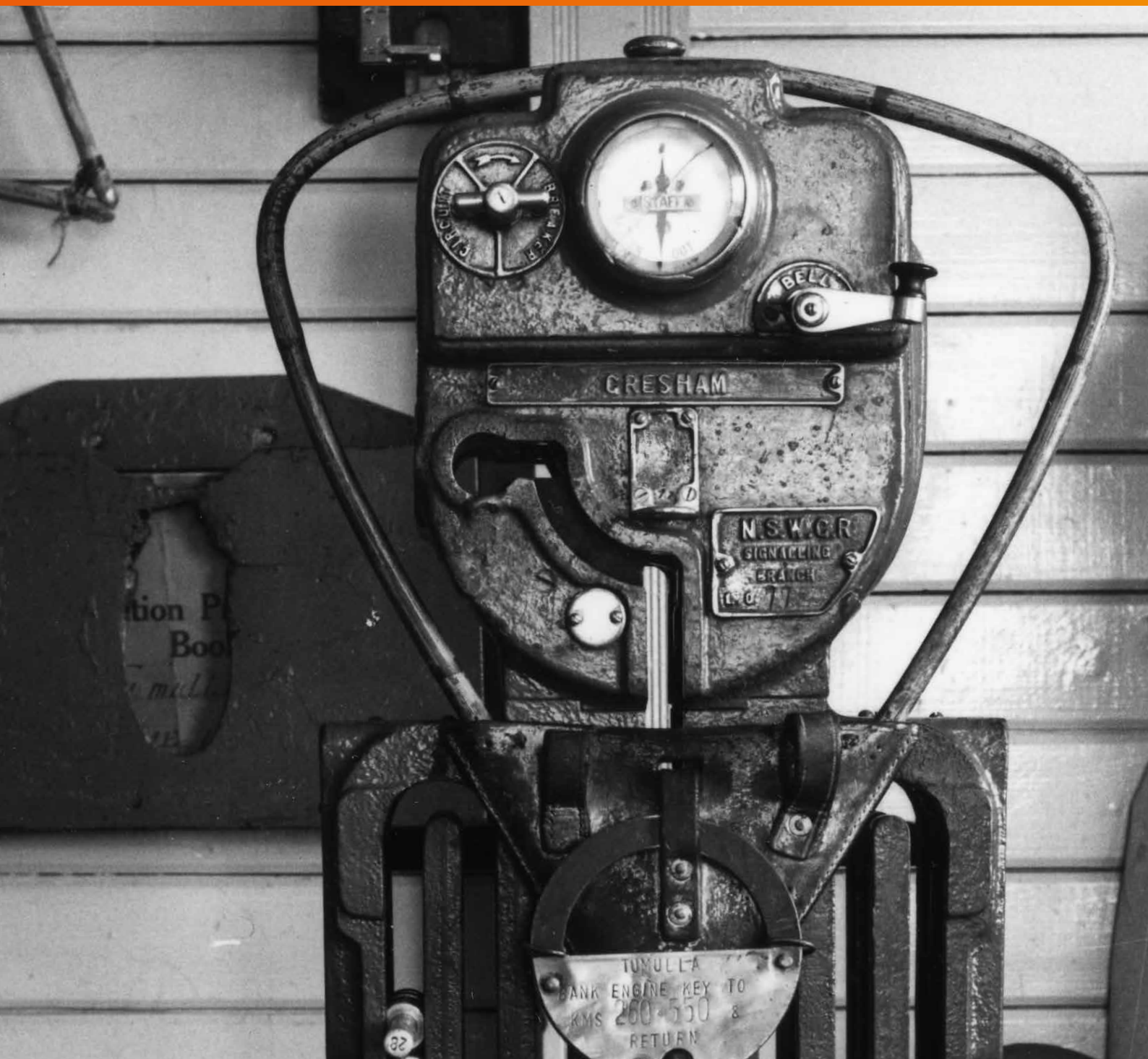# End of the Line
The Electric Train Staff System

End of the Line – The Electric Train Staff System

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About this report

In June 2014 Sydney Trains closed an important chapter in rail history by decommissioning one of its oldest signalling technologies, the 'electric train staff system' (ETS) on the Kiama to Bomaderry line, the last on the passenger network still to use it.

This report is part of an oral history project commissioned by Sydney Trains in 2014. The project comprised the making of an 18-minute video production, a Compilation CD of 47 minutes duration and this Report.

Research was undertaken and eleven persons were interviewed on video and audio media. They included current and former staff of the NSW Railways (Sydney Trains, NSW TrainLink, RailCorp) including the Director of Operations, the former Chief Engineer, Signals and Control Systems, Station Managers at Berry and Bomaderry, a train driver, a train guard, two Signal Electricians, a Train Controller, the Principal Trainer at Training College and a Rail Historian. The writer/producer appreciates the contributions that these persons have made to the project in sharing their knowledge and experiences.

The project was completed in March 2015.

Please note that the opinions expressed in the interviews are those of the interviewees themselves and do not necessarily represent the views of Sydney Trains.

Train guard with tablet in sling, 1890s. Photo courtesy Australian Railway Historical Society, image no. 023611

Location map

NSW Railway intercity network map showing location of the former ETS from Kiama to Bomaderry (circled red). Map: Courtesy of Sydney Trains
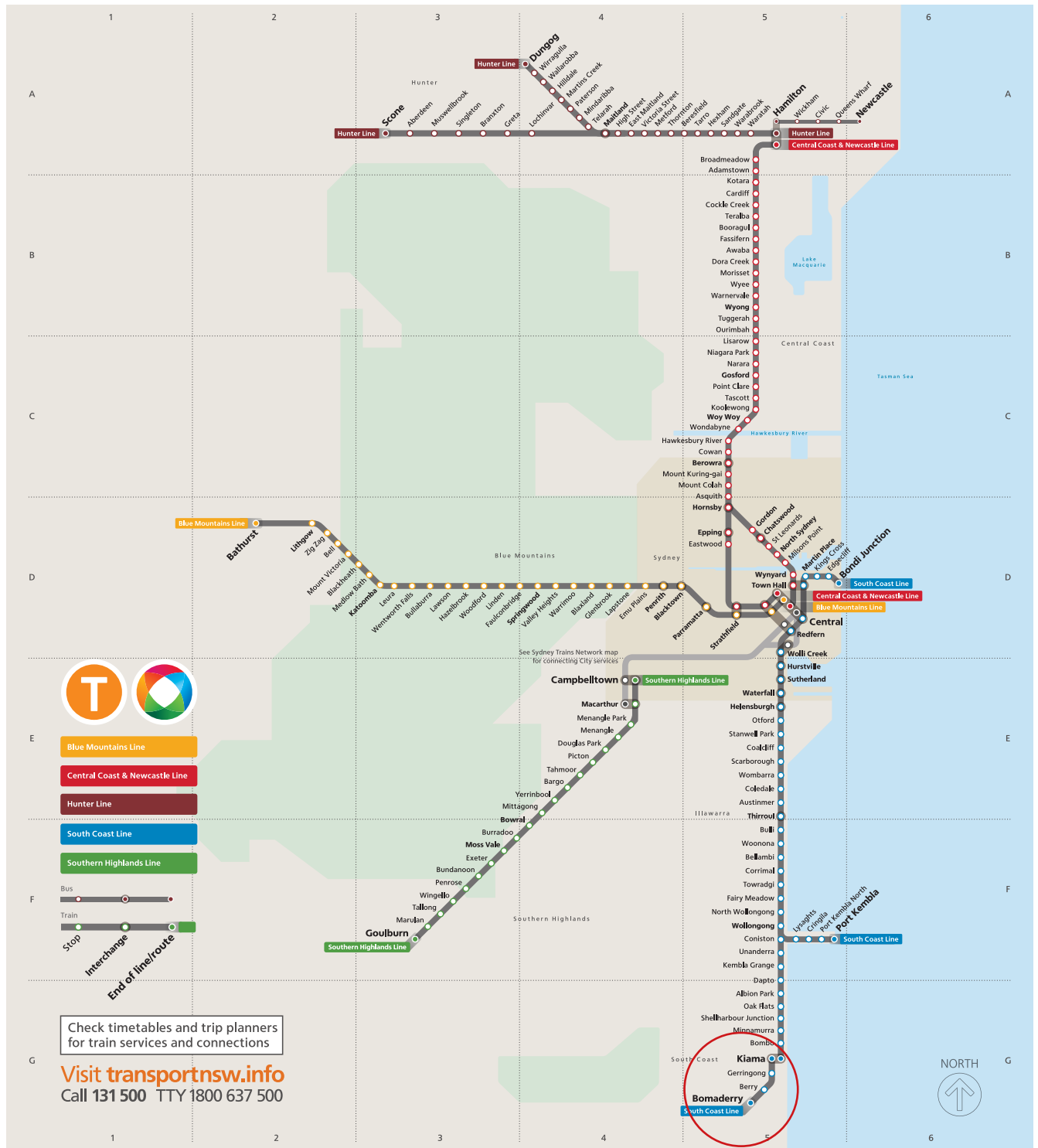
Beginnings and endings

First installed on the Kiama to Bomaderry line in 1908 during the steam train era, the 'electric train staff system' (ETS) had provided 116 years of safe and faithful service prior to it being decommissioned.

Graham Duke, Station Manager at Bomaderry, when interviewed, remarks:

'That was probably something that is quite unique, that's part of history that has gone now. It will be strange for the train to be ready to leave without somebody actually asking, 'Has the driver got the staff?' I have never sent a train without the staff, and that is our basic safe working system, it has served us well.'

Graham Duke, recorded at Bomaderry Station, 29 May 2014

When the railways started in New South Wales signalling equipment was limited to just a two-arm signal, as Robert Taaffe, a Rail Historian, asserts:

'We firstly have the physical form, the signal, which is the way a driver is told normally where to proceed, or how far ahead the line is clear. So that starts off with probably the first train, the rule book says it is there, but we are not confident that they are actually in place on the opening day. So originally it was a two-arm signal and it simply said 'stop at the station, or, 'the last train has gone ten minutes before,' or, 'the previous train has gone fifteen minutes before,' and that is all it said. You go round the corner beyond the ant hill and there might be the other train broken down, but that's all you got.'

Robert Taaffe, recorded at Cremorne, 21 November 2014

From the introduction of railways in Australia in 1831 to the mid-1850s trains have run on timetables. Warwick Allison, former Chief Engineer, Signals & Control Systems for RailCorp elaborates:

'The train had to follow the timetable and if it didn't arrive when it was supposed to then there was obviously a dilemma. Communication in those days was very poor, there were no telephones, so it would be quite difficult for people to understand where the other train was'.

Warwick Allison, recorded at Cremorne, 23 October 2014

Ordinary Train Staff - manual system, known as Staff and Ticket. Photo courtesy, Robert Taafe.

With the opening of the first extension line from Granville to Liverpool in 1856, a token system was introduced on single lines whereby the train driver is given a physical token that applies to his section of line only, giving the driver surety that no other train is in his section. This system is known as 'Staff and Ticket'.

'There is one staff at each section of line, they are unique, it is a colour, a shape, plus the name. They gave them colours and shapes and they ended up being red round, blue square, green heart, white triangle, they were the combinations. So the tickets would be the same colour as that and there is a medallion on the ticket box and there is an outline of that symbol on the head of the staff. So let's say we have got four different sections. On the safest system, the Absolute Block, you only have the staff, so the staff always has to be at the right end of the section. To go into a section - we will call it Molong - you would get the staff to the section Manildra, it would be handed to you. You would take that through to Manildra and you would hand it in there. You would then get the next staff to go to Bumberry, we will assume Bumberry is attended, and that would take you to Cookamidgera and on to Parkes, and so on.

You would have a procession of trains until one train needed to come the other way, then you simply change direction and it comes back. But without the staff you are not allowed to enter the section, it is sacrosanct.

But then you can only have one train go down and that train has to come back. If you want to have a procession you introduce the Ticket. Now the staff is the key in more ways than one, it unlocks a box. In the box is kept a book of tickets, so you write down the appropriate details and the colour of the ticket is the same colour as the box and the same colour inscribed on the staff, or the staff was painted in the early days. The driver is shown the staff and given the ticket. If he is given the ticket and there is no staff there is something funny going on and he should refuse, but he must see the staff to know that the staff is at the correct end. So you can have a whole procession go through and then the staff is on the last train in the procession. Then you change direction and you go back the other way'.

Robert Taaffe, recorded at Cremorne, 21 November 2014

Train Staff Ticket. Photo courtesy Australian Railway heritage Society, image no. 008015

John Whitton and other catastrophes

The token system, using Staff and Ticket increased safety on the railways, although the system was still far from perfect. However, the appointment of John Whitton as Engineer-in-Charge to the NSW Railways reversed that situation.

'Whitton comes along in 1858 and I think one of the problems with Staff & Ticket: if traffic patterns change you can have the staff at the wrong end of the section and how do you get it back? You normally wait until another train brings it back, so it is probably with that in mind that Whitton decides simply to use telegraph, and telegraph is being rolled out at the time, so I think he pulls Staff and Ticket out.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

THE FATAL COLLISION AT EMU PLAINS, ON THE GREAT WESTERN RAILWAY.
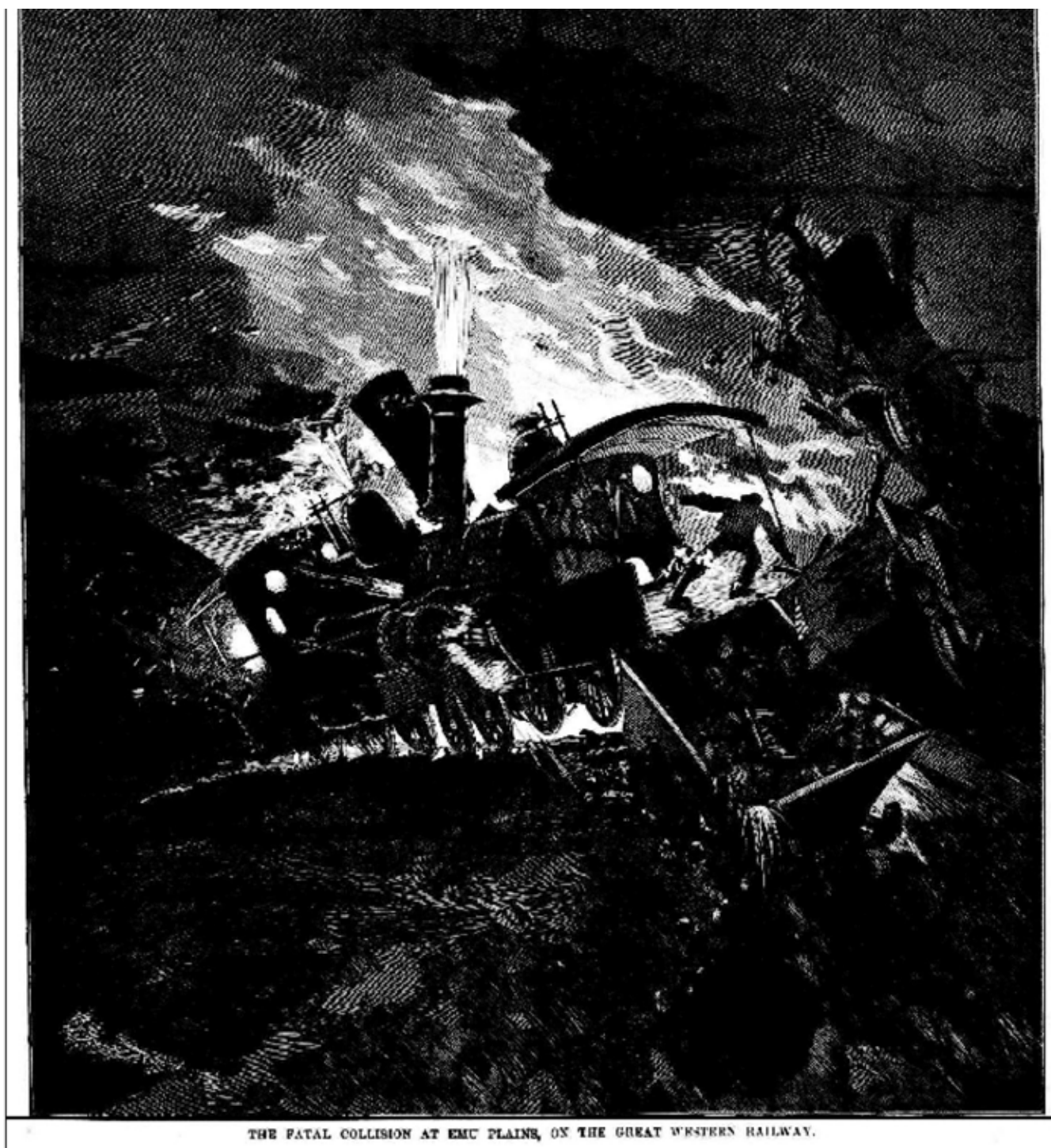
Artist's drawing accompanying newspaper article. (Illustrated Sydney News, 1878)

With the withdrawal of the token system in about 1860 trains reverted back to timetables, with their inherent dangers.

'That stays that way and people are becoming uneasy in through the 1870s, it's becoming a bit like a Mickey Mouse railway. Like the American system, there are timetables and a telegraph system. Trains are assigned rights, so you are superior by direction, or by class. That means that if you are the superior train everything else has to be out of your way before your timetabled arrival, usually ten minutes.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

As train traffic increased throughout the 1870s, controversy erupted among rail managers about safe working methods in using timetables. In 1877 there were three near-misses due to outdated safeworking methods, but John Whitton rejected all attempts to upgrade the rules.

Robert McKillop, 'NSW Railways Thematic History'.

'Various people in the railways were attempting to introduce more formal systems of safe working. This was resisted at the time, but in 1878 there was an accident at Emu Plains which really put paid to the old timetable method. There was a train coming down the mountains to Glenbrook and he was running very late. He should have waited there because there was another train travelling west out of Penrith, due to depart. The people at Glenbrook decided that they would give it a go and see if they could get to Penrith in time, but of course they met the opposing train head-on at Emu Plains.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

The Emu Plains accident, on 30 January 1878, resulting in the deaths of a driver, guard and stoker and changed everything:

'That accident really put paid to the old timetable method. Following that accident there was no going back, they introduced more formal safe working systems and this then used technology to provide the safe operation of the trains.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

'So we reintroduce Staff & Ticket with new rule books, within probably two weeks of Emu Plains. Within a matter of weeks the whole system is done, an incredible process.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

Rylstone station train and staff, 1893. (Courtesy Australian Railway Historical Society)

Tablets and Tokens

At the time of the Emu Plains collision, development on various token systems had already begun in England and one of the earliest being the Tyre's Tablet, used on single lines.

'Edward Tyre is the one that invents the electric token instrument, if we give it the generic term, so it is the tablet instrument, he is the inventor. He becomes a bit of a crusader for railway safety and he introduces, or invents quite a few, mostly tablet instruments with different variations, so each one gets a number. One is the original and I think there is a One Improved, One Restoring, we didn't use all those, you get a Two, and so it goes on. So every six to twelve months, it might be like cars, he introduces another model.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

Tyre's No. 3 Tablet. (Courtesy Robert Taaffe)

But how do token systems actually work? Warwick Allison provides this explanation:

'Token is a generic name for a device which the driver has to have in his possession to be able to occupy a section of track and every section has a token with different configurations. Initially there were instruments which had what they called tablets - a token is a general word for a tablet, or a staff. Tablet instruments were used in New South Wales in the early days and the first safe working system between Kiama and Bombaderry was a tablet system. The problem with the token system is that if the token is at the wrong end of the section when you want a train to go through then somebody has to transport that token to the other end so that the train may then proceed.'

NSW Railways' Tyer's Tablet Instrument – most likely No. 3 pattern – the last of its type in-use in New South Wales. (Courtesy Robert Taaffe).

Warwick Allison, recorded at Cremorne, 23 October 2014.

Once a tablet has been removed from an instrument it has to travel through its designated single-line section and be inserted into the instrument at the end of that section. However, should a train failure occur, the tablet has to travel by foot, or horse to the receiving instrument. The Kiama-Bomaderry line used Tyre's tablets from 1893 until about 1900.

'Eventually the London to North Western Railway in England introduced the electric train staff system. New South Wales then used both tablet and electric train staff instruments.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

'You could say: 'Why are we buying electric staff and why are we buying tablet?' Well, I think the reason is that the first electric staff instruments were two-thirds the price of the tablet instruments, so there is the incentive for the electric staff. Electric staff instruments are very robust, in fact one large staff was used to kill somebody in Tasmania, it was a good weapon. The tablet, even the Railway Signal Company had to pay, I think, a pound an instrument as a licence fee because Tyre had the patent on this.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

Type-C Standard interlocking machine, Berry Station (Cinetel Productions)

The electric staff system is complimented in the 1880s by the invention of electrical interlocking. The first interlocking frame was installed at Burwood.

'Interlocking is a contrivance to make sure that the signal given to the driver aligns with which way the points are set. So you don't want a signal for a straight route being at clear when the point is set for a low-speed diverge. It's a mechanical contrivance and some of the early ones were akin to a Heath Robinson contraption, they were really weird. In 1910 we introduce power interlocking in the Sydney Rail Yard and that introduces air-operated signals and then in 1913 we introduce automatic signalling.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

The use of the electric train staff was a significant step forward in ensuring rail safety. NSW may have been the first railway outside of the UK to use it in 1889, in fact, before it was patented. The Electric Train Staff (ETS) is in use by 1891 on the Western Line and parts of the Northern Line. In 1892 NSW Railways started buying instruments in bulk and within six months electric train staffs were controlling the line from Penrith to Dubbo. The first staffs were known as Ordinary Electric Train Staffs and are larger and heavier than the later Miniature Electric Train Staffs. The latter are about eight inches in length and made of steel, and later aluminium. Warwick Allison explains how they work:

'All electric staff is interlocked within the instruments themselves. The electric staff is designed to prevent two trains in the one section, so the instruments themselves are connected together so that you can only get one staff out at a time. Interlocking is a term that usually refers to the mechanical lever frames and the mechanical lever frames operate the signals and the points at a particular location, so the two systems have to go together. The signals and the mechanical lever frames operate the equipment at the location and the electric train staffs would then provide a surety that there was no train in the section between the interlockings. The electric train staff instruments themselves were electrically connected together, so you couldn't get more than one staff out for the section at the time. The staff instruments are provided with gauges and there are a number of different types of staffs with different gauges in them so that you cannot put the wrong staff into the wrong instrument. If you have multiple sections, one after the other, there is the potential for a staff to be over-carried and it may accidentally attempt to be put into the wrong instrument. To avoid this the rings on the staff instrument and the gauges in the instrument itself will prevent the staff being re-inserted if it's in the wrong instrument.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Electric Train Staff, the large and original electric staff system. (Courtesy Robert Taaffe)

But how do the instruments actually interlock?

'The instruments each have two coils, a line coil and a local coil and these provide magnetic fields which operate a lock. There is a cam in the instrument and a drum, and the drum rotates when you extract or insert a staff. The drum will operate the various cams and change the polarities on the battery. When you want to get a staff out you must ensure that the polarities of the coils are the same, so the Signalman at one end of the section, the end where the train will be proceeding to, will operate his bell key. Operating the bell key will send current to line, to the staff instrument at the other end. That will energise the line coil of that instrument. The local coil will already be energised by the Signalman at that end and if the two magnetic fields are in alignment it will allow the lock to lift and therefore allow the drum to rotate and extract the staff. Once the staff has been extracted the polarity has then changed and it is no longer possible to extract a staff until one is restored to either of the instruments.

The line and the local coils are powered by batteries that are located in cupboards adjacent to the staff instruments and the number of batteries varies, depending on the length of the section and the resistance of the line in the section. If the batteries are too many on the line coil then they can draw an arc when the cam operates and this could cause false operation of the instruments. In those cases an isolating relay is provided in order to disconnect the line and provide a greater impediment to the higher voltage. The voltage is set by trying to achieve a hundred and thirty milliamps through the coils.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Miniature electric staff. (Cinetel Productions)

How safe were these instruments? Was it still possible for collisions to occur?

'The electric train staff systems really only provided an apparatus to assist the staff in following the rules. They still had to do certain things and the safety of the system relied on them doing those things. For example, the driver had to make sure that he had the correct staff for the section, if he took the staff and didn't read the inscription he could be travelling on the staff for the previous section. If he made that mistake then he wouldn't have authority to be in that section and there could well be another train there. So to make these sorts of mistakes several people would have to make the mistake. The person who withdrew the staff from the instrument would have to give it to the wrong train, the driver would have to not read the inscription on it and usually there was a second person there also who would not notice the mistake. The system always relied

on compliance with the rules because it was largely a manual system. There was no technology to actually tell you where the train was, so there was still the opportunity for the staff to make a mistake and that mistake could have catastrophic consequences.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Tony Eid, Director of Operations for Sydney Rail concurs:

'I have worked the electric staff system - very frightened of it when I first used it many years ago in 1979, very frightened of it, but when you get to know the system, how it operates, its fundamentals, it is quite a safe system.'

Tony Eid, recorded at Sydney Central Station, 27 May 2014.

The first staffs were known as ordinary staffs and were larger and heavier than the later miniature electric staffs, about eight inches in length and made of duralumin.

'We have a trial in 1907 of miniature staff and magneto, so it is a hand generator, and that is on the line between Blacktown and Riverstone. I think we bought some miniature train staffs about 1914, 1915. We didn't buy many, a couple of dozen, maybe. We don't know where they were first used, I suspect between Junee and Narrandera. The other states were using them from 1911, we were not the first, but we probably didn't have a need for any more. Then in 1919 we start making our own and away you go.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

Generally, staff systems, or token systems were only used on single lines.

'A block instrument is used on double lines. On double lines you essentially have traffic in one direction only, so trains are always going in the one direction, so therefore you can't give them a token because you will be sending them away from you all the time. The block instruments were introduced at the signal boxes at either end of the section and the signalman kept a record of the trains in the section through the operation of these block instruments. The block instruments were in a box, which had an indicator on them to tell them what state they were in, and generally a bell plunger. The signalmen could send messages to each other through operation of the bell plunger and by turning the knob they could make the instrument display a particular position. Through this that would assist them in remembering where the trains were. Generally speaking, after the Emu Plains collision, double lines were introduced with the block instruments and single lines with the staff or token working.

Single lines, by their nature should not have been busy because they were only single lines, if they were particularly busy then they should have built a double line. However, some single lines did get busy in that more traffic had to be handled. Generally the solution to that was to duplicate the railway line, or to put in power signalling systems, which was possible when that technology came in the early 1920s. In general the staff system was the only way to operate single lines until power signalling came along.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Exchanging the staffs

Several methods were employed in exchanging the staffs.

'One method is that they would simply hand the staff to the driver, in which case the train would have to come to a stand, or nearly at a stand, and they would simply exchange the staffs. If the train was doing a faster speed you could put the staff into a hoop, or sling. The stationmaster or signalman would stand on the edge of the platform and hold the sling up and would hold the other arm out and the second person on the train would strike a similar pose, but in reverse. As they passed each other the sling would go through the other person's arm and be exchanged that way. There was a speed restriction on being able to do this sort of thing, otherwise you might wrench your arm off, or if you missed it might hit your head, or some other part of your body. You also had to make sure that you had a closed fist, for example, so that the hoop didn't break a finger. That was a fairly low-speed method of changing the staffs on the run and was widely used throughout New South Wales.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Graham Duke reports:

'I haven't been hurt in any way, but the best bit of advice was to stand back at the signal box door and watch the exchange from a distance. I have heard of people that, when they were doing the hand exchange with the bigger cane slings that the driver might have had the sling around the wrong way and the signalman, or whoever was doing the exchange, got a sharp whack across the back of the head with the electric staff as they went through, doing the hand exchange.'

Graham Duke, recorded at Bomaderry Station, 29 May 2014.

Bob Donovan is a train driver who started his 55-year long career in the railways during the dying days of steam trains. Now 72, he's been a driver for over forty years.

'Of a daytime, the staff exchanges were at fifteen miles an hour on the run and then at night time it was ten, but if you were in a hurry, especially to go up a hill on steam engines you were inclined to go a little bit harder. I have dropped the staff a couple of times, which used to happen a lot. If there were no slings you would have to put your hand up and clip the staff in the right way and sometimes it used to hit your thumb and you'd drop it down on the track and just hope you wouldn't run over it. If you didn't find it, they used to allow you a certain time to look for it, but in the steam days the leather pouch that the sling was contained in was painted silver and if it got in the grass, lost, and of a night time, with your kerosene lamp, flare lamp, you could see it a lot quicker. That's why they painted them silver in the old days.'

Bob Donovan, recorded at Wollongong Station, 28 May 2014.
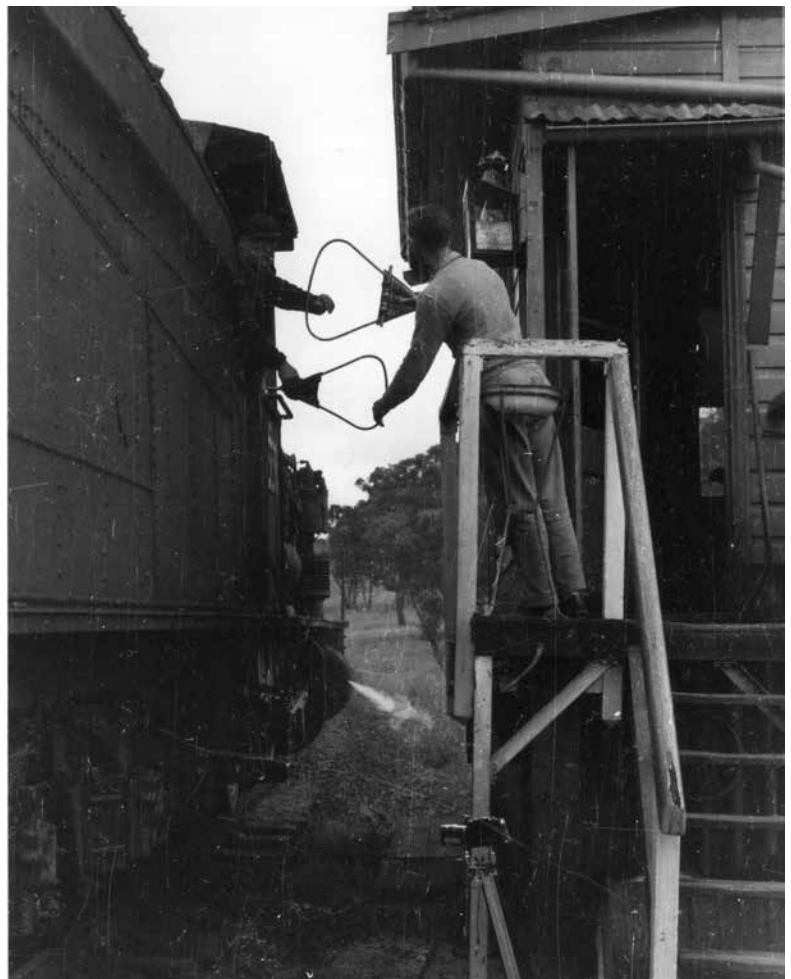
Staff exchange (date and location unknown).
(Courtesy of Australian Historical Railway Society, image no. 040757)

Exchanging staffs at Border Loop, 1989.
(Courtesy of Australian Historical Railway Society, image no. 003474)

Guard holding up sling for exchange of staffs, Scarborough, 1981.
(Courtesy of Australian Historical Railway Society, image no. 004501)

Bob Donovan continues:

'One incident I can remember, when we were proceeding, going from A to B, sometimes the sling that carries the staff - maybe there would be more at one end and not enough at the other end and sometimes they'd give you extra staffs to take to counterbalance either end. This particular day the Station Master give me heaps all tied up and I just thought that the staff was in one of them slings for me and we got to talking, but before I left I double-checked and I realised that my staff wasn't in one of them slings and I yelled out to the Station Master, 'Where are me slings?' and he said, 'Oh, you should have it.' I said, 'I haven't,' and then he realised that he had left the main thing that I wanted, it was still hanging on the staff itself in his office, so just as well I was pretty vigilant.'

Bob Donovan, recorded at Wollongong Station, 28 May 2014.

Under which conditions could a staff actually be taken out of an instrument?

'A staff can only be removed from the instrument if all the staffs are actually in the instrument at the time. The instruments have two coils, to get into the technical side, they have a line coil and a local coil. The line coil is connected to the opposite end of the section, so only when the magnetic fields of both coils are in alignment will the lock be able to lift to get a staff out. When you take a staff out, the polarity of that instrument is reversed, so that then puts it out of phase with the other end, preventing the other end from being able to withdraw a staff. So it doesn't particularly matter which end you put the staff back in - it will always reverse the polarity and align the polarities between the line and the local coil at that particular instrument. It is a very ingenious system.

There were some variants of the electric train staff system. As a general rule, though, you were only permitted to have one train in the section at a time. If the section was very long they did actually introduce a divisible miniature electric train staff section and they had this at Border Loop on the Queensland border. In this case the electric train staff was actually in two components which were screwed together, one part was the staff and the other would be the ticket, so if you extracted the staff from the instrument for two trains to go through the section together you would unscrew the staff and you would give the first train the ticket portion of the staff and then after it had gone you would then give the remaining token portion to the second train. When that arrived at the other end the two parts would be screwed back together again and put back in the instrument. The operation of the trains through the sections: they still have to be kept apart and there would be a time interval before the second train would be due to depart. In later years they introduced Full Section Working in that they had to get telephone advice that the first train had actually cleared the section.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

John Rasborsek, a Signals Engineer with forty years of service in the railways describes the procedure in the use of the ETS for a train leaving Berry to travel to Kiama.

'When the officer at Berry becomes aware that a train is due, he will go to his instrument for Kiama, go to the bell key and press a code, which will cause a bell to ring at the other end at Kiama. He will also notice on the galvanometer that it shows 'out'. If the officer at Kiama is willing to accept the train he will go to his instrument for Berry and press the same code on the key. This

Galvanometer on electric staff instrument.
(Cinetel Productions)

will cause the instrument box at Berry to ring to that code. At Kiama the officer will hold down the key on the last stroke of the code, which will cause the instrument at Berry to keep ringing continually. The galvanometer

will then show 'in'. The officer at Berry will go to the instrument, lift the staff into the neck of the instrument and with the current coming from the bell, the bell coming from Kiama will operate the electric lock, which will allow him to lift the staff through the neck of the instrument and out of the staff instrument. The instrument will then go to 'out', indicating that there is a staff out, the officer at the Kiama end will notice his galvanometer do a kick, which indicates that the staff has been withdrawn. He will then take his finger off the key and stop sending the signal here.'

John Rasborsek, recorded at Berry, 29 May 2014.
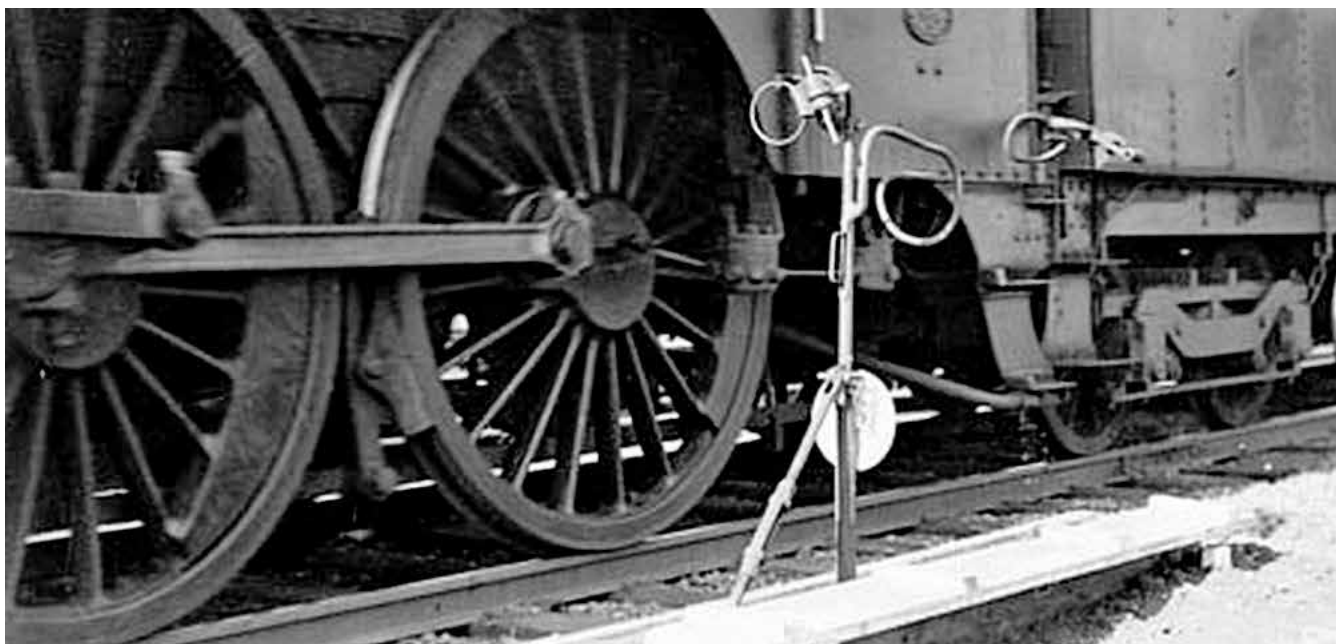
Automatic staff exchange apparatus.
(NSW Railways Safeworking photo)

Automatic staff exchange apparatus, Culcairn 1980s.
(NSW Railways Safeworking photo)

Apart from manually handing a sling containing a staff to the train driver there was yet another method of exchanging staffs at much higher speeds, invented around 1928:

'There was the Automatic Exchanger, where a mechanical device was mounted on a platform with a ring and the staff was attached to a leather strap on that ring and the train had a corresponding hook which was gauged to pick up that ring as the train went through at speeds of up to one hundred and ten kilometres per hour. The difficulty with that could be that if things were not lined up correctly the staff on the ring was struck by the train and it often caused the staff to go flying off, which was a difficulty because the staff often got lost, or damaged.'

John Rasborsek, recorded at Berry, 29 May 2014.

'You'd be coming along about seventy mile an hour and you'd pick them up, and there used to be a hell of a thump! A couple of times you wouldn't pick 'em up because they were out of alignment and then you'd have to walk back and get the right one, and give him the right one and by the time some of the trains pulled up it was about a mile and a half walk.'

Bob Donovan, recorded at Wollongong Station, 28 May 2014.

Automatic staff exchange mechanism on train. (NSW Railways Safeworking photo)

Peter Rodden, a train guard on the Illawarra Line adds:

'Some of the goods trains and the passenger trains would have the Automatic Staff Exchanger, it was on a bull's horn. You would put the staff on that and they'd have a post with a staff on it near the station and when it hit the one on the train would be on the bottom, it would curl around the one on the top, take it off the top, so you'd keep going. But if you missed it the brakes would go on and you'd have to go back and find it.'

Peter Rodden, recorded at Wollongong Station, 28 May 2014.

Did Peter ever lose a staff?

'No, but I think I've over-carried one. I have taken one with me that I shouldn't have taken, I had the staff for that section and also took the one from the section before. But that got put back in time so there was no real harm there.'

Peter Rodden, recorded at Wollongong Station, 28 May 2014.

Numbered staffs. (Cinetel Productions)

If a lost staff cannot be found a special procedure is put in place.

'If the staff was lost there was an eight-hour diligent search and that word 'diligent' was in the rulebook. The purpose of that search was to make sure that the staff really was lost, because if it was found and put back in the instrument, or given to a train you could have a situation where there might be two staffs authorised for that section, so they had to make sure that that wasn't going to happen. The way they did it was that they said you had to have an eight-hour diligent search, and during that time trains would have be worked through by emergency means.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Ray Hiddlestone, Principal Trainer at the Transport for NSW Training College at Petersham elaborates:

'We would search the buildings, the train, the precincts of where the staff has been handed to the driver and where the driver was meant to hand it in. We would look beside the track to make sure it wasn't dropped at the station, or in the garden, or before the station. There are people who have walked the length of a section, some sixteen kilometres, searching for the staff and being unable to locate it. That is eight hours to physically walk that distance, both ways.'

Ray Hiddlestone, recorded at Petersham, 31 May 2014.

Warwick Allison observes:

'At the end of that eight hours the signal electrician was authorised to re-phase the instruments and to permit staff working to again operate. The missing staff would have a number, they'd know what number it was, and they would then advertise in the Weekly Notice that such and such a staff was missing and if it was found it was not authorised for use. Sometimes the staffs did turn up, either months or years later.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Peter Rodden recalls the paperwork involved in documenting each staff transfer:

'You would go in and you'd talk to Train Control. You would tell them your train number, you would write that in the book, what time you got there, the staff number, what time you left, the number of the staff which you took out, the new one, the staff you had just used, you'd put that back in. If the signal box was attended you'd give them a couple of bells just to let them know you had put the staff back in.'

Peter Rodden, recorded at Wollongong Station, 28 May 2014.

Staff instruments at Berry Station. (Cinetel Productions)

Train control and safe-working

Train Control for the Illawarra Line is handled from Wollongong. Graham Duke reports:

'The Train Controller is the one that has got the big picture, all drawn out with graphs in front of him, or her. They have the whole area graphed, especially with it being a single line section between here, right through to Dapto. They are the ones that call the shots basically, for where a slower train or a faster train would go into a siding and allow the quicker trains to go past. The Train Controllers, with the electric staff system are the ones that give us approval to remove our staffs for the departure of the trains. The Train Controller has constant contact with us. Every train arrival, every train departure, are all recorded.'

Graham Duke, recorded at Bomaderry, 29 May 2014.

John Doyle at South Coast Train Control.
(Cinetel Productions)

John Doyle is an Area Controller at South Coast Train Control:

'We're responsible for working trains through the area of Wollongong Control from Waterfall down to Kiama and to extend down to Berry. We're responsible for ensuring the trains are on time, any track work that needs to be implemented and advising Train Control of any incidents that occurred in our area. On any given day we're monitoring, maybe thirty or forty passenger trains in each direction, plus freight, any high rail vehicles that may be going. We don't have the volume of Sydney but we have a larger area of control and monitoring for a greater period of time.'

John Doyle, recorded at Wollongong, 28 May 2014.

What are the challenges for a Train Controller?

'To keep the trains running on time. The biggest challenge is that we've got to work in with track workers, they need to get their work done and we have to find margins for them. You get trespassers, or adverse weather, you never know what the day is going to throw up and you have got to try and manage the trains and ensure safety, liaise with the people who need to know, train control stations, the supervisors we have here now, just ensure everyone is in the loop.'

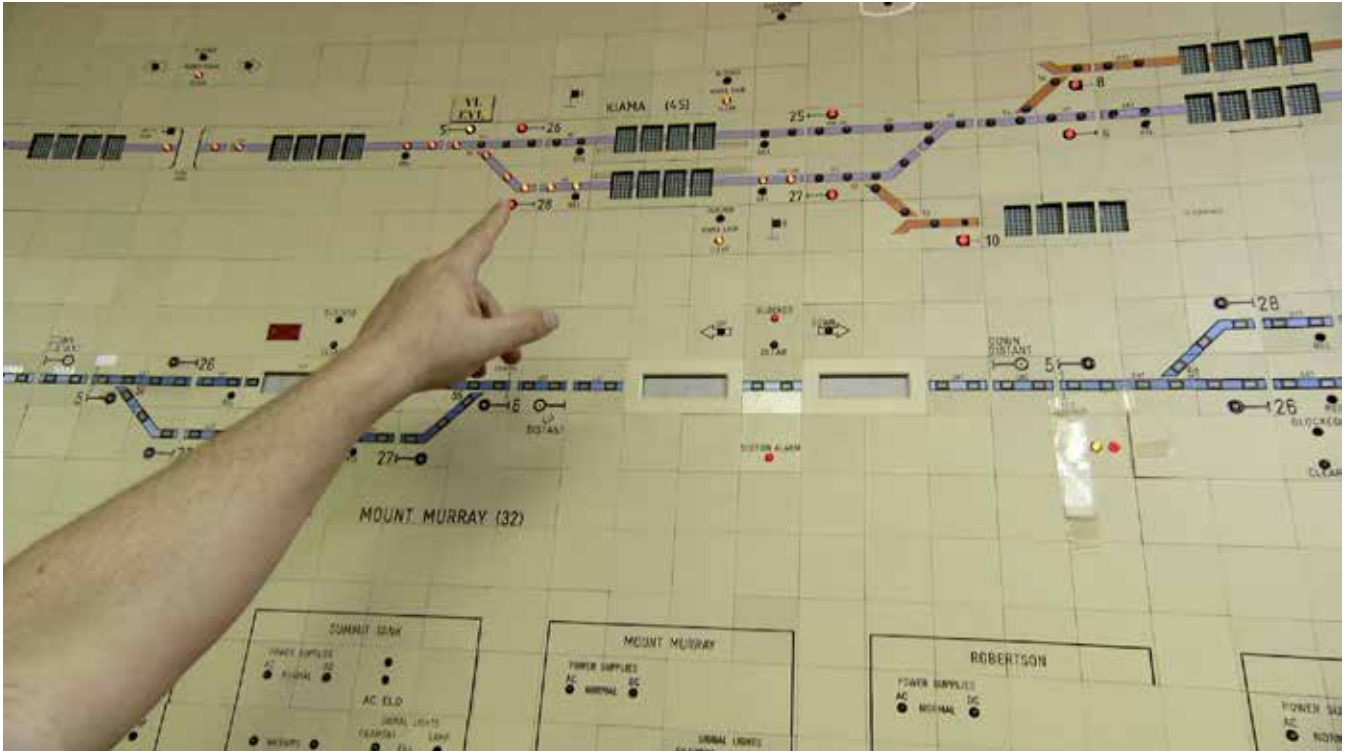**John Doyle, recorded at Wollongong, 28 May 2014.**

Doyle moves to a very large computerised control board and demonstrates:

'This is actually Kiama interlocking here and the station where the staff instrument is located on the platform. We can see down to Number Two signal there. The staff instrument section starts at twenty-five and twenty-seven signal down to Berry. What happens is we set the routes up into and out of Kiama station. When a train comes up from Berry and arrives at the station they put the staff back in to the machine there, the driver changes ends and the station at Kiama gets a new staff if South Coast Control authorises it, they put it into the receptacle there. We set the route, we clear twenty-five signal, the route will light up, the signal will illuminate a flashing ring, which means the route has been set up, that the staff hasn't been put in to the receptacle at that point. When Kiama puts the staff in the receptacle twenty-five signal will clear and give a green indication both to us and the driver, and providing the driver has the token for the section the driver will then proceed down to Berry. We see him on the tracks for approximately two to three minutes and then the train disappears off the track into a dark territory and heads down to Berry.'

John Doyle, recorded at Wollongong, 28 May 2014.

Doyle points to the Kiama to Bomaderry section of the board:

'The lights on the board: if they are illuminated yellow that means we have set up a route and the route is all locked in, the points are in the correct position. Those lights will change to red when a train is occupying that portion of track, that particular track circuit. As far as the signals go the red means the signal is stop, out in the field, and they will change to a green when the signal is clear for the driver to proceed into that section.'

Control Board, Wollongong Train Control. (Cinetel Productions)

John Doyle, recorded at Wollongong, 28 May 2014.

Train Control would also take over in the case of a staff instrument failure, a broken or lost staff:

Control Room at Wollongong. (Cinetel Productions)

'The Train Controller would also be the one to get all parties on the line and go through the safety checks to be able to bring in an alternate safety system for the moving of the trains.'

Graham Duke, recorded at Bomaderry, 29 May 2014.

But under which conditions might the ETS system fail?

'Sometimes there are staff failures, you couldn't get a staff out of the machine, or somebody has taken the wrong staff, or gone with the other staff. Sometimes it was a little bit hairy, but you were able to rectify it without too much fuss. There were always signals being left at stop and you'd have to walk in because the guard before you, or the driver before you had forgotten to change the signal and it was still set for the other way, so you couldn't go against it.'

Peter Rodden, recorded at Wollongong Station, 28 May 2014.

Robert Baillie, Station Manager at Berry and Kiama confirms:

'When the ETS system fails we go into another form of safe working, we have to use 'Special Process Authority', which is a written format, and then it is communication by phone between Kiama, myself and RMC. We go through our safety procedure to ensure that that everything is covered, there are no other trains in this section. The reason why we instigated this is because staff machines will fail and then we have the driver's name, my name and the signaller's name and then we hand it to the driver - that is his authority to travel the section. It is like a token for the section then, that replaces it, the token.

Robert Baillie with miniature staff instruments at Berry Station, May 2014. (Cinetel Productions)

When these become null and void we place a cover over it, as such. Once the cover is over the instrument it's deemed out of use and the only time that the cover can be lifted is when RMC, Sydney Control, tells us we can do it. The system is finished then, we have to go to a paper system.'

Robert Baillie, recorded at Berry Station, 29 May, 2014.

If staff instruments are rendered inoperable, or a staff cannot be located a system of' 'Working by Pilotman' is authorised. Warwick Allison remarks:

'The concept of a single line being safe relies on the token and if you don't have a physical token, such as a staff, you could have a person who acts as the token and that was called a Pilotman. The Pilotman would

wear an armband to distinguish him from the other employees. If you, for example, had a failure of your electric train staff, or you lost your ordinary train staff you could institute Pilot Working, which would use a Pilotman and the train would only go through the section if he was present on the locomotive. There is another variation of that which is called 'Pilot Staff Working' and that is where instead of a Pilotman you would have an ordinary train staff, which was specially coloured and shaped and called a Pilot Staff. They would introduce the temporary pilot staff until they could reinstate the normal system.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

But what is the procedure with ETS when a station is unattended?

'That's called 'Automatic Working'. Along this line Berry is the only station that is being used in Automatic Working of a nighttime. That allows for us here at Bombaderry, when Berry is unattended to withdraw a staff from our electric staff instrument and issue that to the driver without Berry being attended. Generally the train crew would be talking to Train Control to ask which way the signals had to be set. So if a train was coming from Bombaderry-Nowra to go to Berry the signals would be set in that direction so that the train could come to the platform at Berry. Then after the train arrived the train crew would go in, speak with the Train Controller, they would deposit the staff from our section into the Bombaderry instrument over at Berry, then seek approval then to take a new staff out to go towards Kiama.'

Graham Duke, recorded at Bomaderry, 29 May 2014.

'Automatic Working' uses an automatic switchbox. Warwick Allison explains:

'In the 1920s there was quite an economy drive and the attendance of staff stations by railway staff to operate the staff instruments was a high cost on the system in many areas where there wasn't that much traffic to justify the staff being there. To overcome this problem they introduced an automatic switchbox. The automatic switchbox is installed adjacent to the staff instrument and when a train is to proceed towards an unattended location the automatic switchbox would be in the auto position. The operation of a bell key at the departing end would operate the equipment inside the automatic switchbox and that would emulate a person holding the bell key down to get the staff out. So then the staff would be able to be withdrawn because the automatic switchbox would be doing the work of the Signalman at the other end of the section.

Another interesting thing working with electric train staff was Back Engine Working. In some locations there would be a steep incline out at the interlocking and they would have to put a locomotive on the back of the train and help push it up out of the interlocking. That locomotive would get it over the hill and then it would drift back into the interlocking from whence it came, ready to push up the next train. So, strictly speaking you had two trains in that section and the way this was handled is that the first train would have a staff taken out of the instrument and it would be given to the driver of that train and then the bank engine would be given a key. When the key was provided to the bank engine it would cut the staff line, so that it was no longer possible to get a staff out of that instrument until the bank engine key had been reinserted. The bank engine was authorised only to travel for a certain mileage, whereupon it would drop off the train and return back to the interlocking. Once back in the interlocking the bank engine key would be restored from the driver of that bank engine into the lock. That would permit the staff instruments to again be energised, such that when the staff was inserted at the other end you could get another staff out for another train. Bank engines were in use at places like Molong, for example, and at Ardglen in the New England area. They don't use them too much these days because the locomotives are powerful enough to be able to pull the trains up.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

What happens if there are no staffs left in the instrument when one is needed?

'Train movements are generally scheduled so that there are an even number of movements on the 'up' direction to Sydney and on the 'down' direction, away from Sydney. It does happen that there are an uneven number of trains running and there are many reasons for this. For instance, in country areas when there is freight traffic there may be three smaller trains going in one direction, taking three staffs, and another goods train going in the other direction, taking one staff - the three trains will become one train. The result is that

the staffs will move to one end. The consequence of that with time is that an instrument on one end will run out of staffs, there are no staffs left. At that point they cannot use the safe working system for authority to travel trains in that direction, they must revert to manual processes - this is not desirable.

The Signal Electrician, who is the maintainer for the area must monitor staff movements so that when too many staffs are moving down one way he will transfer a number of staffs to the other instrument. There can be a difficulty with this because these staff sections may be a hundred kilometres, maybe longer, and in that long section there may be multiple staff sections. A normal staff section is about twenty kilometres, so in a hundred kilometre length you may have staff instruments, with all the staffs travelling to one end - this electrician has to travel, move multiples of these staffs all the way to the other end, maybe a hundred staffs, maybe more. That can be a very frustrating job.

As an example, a very wise electrician will check before the weekend that his staffs are balanced in his sections, the last thing you want is to get a phone call on Saturday night from an officer on a station who has calculated his trains and says, 'By Monday morning I will have no staffs left - we cannot accept trains.' So the electrician then has to go out and perhaps spend half a night travelling in the bush transferring staffs from one instrument to the next, to the next, to the next, so that the section is balanced again. So you have to manage your staffs for each section and keep an eye on train running so that you don't get caught in that position.'

John Rasborsek, recorded at Berry Station, 29 May 2014.

John Rasborsek demonstrating inner workings of ETS instrument. (Cinetel Productions)

The ETS system seems to cater for all circumstances:

'One of the things that they did have for intermediate sidings was that if a train had to go into an intermediate siding and stay there for some period of time you might want to restore the main line to service. To achieve that the staff had to be put back in the instrument, but of course the instrument would have been some distance away at either end, so they had what they called Intermediate Instruments. Now the Intermediate Instrument had no bell key, but you could insert a staff into that instrument. You can always insert a staff into the instruments - to get a staff out of an Intermediate Instrument then the signalmen at either end of the section both had to hold down on their bell key. This would then send current towards the Intermediate Instrument and allow the lock to lift to get that staff out of the Intermediate Instrument. By that means trains could go to intermediate sidings and also depart intermediate sidings independently, if you like, but still interlocked with the main staff system.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Maintaining the system

Keith Belfitt is a Signals Electrician who maintains the staff instruments and the copper lines on poles that bring the current to them.

'The maintenance of the electric staff instrument itself is pretty basic and reliable. Most of our issues come from external factors, which is the twenty kilometres between here and Berry, the line route is old and in bad condition – it's been up for nearly a hundred years. It goes through swamps and we have also got a lot of copper thieves, unfortunately, in recent years. Approximately four weeks ago we had a staff failure. We tested the instruments and it showed there was an open circuit out on the track. We proved that it was outside. During the night we don't go chasing faults any more, it's too dangerous. We came back in the morning, did some testing and found two kilometres of copper wire missing down Nowra. We reported this to the police; due to the time of day we didn't fix it at that time, we organised to come back the next day, in which there was another two kilometres missing.'

Keith Belfitt, recorded at Kiama, 28 May 2014.

Copper line wire on upended rail tracks at Bomaderry Station. (Cinetel Productions)

John Doyle emphasizes:

'At times we'd go days on end where the line wire would be getting stolen, day after day. When that occurs the staff instruments no longer work, so we have to introduce Special Proceed Authority Working. It's the paperwork - we have some paperwork we have to do and ensure the interlockings and the points are in the correct position before we let the trains go, all the spar work is filled out correctly. Yes, it causes a few delays with the trains.'

John Doyle, recorded at Wollongong, 28 May 2014.

Maintaining the poles that carry the wire is becoming problematic, as John Rasborsek points out:

'Maintaining this line is also a very serious safety issue now, the poles are well over a hundred years old, they are not like the solid wooden poles we know, they are rails stood on the end of the pole in the ground. They are no longer considered safe to use, so it is very difficult for staff to maintain these in a safe manner and generally it is done with mechanised machinery like cherry pickers and things like that. Considering the landscape this goes over, which is very bushy and very hilly, it can be very hard to do. The skills to work on this equipment are disappearing because these older people have gone and the cost is too great to consider, for instance, replacing thirty-one kilometres of line route.'

John Rasborsek, recorded at Berry Station, 29 May 2014.

So why has the ETS system been replaced after 120 incident-free years of service?

'Well, you can't buy instruments and no one is in a position to make them. They require maintenance, there is a delay if it is unattended. The most efficient way is to have it attended, but that is paying of staff. So there is a time penalty, or there is a labour cost penalty, plus the maintenance. The instruments are getting old, they are wearing, and less and less people know how to repair them. But they are a fairly robust instrument, they have served their place well. If you looked in terms of numbers: approximately in the UK and the colonies I would reckon about ten thousand large ones were made, I don't think there were any more. London North-Western would have made a small number for themselves, of which I know one survives. The miniatures, some of the numbers are a bit of a puzzle but the 'S's' about thirteen to fourteen thousand were made and the 'M's' probably about five thousand, worldwide.'

Robert Taaffe, recorded at Cremorne, 21 November 2014.

Rail vehicle detection

The section between Kiama and Bomaderry has been replaced by ordinary colour light signalling and the current system of working is Rail Vehicle Detection.

'The new system that is going in is one of the latest technologies. We are using two different methods to provide signalling down there. The first is that we have got fibre optic cables, which bypass level crossings and is used through interlockings, and between the interlockings, where there is a long section we are actually using the rails themselves to pass the signalling information. The signalling information is connected to small computer-based interlockings at each of the stations and through those the signals there are now fully electrically controlled.

You don't have to rely on any apparatus or any rules to work out whether or not the section has a train in it before you authorise another train, the system is continuously checking that for you. If the section is clear then you will be able to operate the signal to send a train into the section on the basis that any vehicle there will be detected by the system. Obviously the Rail Vehicle Detection system is much better than electric train staff because an electric train staff system cannot detect whether there is a train in the section or not, it only infers that there is, depending on whether you have a staff out and where that staff might be. In the Rail Vehicle Detection system, however, you can detect a train in the section, even if part of the train was left behind - you can still detect that in the section, and therefore it is almost foolproof.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

How does John Rasborsek feel about the demise of ETS?

'I think it is important that we upgrade to new technology. The society, the users of our system, expect to know where trains are, to want them running reliably, and the ETS system while it has been nice, it is costing us a lot of time and money to keep running.'

John Rasborsek, recorded at Berry Station, 29 May 2014.

Warwick Allison adds:

'As a Signal Engineer you tend to appreciate the history that has gone behind all these systems and why they are there. The equipment itself is very solid and it has an aura of its own. It is definitely Victorian engineering and it is Victorian engineering which has survived into the modern age, so because of that it has a certain attraction. The fact that the instruments are painted bright red, for example, and they have large levers and bells and clunk when they operate is quite satisfying. From the point of view of a Signal Engineer though, providing a safe operation to the railway, they really have had their day. In terms of improving train operations by putting in modern signalling, not only do you make it safer but the trains no longer have to waste time changing staffs and you can provide a better service for the travelling public.'

Warwick Allison, recorded at Cremorne, 23 October 2014.

Graham Duke concurs:

'In today's push-button computerised age, it's a quaint system. It still serves its purpose brilliantly, the engineering that went into it in the 1890s in England, and for us to have copied the system is incredible, the fact that it stood the test of time. It is only in the last few years that some of the mechanical parts are starting to break down, obviously, with machines that are a hundred years old. But the system has stood the test of time and the majority of the drivers and guards I am sure that would have been interviewed would have said that they felt quite safe while they were in possession of the staff.'

Graham Duke, recorded at Berry Station, 29 May 2014.

Tony Eid has the last word in this Report:

'Today the need for ETS is no longer required. Not only will the new upgraded system provide a safer railway, it will provide for extra capacity if we ever need to go there. We can run more trains than the electric staff system. The drivers and the train guards that operate the trains can now worry about the customers in driving the trains, it's a fantastic thing. But what we leave behind is the last bit of legacy that this railway had in its history, taking away the ETS system, the last ETS system on our network. I will be sorry to see it go, but what we are planning for the future and will be on for Sydney and its community in the Sydney Rail Plan is very much so exciting. So where we leave behind the history of the railway we look forward to the future, and the future talks about a metro-style operation, talks about turn up and go, talks about a brand new delivery of a timetable, talks about a very fast metro-style service, like the London Underground, like New York, like the rest of the world enjoys today, we now need that same sort of model in Sydney and that is what we are moving towards.'

Tony Eid, recorded at Central Station, 27 May 2014.

The end of an era – ETS instrument. (Courtesy of Robert Taaffe)

Interviewees' Biographies

Warwick Allison

Starting in the Public Transport Commission in1978 as a Signal Designer, Warwick Allison worked his way through various positions, such as Systems Maintenance Engineer at Transport House and Signals Electrical and Communications Engineer for FreightCorp. He became Chief Engineer, Signals and Control Systems for RailCorp (Sydney Trains) until his retirement in 2014.

Known by other rail staff as the 'guru' of signalling, his advice on signalling matters is still keenly sought by rail authorities nationwide.

Robert Baillie

With his father working on the Railway at Narrabri, it was only natural that Robert Baillie should follow in his footsteps. Now Station Manager at Berry his career with the railways has spanned a period of thirty-five years, thirty-four of those working with the Electric Train Staff system.

Robert was familiar with the ETS on a daily basis and at the time of interviewing was eagerly looking forward to working with the all-electronic Rail Vehicle Detection system in use on all lines.

Keith Belfitt

Born in 1967 in England, Keith Belfitt arrived in Australia in 1969. He started with the Railways in 1985 as an apprentice in the Signal Branch, went through his apprenticeship and trained to become a Signal Electrician. Keith maintained the ETS instruments on a regular basis and knows more about their inner workings than almost everyone else.

John Doyle

An Area Controller at Wollongong Signal Box, John Doyle is responsible for all train movements on the South Coast line. He started in 1997 at Exeter as a Grade 1 Signaller, then moved to Sutherland and Sydenham and was on duty during the Sydney Olympics. He also has a Bachelor of Commerce degree from Wollongong University.

Robert (Bob) Donovan

Spanning a 55-year career in the railways, starting on steam trains as a Fireman and Acting Driver, Bob Donovan still drives trains on a daily basis. He comes from a long railway family: his grandfather was Station Master at Culcairn, grandmother was a gatekeeper, of his father's two brothers one was a guard and the other a porter and Bob's aunt was on the buffet cars on steam trains and the later express trains.

Bob also still drives steam trains for the Thirlmere Museum and believes that he is the only one still operating them.

Of the steam era he says:

'It used to be hard yakka in the old steam days, you know. When you done your job firing up to Sydney, or whatever, driving from A to B, and then you had to put the engine in the loco and then you had to do the fire and shovel forward and things. It was hard work, but we never whinged because that was the job and we were fit too then.'

Aged 72, he is having thoughts of retiring, but enjoys the job so much that he is 'still moving the retirement goal posts forward'.

Graham Duke

Station Manager at Bomaderry, Graham Duke has been on the railways since 1978 when he started at Culcairn. He worked at all of the stations between Junee and Albury and saw the end of the electric staff on that section in 1983. He recalls:

'We had all the quaint-name trains, I suppose. We had the Southern Aurora, we had the Spirit of Progress, with all the neon signs on the back of the trains and those nostalgic type of things that you don't see on the XPTs. We had two trains heading towards to Sydney of a night-time and two trains heading towards Melbourne through the night as well.'

Graham enjoys his work and feels some nostalgia about the end of the ETS era, but he is not nostalgic enough to put his hand up to say, 'I would like an electric staff in my lounge room to look at'.

Anthony (Tony) Eid

Tony Eid's career spans over thirty-three years in the railways, starting as a phone boy in 1979, recording trains past the Signal Box to becoming Train Controller in 1992 and ultimately Director, Operations for Sydney Trains. He is responsible for all the signal box management and train control, incident management, timetabling, train crewing and the running of the operations.

In 2000 he directed and delivered the rail transport for the Sydney Olympic Games in an extraordinary effort to produce a most successful transport outcome. He has a positive outlook for Sydney Trains and its future.

Ray Hiddlestone

Principal Trainer at the Signals Training Centre, Transport for NSW College at Petersham. Ray Hiddlestone has a detailed knowledge of Signalling and the Electric Train Staff. He joined the NSW Government Railways in 1972 and became an Electrical Mechanic in the Signals & Communications Branch. After several other positions he joined Sydney Trains as the Signalling Competence Engineer, Engineering and Systems Integrity in June 2014.

John Rasborsek

As a Signals Engineer, John Rasborsek has pretty well seen it all and worked with a great range of equipment, from the ETS to the latest computerised signalling systems. He started as an Apprentice Signal Electrician with the Railways in 1974, became a Signal Electrician and progressed to a Signal Engineer. He is an expert on the Electric Train Staff, having worked with it for his entire career.

He enjoys the signalling discipline and the discipline of safeworking and likes working with people, especially young people, instructing them and also learning from them different ways of doing things.

He considers the electric staff machines as 'a marvellous bit of electro-mechanical engineering for its time' and is pleased that this oral history project will be a legacy to their memory.

Peter Rodden

A train guard with 36 years of experience, Peter Rodden started in the railways through playing with the local team at Werris Creek, which was sponsored by the NSW Railways. Their jerseys had the Railway emblem and the words 'Go By Rail' on the back.

He worked at Werris Creek for ten years, then was transferred to Port Kembla to work on freight trains and later to Wollongong on the passenger trains. He is very familiar with the ETS system, having used it throughout his career. Of his time in the railways, he quotes:

'In thirty-six years I haven't missed a payday, so I am quite happy with that. I think with all jobs you whinge about them now and again, but I don't think I could have found a better job, as in security and everything, it has always been there'.

Robert Taaffe

As a metallurgist and professional Mechanical Engineer, Robert Taaffe spent the first thirty years of his career in the power industry in New South Wales. He also spent ten years in with Rail Access Corporation as Geographic Information Systems Manager and later, Configuration Manager. He also has completed two postgraduate theses, looking at railway signal box buildings and the evolution of the designs. Robert is an acknowledged rail historian with a detailed knowledge of signalling, the evolution of ETS and other token systems.

Signalling & ETS chronology

1856 – The first railway extension, from Granville to Liverpool was opened. Evidence suggests that the new single line was regulated by Staff and Ticket, a token system where the driver was issued a physical token or staff that applied to the nominated section of single line only.

c. 1860 – Soon after John Whitton was made Engineer-in-Chief, NSW Government Railways (1856-1890), the token system was withdrawn in favour of timetable working. As traffic increased so did accidents and near-misses.

1876 – From about 1876-1877 Staff and Ticket was re-introduced on new lines until the telegraph could be installed.

1877 – A new Rule Book, incorporating Staff and Ticket and Block Telegraph systems was printed. The Staff and Ticket system was introduced as the primary system of safeworking on single lines.

1878 – Edward Tyer patented a system of working single lines with Absolute Block. This system used electrically connected instruments and the token was a circular flat disc called a tablet.

1878 – Emu Plains collision- two freight trains collided head-on, three rail staff died. End of Timetable Working on single lines.

1879 – McKenzie & Holland exhibited their new signalling equipment at the Garden Palace Exhibition in Sydney, including their patented interlocking machine. NSW Railways purchased the machine and orders were placed for more machines to interlock Sydney and Newcastle. Introduction of Absolute Block Telegraph working for double lines and Staff and Ticket continued for single lines. (It is believed that the use of block instruments may have been delayed until 1880).

1888 – Tyer's Electric Train Tablet was introduced to NSW Railways and installed between Balmoral and Mittagong.

1888 – Francis Webb and A. Thompson of the London and North Western Railway patented an Electric Train Staff instrument.

1890's – Severe economic depression hit Australia.

1891 - First use of large Electric Train Staff on the Blacktown to Richmond line.

1893 – On 2nd June Kiama to Bomaderry line opened with Tablet Working. At first mainly dairy traffic, milk, cattle, timber, petrol, etc. Sidings at milk factories at most stations.

1893 – Quirk tablet exchangers were introduced

between Picton and Mittagong and later, Albury. This and modified versions were the only type of tablet and, later, staff exchangers used in NSW.

1900 – ETS was the dominant system of electric token operation and replaced tablet as needed, from about 1900 until 1959.

1904 – Smith patented the Miniature ETS instrument. Railway Signal Co. became the licensee.

1907 – First use of the Miniature Electric Train Staff on the Richmond Line as a trial.

1913 – The first automatic signals in Australia were brought into use between Erskineville and Sydenham, replacing Tyer's One-Wire Block. Automatic signalling between stations on double lines where economically justifiable.

1914 – Miniature ETS introduced in NSW, replaced large ETS for most new installations.

1919 – Workshops started making their own miniature ETS instruments. Four hundred and forty-two units were manufactured before production ceased around the late 1950s.

1925 – The American Absolute Permissive Block system, known locally as Single Line Automatic, was installed on the Molong to Dubbo Line. It was replaced by the Electric Staff system in 1933.

c.1928 – Automatic Staff Exchange equipment introduced on Junee to Albury section of the line. This replaced tablet exchanging. Note: the same equipment was used for tablet and miniature ETS.

1939 – Single line track block, using colour light signals was introduced between Sutherland and Cronulla.

1977 – Introduction of CTC (Centralised Traffic Control) to NSW, replacing the electric staff. This system was to spread to most single-track main lines in NSW.

1998 – The last large ETS systems were phased out in NSW.

2014 – In June the last miniature ETS was decommissioned on non-ARTC operated lines in NSW, between Kiama and Bomaderry.