512. The Network Rules Glossary described 'manual block working' as: 'A method of special working, which ensures sole occupancy by manually maintaining the block between rail traffic movements'. The specific requirements for these trains to be 'block worked' on the Up and Down Local lines between Revesby and Turrella was referenced in the Train Operating Conditions (TOC) Manual, General Instruction Pages, Section 2, page 7 of 8 (document last updated by RailCorp in April 2013).

which could potentially cascade until the commencement of the afternoon peak period. Minimising delays to peak services were strong influences in the train control area, as 'on time running' statistics were regularly published and these figures were predominately based on the performance of peak services.

In response to this situation, the train controller discussed with the PPO about delaying the start of the possession to allow the late running 'Endeavour' services to run normal, that is, via the Up Main line, which would minimise delays to other city-bound trains. The PPO indicated that he would still be able to complete the required engineering tasks within a reduced possession period and agreed to the request.

A preoccupation with the block working situation, the late running 'Endeavours' and potential delays to following services resulted in the train controller not reconsidering the problem of pathing city-bound services around the terminating trains at platform 2. In comprehending the combined impact of terminating services on platform 2 and the possession limits at 55 points preventing pathing via 51 points (Figure 1), the train controller would have realised the possession and train pathing arrangements documented on the STNs were incompatible and not operationally viable. This would have led to other alternatives being considered including, as a last resort, cancelling all the work.

In summary, the train controller made a number of assumptions about the area controllers understanding of the LPA and accepted affirmations when he sought assurances. The train controller felt it was impractical under some circumstances when implementing LPAs to seek a repeat back of information, so he applied this to all LPAs. His decision to only reaffirm two assurances and not repeat back information recorded on the LPA meant he missed an opportunity to detect the incorrect assumptions of the ACs. Further, when confronted with two emerging operational/STN problems (terminating trains on platform 2 and block working), the train controller became preoccupied on the block working issue and it meant he missed an opportunity to re-examine the problem with terminating trains on platform 2.

Possession protection officer

The PPO arranged for possession protection to be placed to protect against unplanned entry of trains at each end of the possession area and this was effective as an additional control measure and defence when the blocking facilities were placed in the wrong location. In this instance the PPO had not taken into account the existence of two other entry points into the possession - 512 points near Beverly Hills and 54 points at Revesby, even though they were shown on the DRKDs. As such no additional possession protection was placed in those areas.

The PPOs planning was totally reliant on the DRKDs as he considered them to be the only reference source containing sufficient detail for him to compile the Worksite Protection Plan and Pre-work Briefing material relevant to that particular possession. The PPO indicated that this was his first LPA with an increased possession configuration since the K2RQ commissioning. Previous possessions that he was involved with only went as far as Kingsgrove, that is, clear of 512 points at Beverly Hills. He indicated that he 'overlooked' the fact that, for this configuration, 512 points were now intermediate points, but any risk of unauthorised access was mitigated by the ACs who had already applied blocking facilities to those points.

Another factor that may have contributed to this oversight was that, contrary to the requirement of the rules/procedures, the PPO made no direct contact with any of the ACs. He indicated that he did not think it was within his responsibility to be involved in train running arrangements and only made direct contact with ACs if required for work train movements or if it became necessary to manually apply a 'point clip'²⁴ to the points to prevent unplanned use, or access. His

²⁴ Point clip – A lockable clip for manually securing a point switch to the stock rail. (RISSB – National Guideline Glossary of Railway Terminology).

understanding was that the train controller had ultimate responsibility and authority for the LPA and that the PO and ACs did their part in placing possession protection and blocks (respectively) in the right locations. Thus the PPO had limited contact with the ACs and concentrated his initial efforts on placing the possession protection and commencing the inspection work at the Turrella end.

In summary, there were a number of individual actions by key stakeholders whereby the relevant rules and procedures were not followed during implementation of the LPA.

Handover procedures between area controllers

An effective handover between ACs at the Sydenham signalling box relied on accurate communication of key information on the current state of operations and what was known and could be reasonably expected to occur in the short to medium term. There was no formal procedure. It relied heavily on the local knowledge and experience of the individual. The information exchange with the relief AC was brief, verbal and limited in detail and included the incorrect information on the limits of the LPA.

A relief was not expected to undertake or receive a detailed review/validation of all aspects of STNs. Sydney Trains' expectation was that this process should have already been carried out initially by a 'Tableman'²⁵ once STNs were received (at least seven days prior to the start), then again by the rostered ACs (on the actual day of implementation).

Significantly, there was no login/logout process for ATRICS or any of the systems and equipment on the panel, and no specified requirement to advise the train controller of a changeover in personnel. Therefore, the train controller was not alerted to the change of ACs. The ramification of this was a lost opportunity for the train controller to reinforce the possession limits with the relief AC.

In summary, there was an absence of a formal handover procedure to ensure accurate information and current activities were passed onto relief ACs. The ACs' handovers were informal; key information was exchanged verbally, and there was no requirement to login/logout or advise a train controller of a staff changeover.

Production, validation and distribution of STNs

Sydney Trains has a Train Planning unit whose responsibilities include the production of STNs. Within that unit, two main areas worked closely in the production of STNs 1003 and 1004. The first was the specifications area, where a Specifications Officer was responsible for using the information from the approved possession bid and creating a (sometimes highly) complex operational specification taking into account the possession parameters, network access guidelines, infrastructure/rolling stock constraints, special events and overall impact on operational working. This specification formed the basis of proforma STNs, in this case STN 1003.

The second area was the Daily Timetable Production (DTP) area where Train Planners were responsible for checking the specification and identifying what specific trains would be affected and needing alteration by a particular possession scope (and also taking into account the above parameters). Typically, a specification would be passed from the Specifications area to a Team Leader within the DTP area who then allocated the work to a Train Planner. The Train Planner would identify what specific trains would be affected by creating and running a conflict program referred to as the Track Closure file, which is a program within their timetabling tool called RailTable. After identifying what trains would be affected, the Train Planner would develop a plan

²⁵ Tableman positions exist at major signalling complexes including Sydenham. Tablemen are managed by the shift supervisor and their roles include assisting with risk mitigation in overload, fatigue and staff failure/shortage situations; area controller relief; and assisting supervisors with administrative functions, including the management of safety critical documentation such as STNs.

confirming the times and scope of the possession and altered train working arrangements (shown on STN 1004). Significantly, it was the sole responsibility of the DTP, specifically the Train Planner, to provide final confirmation of the times and scope of the possession to the specification area so that they could validate and finalise their specification and ultimately the profoma STN.

In the event of an approved change to the possession bid or parameters, internal processes required an updated specification to be passed onto the DTP area. The Track Closures file would be updated by the Train Planner and confirmation of the times and scope of the possession sent back to the specification area.

Specification Officers and Train Planners had supervisors (Team Leaders, or Senior Timetable Officers) and managers whose roles were to manage, check and validate the work processes and outcomes to predetermined standards and established practices. They also had similar but independent validation (using different validation forms, or checklists), customer review (review by external stakeholders) and distribution arrangements and a range of documents were provided detailing each of these processes.

Following the incident, the Train Planning unit undertook an internal investigation as to how STN 1004 had been finalised with train pathing via 51 points at Revesby that was not compatible with the possession limits, or STN 1003. Evidence provided from the Train Planning investigation was explored during interviews with staff from the Train Planning unit, which highlighted the following chain of events:

- On 1 May 2013 the engineering bidder amended the possession bid for an increased possession scope from Turrella through to 55 points at Revesby. This was approved by 3 May 2013 and was actioned by the Specifications area by updating their specification then passing this onto the DTP Team Leader who acknowledged receipt, then left it on the desk of the Train Planner, who happened to be absent from his desk at that moment.
- When he returned to his desk, the Train Planner reviewed the updated specification and possession bid (TRAK2 information) and considered that, of the changes he was able to identify, none appeared to be of any significant magnitude to update the Track Closure file or alter the train plan. In the absence of any accompanying advice specifying the changes, or directions from the Team Leader on his expectations (nor did the Train Planner seek any), the Train Planner simply provided feedback to the specification area that no further action or changes were required.
- Based on this advice, the specifications area validated and finalised the specification showing possession through to 55 points at Revesby and on 19 June 2013 commenced distributing the profoma STN 1003 to downstream stakeholders.
- On 25 June 2013 the Train Planner compiled a validation form for further validation and approval by the DTP Team Leader, in conjunction with another Team Leader. In conjunction with this form, some criteria required supporting documentation be provided, which included a copy of the latest Track Closure report and specification. Both of these were endorsed on the validation form as being 'Attached', but there was no evidence provided to confirm if this actually occurred, or if they did, why the Team Leader and Train Planner failed to recognise the incompatibility amongst the various documents. In any case, the Team Leader authorised the validation form and supporting documentation that day.
- On 26 June 2013, the Train Planner validated and finalised the train plan which was still based on the assumption of train pathing via 51 points and later that same day commenced distribution of STN 1004.

Some parties indicated that in the six months prior to the incident, the Train Planning unit had undergone a series of structural changes, during which time staff numbers were rationalised and some responsibilities passed onto others. Management of the Track Closure files was amongst those changes. Previously, where they were the sole responsibility of a person performing this as a specialised role, the responsibility was distributed amongst the Train Planners, who indicated

they would have preferred further instruction or training. Based on their internal investigation, the Train Planning unit implemented a number of changes to their processes, including:

- Passing overall responsibility for creating and updating the Track Closure file to the specifications area, specifically the Specifications Officer role. While the Train Planner still had access to the Track Closure file for the purposes of updating and verifying the final possession scope and times, it was now the Specifications Officer responsibility to ensure that the verified information was consistent with the parameters of the possession bid and their specification.
- Introducing a requirement that both the DTP Team leader and Train Planner sign an acknowledgement when a specification had been received in their area.
- Introducing an additional requirement to cross-check the specification, proforma and Track Closure file against the dates and times on the train running STN through:
 - weekly meetings between the Specifications Officer and DTP Team Leader to carry out the cross-check
 - including this as an additional parameter on the respective validation forms used in both areas.
- Providing instruction and training to relevant staff in the specifications and DTP areas reinforcing the key requirements and responsibilities under these changes, particularly the management of the Track Closure file.

In summary, it was established that the STN production processes were not effective in recognising and reacting to routine changes in the possession bid and specification. Internal validation processes and external customer review processes also failed to detect the anomalies. In response, the Train Planning Unit had undergone their own internal investigation of this incident and implemented a number of changes to strengthen their production and validation processes.

Effectiveness of customer review, feedback and distribution processes

Further analysis of the 'Customer review' process was undertaken to establish why they failed to detect anomalies between the STNs. It found that the review process consisted of e-mailing draft STNs to nominated external stakeholders including the RMC and Sydenham signalling complex. It was envisaged that this process provided some advantages, including:

- exposing the draft STNs to a large group of affected stakeholders who could use this as an advanced opportunity to commence their respective pre-planning activities
- increasing the opportunity for the Train Planning unit to get feedback on the accuracy, format and relevance of STNs in general.

However, the benefits of this process were negated by the following:

- STNs working in conjunction with each other (like STNs 1003 and 1004) were routinely distributed on different dates independently of each other which made cross-referencing more difficult
- the Train Planning Unit had no realistic expectation of receiving feedback from the review process and often finalised and distributed the STNs on the same day they distributed the draft – as was the case for both STNs 1003 and 1004. There was an acceptance by the Train Planning Unit that any errors, omissions, changes to final STNs as a result of this customer review process could be documented in a VIDE,²⁶ or Safe Notice, or Safe Telegram,²⁷ depending on how close it was to the start of the work.²⁸

²⁶ VIDE (also known as 'GM Wire') is a term that refers to the amendment of or alteration to an STN and is issued by the Train Planning Unit as a 'Tables Telegram'. This can be transmitted by fax and is also posted on line.

²⁷ A Safe Notice is issued to give immediate notice of changes or exemptions to RailCorp/Sydney Trains Network information publications. Where there is insufficient time available to permit the printing and distribution of a Safe Notice, a Safe Telegram is issued.

Sydney Trains confirmed that the RMC and Sydenham signalling complex had processes in place to receive and review STNs, but did not provide an explanation as to why in this case neither area detected any incompatibility between the STNs until the day of the LPA implementation.

Consideration of the operational implications of STNs rested with the end user. This was made difficult by STNs often being finalised on the same day drafts were released for review and related STNs being issued in isolation without cross-referencing to one another as was the case with the two Revesby-related STNs. The STN document itself contained no instructions as to where to direct any enquiries about perceived errors or anomalies. Draft copies distributed for review provided little more than advanced notice of the content of the final document...

In summary, ineffective validation processes did not detect changes in the possession bid and specification that subsequently affected the accuracy of STN 1004.

Maintenance of operational publications

Key publications such as Weekly Notices, STNs, Electrical Operating Diagrams (EODs, or 1500 Volt OHW Sectioning Diagrams), Train Operating Conditions (TOC) Manual,²⁹ Network Local Appendices (NLAs), Drivers Route Knowledge Diagrams (DRKDs) and a list of Signal Box Telephone Numbers assisted personnel to maintain awareness of what activities were occurring on the network at any particular time and were routinely used to plan and implement worksite protection and operational arrangements. With the exception of DRKDs and the signal box phone list, all these publications were controlled documents and their use was mandatory.³⁰ However, Sydney Trains' document control system was not consistently utilised by protection officers, train controllers, or signallers/area controllers. Instead, they preferred to rely on forms from previous entities or outdated or locally developed checklists and forms all of which were available on their intranet.

A number of anomalies were identified in the key publications, including:

- EODs, TOC Manual and NLAs relating to specific requirements in the rail corridor between Turrella and Revesby were in some cases providing conflicting kilometrages for stations and other structures in the rail network.³¹
- DRKDs were clearly endorsed: 'This document is approved for Train Crew Route Knowledge Only. Information in this diagram is uncontrolled. Updated diagrams are published every six months. DO NOT USE THIS DIAGRAM FOR ANY SAFETY RELATED PURPOSE without validating the information against a controlled source or in the field'. Regardless, some rail safety workers used DRKDs. Sydney Trains acknowledged this practice and explained: 'This may be a legacy practice, or habit due to these diagrams being the only readily available network maps prior to the introduction of the printed Worksite Protection Planning Diagrams (GIS maps)'. Sydney Trains added that DRKDs should only be used as a guide and that 'Sydney Trains does not prohibit the use of DRKD provided they are validated'.
- A signal box phone numbers list was made available on the RailSafe website and the Local Possession Authority Handbook. This list was not considered by Sydney Trains to

²⁸ Ideally, STNs were validated and finalised at least two weeks from the start of the work and were to be distributed and received by stakeholders by one week out. Any changes needed to the STN after finalisation up until three days out from the start of the work were documented on VIDEs. Changes within the three days prior to the start could be documented on Safe Telegrams.

²⁹ With effect 1 July 2013, the Asset Standards Authority within Transport for NSW assumed responsibility for the publication of the TOC manual.

³⁰ Refer to Network Rule NGE 212 Network information publications.

³¹ TOC Manual showed the location of Revesby Station at 20.964 km, the EOD Diagram 9 showed 20.963 km, which differed by some 78 m from that shown in the NLA 510 for Sydenham to Glenfield section which showed Revesby Station at 20.885 km.

be a controlled document and as such was only updated periodically. It was last updated in October 2012. As this list pre-dated the K2RQ commissioning, it did not reflect any AC panel phone numbers that were subsequently modified at Sydenham signalling complex.³²

It was also established that there was routine use of guides and informal checklists in the RMC which were designed as an aid to implement worksite protection arrangements but were not incorporated in their rules, procedures or document control system. A checklist to be used by all train controllers at the RMC was embedded with important considerations or 'assurances' that were in addition to the requirements of the network rules/procedures. No evidence was provided to the effect that either formal guidance or instruction accompanied the introduction of these guides and checklists or that any assessment of the potential impact they may have on controller workloads had been undertaken.

In summary, some mandatory controlled operational publications were found to contain conflicting, or incorrect information, whilst some uncontrolled publications were used contrary to intent, or were not incorporated into the document control system.

³² Sydney Trains stated: 'In light of this anomaly being identified the listings have been updated on the RailSafe website and the next version of the PO hand book will be amended accordingly'.

Findings

On 10 July 2013, a pre-planned and advertised Local Possession Authority (LPA) was implemented on the Up Main line between Revesby and Turrella. Thirty minutes after the LPA was implemented, passenger train 709C entered the limits of the possession area and immediately ran over railway track signals and was brought to a stand. Prior to 709C arriving, a Sydney Trains' protection officer had placed railway track signals near 55 points to protect against unplanned entry of trains into the possession area then moved off the track to a safe place. When the incident occurred, no work had commenced or equipment placed on track between 55 points and 51 points. There were no injuries or damage.

From the evidence available, the following findings are made with respect to the incident and should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance.

A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The inherent levels of safety and efficiency of the Local Possession Authority (LPA) were compromised by the inaccuracy of Special Train Notice (STN) 1004 and by the relevant rules and procedures not being followed during implementation of the LPA by key stakeholders.
- The train controller did not routinely seek confirmation by area controllers by repeating back information recorded on Local Possession Authorities (LPAs) as this process was considered to be impractical under some circumstances.
- **There were non-compliances to the repeat back provision because it was viewed as onerous under certain Local Possession Authorities (LPAs). An opportunity exists to review rule non-conformance with the implementation of LPAs. [Safety issue]**
- Both area controllers expected the termination of down trains at Revesby station platform 2 based on previous Local Possession Authority (LPA) works at this location.
- When confronted with two emerging operational problems (terminating trains on platform 2 and block working), the train controller was preoccupied on the block working issue and did not re-examine the problem with terminating trains on Revesby station platform 2.
- The relief area controller became distracted with the ongoing train running responsibilities noted on Special Train Notice (STN) 1004 (routing up direction trains via the Up Main line and 51 points), even though instructions about 55 points were documented on STN 1003 and this information had been mentioned by the train controller.
- **Sydney Trains' validation processes were not effective in detecting errors in Special Train Notice (STN) 1004 prior to the Local Possession Authority (LPA) implementation. [Safety issue]**

Other factors that increase risk

- Safe work operational documents directly affecting the planning and implementation of work on track contained conflicting and incorrect information. Other documents were not included in Sydney Trains' railway safety management document control system.
- The absence of procedures and a formal handover process between the Sydney Train's Area Controllers resulted in incorrect information of the Local Possession Authority boundaries being passed on.

Other findings

- As the chosen method in this case, Local Possession Authority (LPA) was adequate for and compatible with the type of work to be performed.
- The placement of possession protection (consisting of a red flag and three detonators) at each end of the Local Possession Authority (LPA) worked as a defence against unplanned entry of trains.

Safety issues and actions

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the rail industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

Non-compliance with repeat back provisions

Number:	RO-2013-017-SI-02
Issue owner:	Sydney Trains
Operation affected:	Rail: Passenger - Metropolitan
Who it affects:	All rail operators

Safety issue description:

There were non-compliances to the repeat back provision because it was viewed as onerous under certain Local Possession Authorities (LPAs). An opportunity exists to review rule non-conformance with the implementation of LPAs.

Response to safety issue and/or Proactive safety action taken by: Sydney Trains

Sydney Trains undertakes assurance activities in relation to safety critical communications; these include checking of audio recordings of these conversations. Sydney Trains proposes to undertake targeted assurance in relation to adherence to safety critical communications protocols in LPAs in order to determine whether the non-compliances revealed in this investigation represent a systemic failure. Should systemic failures be identified further investigation will be undertaken.

ATSB comment/action in response:

The Australian Transport Safety Bureau recommends that Sydney Trains takes further safety action to address to what extent the inherent safety and efficiency of Local Possession Authorities can be compromised by non-compliance with rules and procedures by key stakeholders and if evident, whether they represent a systemic failure.

ATSB safety recommendation to: Sydney Trains

Action number: RO-2013-017-SR-055

Action status: Monitor

The Australian Transport Safety Bureau recommends that Sydney Trains undertake further work to address this safety issue.

Detecting errors in Special Train Notices

Number:	RO-2013-017-SI-03
Issue owner:	Sydney Trains
Operation affected:	Rail: Passenger - Metropolitan
Who it affects:	All rail operators

Safety issue description:

Sydney Trains validation processes were not effective in detecting errors in Special Train Notice (STN) 1004 prior to the Local Possession Authority (LPA) implementation.

Response to safety issue and/or Proactive safety action taken by: Sydney Trains

Sydney Trains has implemented a number of changes to their STN production and validation processes and incorporated new tools and systems to improve the integrity of the validation process and make it easier to independently assess possession information.

ATSB comment/action in response:

The Australian Transport Safety Bureau is satisfied that the action taken by Sydney Trains addresses this safety issue.

Action status: Closed

General details

Occurrence details

Date and time:	10 July 2013 – 1049 EST	
Occurrence category:	Incident	
Primary occurrence type:	Safeworking breach	
Location:	Revesby, New South Wales	
	Latitude: 33° 57.147' S	Longitude: 151° 0.787' E

Train details

Train operator:	Sydney Trains	
Registration:	709C	
Operation affected:	Rail: Passenger - Metropolitan	
Persons on board:	Crew – 2	Passengers – N/A
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- The Bureau of Meteorology
- The Office of the National Rail Safety Regulator
- Rail Industry Safety and Standards Board (RISSB)
- Sydney Trains
- The Sydney Trains possession protection officer
- The Sydney Trains protection officer
- The Sydney Trains relief area controller
- The Sydney Trains rostered area controller
- The Sydney Trains train controller
- The Sydney Trains Train Planning unit manager
- The Sydney Trains Train Planning unit specifications officer
- The Sydney Trains Train Planning unit team leader
- The Sydney Trains Train Planning unit train planner
- Transport for NSW, Asset Standards Authority

References

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Chabris, C. & Simons, D. (2010). *The Invisible Gorilla and other ways our intuition deceives us*. Harper Collins: Hammersmith.

Independent Transport Safety Regulator (2013). *ITSR Rail Industry Safety Report 2011–2012*.

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Rail Industry Safety and Standards Board (RISSB, Dec 2010). *National Guideline Glossary of Rail Terminology*.

RailCorp Engineering Standard – *NSW Signalling SGS 01 Infrastructure Engineering Manual – Glossary of Signalling Terms*.

RailCorp General Rule NGE 200 – August 2005.

RailCorp General Rule NGE 204 – November 2008.

RailCorp General Rule NGE 212 – November 2008.

RailCorp Network Local Appendices NLA 402, Permanent Safe Notice 094 – October 2013

RailCorp Network Local Appendices NLA 510, Permanent Safe Notice 098 – October 2013

RailCorp Network Procedure NPR 700 – July 2012.

RailCorp Network Rule NSY 500 – August 2005.

RailCorp Network Rule NSY 512 – July 2012.

RailCorp *Signal Box Operations – Signal Box Phone Numbers*

RailCorp *Train Crew (Driver) Route Knowledge Diagrams – East Hills Line, maps 01 to 11.*

RailCorp Weekly Notice 14-2013 – April 2013

RailCorp Work on Track Rule NWT 300 – July 2012.

RailCorp Work on Track Rule NWT 302 – July 2012.

Rail Safety National Law National Regulations (2012) – Made under the Rail Safety National Law (NSW).

Train Operating Conditions (TOC) Manual – April 2013

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to:

- The Office of the National Rail Safety Regulator
- Sydney Trains
- The Sydney Trains possession protection officer
- The Sydney Trains protection officer
- The Sydney Trains relief area controller
- The Sydney Trains rostered area controller
- The Sydney Trains train controller
- The Sydney Trains Train Planning unit manager
- The Sydney Trains Train Planning unit specifications officer
- The Sydney Trains Train Planning unit team leader
- The Sydney Trains Train Planning unit train planner
- Transport for NSW

Submissions were received from all parties, with the exception of the protection officer and possession protection officer. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report Rail Occurrence Investigation

Safeworking breach involving a Local Possession Authority
Revesby, New South Wales, 10 July 2013

RO-2013-017

Final – 19 September 2014