TERMINAL PROTECTION ET AL

Further to John Hawkins' letter regarding "Terminal Protection" in the April 2008 issue of *Underground News* (page 319), it does indeed seem that "…. most advances are made with the benefit of hindsight".

The development of terminal protection can probably be said to have started as a result of two end wall tunnel collisions by empty trains in the siding at Tooting Broadway, the first on 7 October 1960[1]. In this the motorman was injured, but there was no loss of life. Probably for this reason, no accident report was generated. This produced a knee-jerk reaction from London Transport and with effect from 6 November 1960, a 'sand drag' was installed at the end of the siding. This did absolutely nothing to prevent a second accident at the same location on 4 May 1971[2], but on this occasion the motorman lost his life. The Accident Report suggested that either the motorman may have been reading, or thought he may have been going into the much longer reversing siding at Kennington.

The result of this was that a series of orange warning lights were installed in tube tunnel sidings between 1961 and 1964 as a reminder to motormen that they were entering a dead-end siding. Some progress was also made in further protecting drivers entering tunnel sidings in that two fixed red lights and a fixed trainstop were installed in tube tunnel sidings between 1972 and 1974. In two 'long' tube tunnel sidings (Kennington and Down Street), these were 'shortened' to provide a berth for just one train in each instead of two. As a result, the stop lights had to be moved and some of the yellow warning lights repositioned. One much later addition to yellow lights in a tunnel siding was the shunting neck in London Road depot, which received six yellow warning lights from 8 November 1981.

In addition to the two incidents at Tooting Broadway, there had been a "pre-Moorgate" incident at Aldwych on 3 August 1955, when the shuttle train, then comprised of a two-car 1935 Tube Stock unit, overran the stopping mark and collided with the tunnel wall. The driver survived but suffered severe injuries. There was considerable damage to DM 11010 which had to be rebuilt at Acton Works. (A photograph of the damaged car in Cockfosters depot was published – with permission! – in UNDERGROUND No.10 on page 27 [now out of print] before it was taken to Acton Works for repair).

There is also a suggestion that a "pre-Moorgate" incident occurred actually at Moorgate in platform No.9 (in the same location where the 1975 accident took place) one Christmas Day afternoon/evening in the 1950s involving a two-car train of Pre-1938 Tube Stock. The story goes that this was apparently "hushed-up" at the time because the train that overran the stopping mark managed to stop short (just) of the end tunnel wall, and also because of all the extra money and time that would be needed to protect against it happening again – system wide. Probably for that reason and despite extensive researches, no documentary evidence has been found of the incident. It may be, of course, that this information, handed down over many years, may have become distorted or even exaggerated – we will now probably never know.

---

1 The cars involved here were 1938 Tube Stock DM 11103 and 1935 Tube Stock trailer 012488 and were effectively cut up on site, although salvaged parts were later used to provide demonstration door equipment for a mock-up car in the then new Railway Training Centre at White City.

2 1938 Tube Stock cars 11047 and 012421 were scrapped on site.

In addition to the incidents already mentioned there were two other collisions where motormen lost their lives. Both were on the Piccadilly Line. One was at Rayners Lane on 14 December 1972, when a train overran the stopping mark in the siding, collided with the buffers and demolished the eastbound home signal immediately beyond[3]. In this case the car involved (1959 Tube Stock DM 1012) was later repaired. Thought was afterwards given to survey all signal sites that were in a similar position, i.e. those which could be swiped by a train that would normally have nothing to do with them.

The second collision was near Uxbridge on 25 June 1973, when a train leaving Uxbridge sidings and running empty to Hillingdon to pick up passengers (a timetabled move) passed the reception road outlet signal (which was at danger) at speed and, because the points weren't set for the main line, ran into a bridge abutment. The leading two coaches of the train (1959 Tube Stock DM 1071 and trailer 2070) were subsequently scrapped. Other than an individual loss of life at some of these accidents, nothing was to prepare London Transport for the tragic loss of life at Moorgate on 28 February 1975 – 43 people died, including the motorman.

London Transport was brought up sharply in their belief that such an incident couldn't happen, but actually did (after all, the motorman is regarded as being in control of the train and therefore would [without question] stop at the designated stopping mark at a terminus). As can be appreciated, the sand drag and single red stop lamp at Moorgate did nothing whatsoever to reduce the speed of the train and the impact of the collision.

Very quickly following Moorgate, a 10mph speed restriction was implemented into all dead-end terminal platforms, irrespective of whether they were in tunnel or not. Moreover, the function of inner home signals at terminal stations and into bay platforms was altered so that they would not clear to green until an approaching train had almost stopped, or actually stopped. By doing this, a conscious effort to slow down had to be made by the driver, proving he was alive and well[4] and thereby eliminating the possibility of a full-speed run into a platform with a dead end by a train. This was a rather simple operation in comparison with what was to follow, but all of these measures had a far-reaching effect on the train service, effectively reducing capacity in many places. Of course, the London Transport Signal Department engineers had to cope with all this extra work, plus progressing planned new signalling and modernisation – Heathrow (opened 1977), the Jubilee Line (opened 1979) and the Metropolitan and Jubilee Line resignalling (into the 1980s) and beyond.

The next stage of terminal protection was to install pairs of fixed red lights at terminal stations, in addition to and just beyond the one that was there already (tunnel sidings had already been equipped in 1972-74 following the second end wall collision at Tooting Broadway). Adjacent to the additional pairs of fixed red lights, a fixed trainstop was also installed, which was permanently in the raised position. These were arranged so that normal length trains fitted snugly between the stopping mark

---

[3] Once the driver had been taken away, work continued on the recovery operation. However, your Editor recalls making the journey to work at Neasden during the following morning rush hour (Friday 15 December 1972) with the crash train still in position in the siding (but with Breakdown staff working away on it) and Metropolitan Line trains being authorised past the site and the (then removed) signal, "under failure conditions".

[4] Some people, particularly those who are drivers themselves, might argue that the deadman's handle on the train is the first proof that the driver is 'alive' if not actually 'well'!

and the starting signal and meant that in most cases trains no longer continued right up to the end of the line.

This is why places like Stratford (Jubilee Line) have the stopping marks located a considerable distance from the actual end of the line which means passengers have a walk between the concourse and the first available carriage. On the existing railway, Stanmore is another example where trains no longer reach the buffers.

Left: Two fixed red lights, a 'diamond' stopping mark (which denotes the point where all trains should stop, irrespective of length) and a fixed trainstop are seen at the east end of the bay platform at Plaistow on 18 June 2008. The sand drag and single fixed red light (which were all that were provided pre-Moorgate) are seen beyond.

Photo: Brian Hardy

The first location to be so modified was at Aldwych in April 1975, which was the only place that another 'Moorgate' could happen (and indeed had happened some 20 years previously but with less serious consequences – q.v.). Although the platform at Aldwych was much shorter at 250ft than the normal tube stations opened in 1906-07 (which were generally 350ft), there was still plenty of room to accommodate a three-car train of 1959/62 Tube Stock stopping at the west end headwall. The east end of the platform was left in darkness and without décor (see also Supplement to *Underground News*, March 2008, page 226). Now with the stopping mark having to be moved eastwards, the east end of the platform had to have lighting and rather primitive décor installed – white-washed tunnel segments was the result of the latter. The three-car train thus fitted comfortably between the east end headwall and the newly relocated stopping mark.

All of this went well at Aldwych until 30 December 1977, when a three-car unit of 1973 Tube Stock was substituted for the 1959 Tube Stock, the latter not being available for some reason (probably defect). Although the 1973 Tube Stock was destined to operate on the Aldwych shuttle, this was earlier than intended and caught the powers that be off-guard. The 1973 Tube Stock, being a little longer than a three-car 1959/62 Stock unit, meant that the train wasn't fully in the available platform – the east end cab was still in the tunnel, and of course the guard was located in this cab when travelling towards Aldwych. In the event, 1973 Tube Stock

was banned from the Aldwych branch until the fixed red lights and fixed trainstop were moved slightly westwards on 7 February 1978 to accommodate the marginally longer trains.

Stations also featured in the “protection” programme, with those closed on Sundays having their station starting signals modified so that they cleared only when a train reached a specific track circuit at reduced speed. This meant that all trains had to slow right down if passing through, ensuring the speed of the train reflected the short overlap on the starting signal. Previously it was left to the judgement of the motorman as to what speed he passed through a station, which led to liberal interpretations of the authorised speed. Such stations included Cannon Street, Fairlop, Ravenscourt Park, Shadwell and West Brompton- there were many others.

Locations exempt from post-Moorgate signalling modifications included Queen’s Park, Elephant & Castle, Morden, Epping, Hainault and the future termini at Heathrow Central and Charing Cross, because there was sufficient space beyond the stations for any margin of error – and there were no dead-ends. However, the sidings beyond Queen’s Park, Elephant & Castle, Epping and Charing Cross were later protected.

Another stage of “Terminal Protection” was to install trainstops (generally two but sometimes one, sometimes three) in platform areas, which would only lower if the speed of an arriving train had been sufficiently reduced. If the speed was in excess of that stipulated (generally 15 and 10mph), then the train would be ‘tripped’ and brought to a stand long before the dead end. The second of two trainstops, this one *(left)* is set to lower when trains approach at 10mph or less, in platform No.2 at Stanmore.

“Traction Control”, which followed experiments in platform No.9 at Ealing Broadway (District Line), also incorporated approach-controlled trainstops in the platform area but included a traction resistor connected to the platform area current rail section, which prevented trains from accelerating at full speed approaching a dead end if

there was insufficient speed for it to coast up to the stopping mark. If a train did have to accelerate, it would only be possible to do so with minimum power. With it being connected to the signalling system, trains were able to depart unhindered as the circuit was by-passed through the green aspect of the starting signal. Most sidings were also equipped with an approach-controlled trainstop as a train entered them. Moreover, the shunt signal controlling the entry into a siding was altered to remain at danger until the appropriate platform track circuit was occupied, often with a 15-second time delay.

The next stage of "Terminal Protection" was the development of the train "arrestor". Trials were undertaken out of the public eye in a corner of Upminster depot, which involved deliberately running trains into various designs of sand drags and buffer stops at speeds up to 22mph – without a motorman on the front, of course! There was sufficient withdrawn 1938 Tube and CO/CP Stock available to do these tests and in the end the system decided upon was a "crash dolly" which, if hit by a train, would engage with it and slide back into a large rectangular area full of granite chippings.

The train arrestor at the end of platform No.1 at Edgware on 25 June 2008 *(left).* To the left is the crash dolly which will slide along the track if hit by a train. The large 'container' of granite chippings is beyond it.

The train arrestor at Cockfosters at the end of platforms 2/3 is seen *(left)* on 1 July 2008. Wire netting has been placed over and proud of the granite chippings, and plants and flowers now stand on top, making the ambience more presentable.

Both photos: Brian Hardy

Not all dead-end sites were so treated, however. On single line sections a proper 'signal' and series of trainstops was the decided option, which included Mill Hill East, Chesham, Holborn and Aldwych. On the approach to the terminus a two-aspect automatic signal (with trainstop) was provided, which would clear only when the approaching train had reduced to the required speed. If not, then the train would be tripped at this point and be brought to a stand long before the end of the line. Once the signal cleared, the train was able to continue into the platform at reduced speed, reducing speed further to negotiate the approach-controlled trainstops. These signals were numbered A1000 (Chesham), A1001 (Holborn), A1002 (Aldwych) and A1004 (Mill Hill East). It is believed that A1003 was planned for Ongar but this wasn't in the end done, two fixed red lights and a fixed trainstop being deemed sufficient. The fact that trains approached Ongar on a downhill gradient and had a brick wall at the end of it didn't seem to matter, although the fixed red lights and trainstop were located about four cars' length from the end of the line.

Of course, all this 'protection' came at a cost – not only in money, but to the train service as well. Additional running time had to be built in to the timetables to cater for the slowing-down process arriving at terminal stations and in some cases services were reduced in consequence. Until the situation had been regularised, at Uxbridge for example, the all-stations local trains in the morning rush hour started up empty from the sidings and ran direct to Hillingdon, rather than operate via the platform – the layout was unable to cope with the existing service with all the newly-installed restrictions.

'MOORGATE' SIGNALLING

The list below shows the different sites that were affected by the Moorgate incident. However, it may not be totally complete but is the most that can be gleaned by your writer from sources currently available. For example, Track Circuit Interrupters were installed in each of the Victoria Line sidings (Brixton, Victoria, King's Cross and Walthamstow Central) some time after the line opened, but quite when seems to be

elusive. It is also believed that the main sidings at Woodford were not completely 'protected' until the upgrade resignalling. Even to this day, Farringdon sidings each have just a single red light (and solid brick wall) at the end of it – no pairs of fixed red lights or fixed trainstops. There may be other places? Farringdon also has the deterrent of a brick wall at the end of the sidings. As time has passed, there have been further changes to signalling at some sites in the light of experience. No doubt there will be further 'tweaks', although new signalling systems, when they eventually arrive, may see even more radical changes.

Signalling changes to protect trains entering dead-end sidings pre-Moorgate are shown thus.

GENERAL

14.04.75 Blanket 10mph speed restriction imposed for trains entering all terminal stations – Traffic Circular entry.

ACTON TOWN

04.03.79 2 fixed red lights and fixed trainstop at end of west (No.26) siding.
Approach controlled 15mph trainstop in west (No.26) siding.
Shunt signal WL26 ex-platform No.2 to west (No.26 siding) 15 second time release.

08.04.79 2 fixed red lights and fixed trainstop at end of east (Nos.21/22/23) sidings.

02.08.80 Approach controlled 15mph trainstop in east (Nos.21/22/23) sidings.
Shunt signal WL116^{A} ex-depot east end 15 second time release.

ALDGATE

17.05.75 Home signal OB1/2/3/4 15 second time release into platforms.
Signals OB8 and OB9 into platforms 2/3 approach controlled.

22.07.77 2 fixed red lights and fixed trainstop at end of platforms 2 and 3.

22.02.80 Additional fixed red light at 'south' end of inner rail platform 4.

21.10.84 Approach controlled 15mph and 10mph trainstops in platforms 2 and 3. "Draw-up" signal OB4900 provided for outer rail protection.

AMERSHAM

20.04.78 2 fixed red lights and fixed trainstop at end of each siding (Nos.31 & 32).

14.12.80 Approach controlled 15mph trainstop entering each siding (Nos.31 & 32).

ALDWYCH

04.75 2 fixed red lights and fixed trainstop in platform (stopping mark moved
08.02.78 eastwards).
2 fixed red lights and fixed trainstop moved 10ft westwards to
02.03.80 accommodate slightly longer 1973 Tube Stock.
Branch signalled with 10mph approach controlled signal A1002 approaching Aldwych westbound and 10mph approach controlled trainstop in platform for arriving trains.

ARCHWAY

17.07.64 Yellow warning lights installed in siding.

07.09.73 2 fixed red lights and fixed trainstop at end of siding.
Approach controlled 15mph trainstop entering siding.

ARNOS GROVE

03.82 2 fixed red lights and fixed trainstop at end of siding roads 25-31.

BAKER STREET (Metropolitan Line)

13.07.75 Signal MB330^{B} 4½ second time release.
Signal MB33 approach controlled.
MB32 approach controlled for platforms 1/2/3.

09.02.77 2 fixed red lights and fixed trainstop at end of platform 4.
2 fixed red lights at end of platform 1.

23.10.83 Approach controlled 15mph and 10mph trainstops in platforms 1 and 4. Speed at signal MB33 relaxed to 20mph approach controlled.

26.07.87 Approach controlled 15mph and 10mph trainstops in platform 2 for southbound trains.

BARKING

02.11.75 Signal FF59 approach controlled into bay platform.

08.01.77 2 fixed red lights and fixed trainstop at end of bay platform.

07.10.84 Approach controlled 15mph and 10mph trainstops in bay platform. Approach controlled speed on signal FF59 relaxed to 20mph. Track circuit interrupter commissioned.

BRIXTON

04.05.75 2 fixed red lights at end of each siding and speed entering sidings restricted to 15mph in coded manual.

24.01.79 Fixed red light by shunt signals south end of platforms to sidings.

BRIXTON MUSEUM

22.03.64 Yellow warning lights installed in siding.

15.12.72 Shunt signal CC9^{B} approach controlled to 10mph.
2 fixed red lights and fixed trainstop at end of siding.
Approach controlled 15mph trainstop entering siding.

CHESHAM

23.01.76 2 fixed red lights and fixed trainstop.
Signal A1000 at 4-car stopping mark and 4½ second time release at signal A1000 for 8-car trains.

19.08.84 Approach controlled 15mph trainstop at south end of platform for arriving northbound trains and track circuit interrupter commissioned.

21.02.88 15mph approach controlled trainstop moved 41m south. Signal A1000 removed but trainstop retained (but moved 10.3m south) and 10mph approach controlled. New fixed trainstop and two fixed red lights at north end of platform (where all trains to stop) and new track circuit

21.05.94 interrupter commissioned.
Axle counters commissioned and fixed distant becomes new A1000 south of station for northbound trains.

CHARING CROSS (Jubilee Line)

30.11.86 Track circuit interrupters commissioned at the end of each overrun siding.

CHALFONT & LATIMER

16.11.75 2 fixed red lights and fixed trainstop at end of bay platform.
Home signal JT9 ex-Chesham branch 15 second time release to bay

platform.

19.08.84 Home signal JT9 to bay platform clears when train has stopped at signal. 15mph approach controlled trainstop entering bay platform. Track circuit interrupter commissioned.

COCKFOSTERS

26.10.75 Home signal M41/42/43 4½ second time release into each platform.
27.08.77 2 fixed red lights and fixed trainstop at end of each platform.
16.09.79 Approach controlled 15mph trainstop entering each platform.
30.09.79 Traction control commissioned all platforms.
03.03.80 Crash dolly and granite chippings provided at end of platform No.1 and speed limit on trains entering platforms relaxed from 10mph to 15mph.
11.05.80 Crash dolly and granite chippings provided at end of platform No.4 and speed limit on trains entering platforms relaxed from 10mph to 15mph.
14.07.80 Crash dolly and granite chippings provided at end of platforms 2/3 and speed limit on trains entering platforms relaxed from 10mph to 15mph.
17.08.80 Track circuit interrupters commissioned all platforms.

COLINDALE

14.01.78 2 fixed red lights and fixed trainstop at end of siding.
24.10.80 Approach controlled 15mph trainstop entering siding.

DAGENHAM EAST

14.12.75 Signal FG23^{B} 4½ second time release into bay platform.
26.02.77 2 fixed red lights and fixed trainstop at end of bay platform.
23.10.83 Approach controlled 15mph and 10mph trainstops in bay platform and approach controlled speed on signal FG23^{B} relaxed to 20mph. Track circuit interrupter commissioned.

DEBDEN

11.12.77 2 fixed red lights and fixed trainstop at end of each siding.
19.12.78 Approach controlled 15mph trainstop entering sidings.

DOWN STREET

22.03.64 Yellow warning lights installed at end of siding.
17.11.72 Siding shortened from two trains' berth to one.

EALING BROADWAY (Central Line)

06.07.75 Signal WP2 4½ second time release into platforms.
26.08.77 2 fixed red lights and fixed trainstop at end of each platform.
08.04.79 Approach controlled 15mph trainstop entering platforms and approach controlled speed at WP2 relaxed to 20mph.
03.06.79 Traction control commissioned both platforms.
12.08.79 Crash dolly and granite chippings provided at end of both platforms and speed limit on trains entering platforms relaxed from 10mph to 15mph.
29.11.80 Track circuit interrupters commissioned both platforms.
17.08.95 Track circuit interrupters removed on commissioning of ATP.
31.03.97 Arrestor chippings removed.

ELEPHANT & CASTLE

07.11.63 Yellow warning lights installed in southbound siding.
10.11.63 Yellow warning lights installed in northbound siding.
08.12.74 2 fixed red lights at end of each siding and approach controlled 15mph trainstop entering each siding.
25.02.79 Fixed red light by shunt signals at south end of platforms to sidings.
12.08.91 Track circuit interrupters commissioned at end of each siding.

EALING BROADWAY (District Line)

06.07.75 Signal WP17 15 second time release into platforms.
04.04.76 Signal WP17 4½ second time release into platforms.
2 fixed red lights and fixed trainstop at end of platform 9.
Approach controlled 15mph and 10mph trainstops in platform 9.
Speed limit on trains entering platform 9 relaxed from 10mph to 15mph.
26.08.77 2 fixed red lights and fixed trainstop at end of platforms 7 and 8.
04.03.84 Signal WP17 approach controlled at 20mph, speed entering platform 9 reduced to 10mph, approach controlled 15mph and 10mph trainstops entering platforms 7 and 8, track circuit interrupters installed platforms 8 and 9.

EDGWARE

16.05.75 "Draw-up" signal AE100 4½ second time release. Home signal AE1 approach controlled.
11.02.77 2 fixed red lights and fixed trainstop at end of each platform.
22.07.79 Approach control on AE100 removed.
Approach controlled 15mph and 10mph trainstops entering each platform – 2 trainstops platforms 2/3 and 1 trainstop platform 1.
Traction control commissioned all platforms.
Track circuit interrupter commissioned platform 1.
31.10.79 Crash dolly and granite chippings provided at end of all platforms and speed limit on trains entering platforms relaxed from 10mph to 15mph.
29.11.80 Track circuit interrupters commissioned platforms 2 and 3.
10.06.96 Traction control de-commissioned. Additional trainstop at north end of each platform, making 2 in platform 1 and 3 each in platforms 2 and 3.

EPPING

10.12.77 2 fixed red lights and fixed trainstop at end of east siding.
18.12.78 Approach controlled 15mph trainstop entering east siding.

EUSTON

25.06.64 Yellow warning lights installed in siding.

FINCHLEY CENTRAL

29.01.78 2 fixed red lights and fixed trainstop at end of each siding (25/35).
02.03.79 Approach controlled 15mph trainstop entering each siding (25/35).

GOLDERS GREEN

28.01.78 2 fixed red lights and fixed trainstop at end of Nos.24 and 25 sidings.
01.04.79 Approach controlled 15mph trainstop entering Nos.24 and 25 sidings.
26.10.86 2 fixed red lights and fixed trainstop at end of No.27 road.

HARROW-ON-THE-HILL

19.04.78 2 fixed red lights and fixed trainstop at end of siding.
14.12.79 Approach controlled 15mph trainstop entering siding.

HIGHGATE

12.10.81 2 fixed red lights and fixed trainstop at end of shunting neck south of Highgate depot which was close to the southbound bore of the north Highgate tunnel.

HIGH BARNET

14.12.75 20mph inductor removed from signal NUX242. Signal NU300 4½ second time release. Signal NU3 approach controlled.
Shunt signals NU28^{A} – NU28^{H} fitted with trainstops.
26.08.77 2 fixed red lights and fixed trainstop at end of each platform.
18.11.79 Traction control commissioned all platforms and signal NU300 20mph approach controlled.
Approach controlled trainstops provided – two in platform No.1 and three each in platforms 2/3. Track circuit interrupters installed in each platform.
15.09.80 Crash dolly and granite chippings provided at end of platforms 1/3 and speed limit on trains entering platforms 1/3 relaxed from 10mph to 15mph.
26.10.86 2 fixed red lights and fixed trainstop at end of No.32 shunting neck road.
10.02.97 Traction control de-commissioned. Additional trainstop at north end of each platform, making 2 in platforms 1 and 2, and 3 in platform 3.

HAMMERSMITH (Hammersmith & City Line)

29.06.75 Signal OZ 2^{A}/3^{A}/4 4½ second time release into platform 1.
Signal OZ 2^{B}/3^{B}/28 4½ second time release into platforms 2/3.
29.10.76 2 fixed red lights and fixed trainstop at end of each platform.
18.03.84 Approach controlled 15mph and 10mph trainstops in each platform. Signals OZ4/3^{A}/2^{B} renumbered OZ4^{A}/3^{A}/2^{A} and new signal OZ4^{B} provided approaching platform No.1. Approach controlled speed on signals OZ3^{B}/2^{B} and OZ4^{B} relaxed to 20mph. Track circuit interrupters commissioned all platforms.

HIGH STREET KENSINGTON

19.10.75 Signals ED57^{H}/ED58$^{H}_{L}$ 15 second time release into platforms 3 and 4.
30.07.77 2 fixed red lights and fixed trainstop at end of platforms 3 and 4.
26.10.86 Approach controlled 15mph and 10mph trainstops in platforms 3 and 4. Track circuit interrupters commissioned both platforms.

HOLBORN (Piccadilly Line)

02.03.80 Branch signalled with 10mph approach controlled signal A1003 approaching Holborn eastbound.
22.06.80 Signal PD6 converted to 2-aspect colour light.

HOUNSLOW WEST

03.75 Home signal WX2 approach controlled with delta track occupation.

KENNINGTON

01.03.64 Yellow warning lights installed in siding.
22.10.72 Siding shortened from two trains' berth to one.

19.06.77 Shunt signals B4 and B9 ex-platforms 2 and 4 to siding, platform tracks occupied before clearing.

KENSINGTON OLYMPIA

14.01.76 2 fixed red lights and fixed trainstop at end of platform.
26.07.84 Approach controlled 15mph trainstop entering platform. Track circuit interrupter commissioned.

LIVERPOOL STREET (Central Line)

18.06.64 Yellow warning lights installed in siding.
01.06.75 2 fixed red lights and fixed trainstop at end of each siding.
Approach controlled 15mph trainstop entering each siding.
Shunt signal LB5 ex-eastbound platform to sidings, platform track occupied before clearing.

LIVERPOOL STREET (Metropolitan Line)

27.06.75 Junction home signal OD15 15 second time release into bay platform.
28.11.76 2 fixed red lights and fixed trainstop at end of bay platform.

MANSION HOUSE

17.05.75 Junction home signal EG10 15 second time release into bay platform.
05.08.77 2 fixed red lights and fixed trainstop at end of bay platform.
11.03.84 Approach controlled 15mph and 10mph trainstops in bay platform. Track circuit interrupter commissioned.

MARBLE ARCH

22.03.64 Yellow warning lights installed in siding.
24.11.72 2 fixed red lights and fixed trainstop at end of siding.
18.06.76 Shunt signal CD3 ex-westbound platform to siding will only clear with platform track occupied.

MILL HILL EAST

02.03.76 2 fixed red lights and fixed trainstop at end of platform.
01.06.80 New signal A1004 20mph approach controlled approaching Mill Hill East.
Approach controlled 15mph trainstop entering platform.
Track circuit interrupter commissioned.

MOORGATE (Metropolitan Line)

16.11.75 Junction home signal OE47 4½ second time release into platforms 3/4.
16.06.77 2 fixed red lights and fixed trainstop at end of platforms 3/4.
29.07.84 Approach controlled 15mph and 10mph trainstops in platforms 3/4.
Signal OE47 speed relaxed to 20mph approach controlled.

MOORGATE (Northern City Line)

03.75 Approach control at southbound 'home' signal. Although no date can be found for the implementation of this, it can be assumed with almost certainty that it was applied following the crash, when the line reopened after the completion of the rescue and recovery operation.

MOORGATE (City Widened Lines)

26.04.76 Home signal OE23 15 second time release for trains entering terminus.

NEASDEN

27.11.80 Approach controlled 15mph trainstop entering 1/2 roads in south dock.

NEWBURY PARK

18.12.77 2 fixed red lights and fixed trainstop at end of each siding.
20.12.78 Approach controlled 15mph trainstop entering sidings.

NEW CROSS

04.07.76 Signal ET5/6 15 second time release southbound home signal and to depot.
16.01.77 2 fixed red lights and fixed trainstop at end of bay platform 1[5].
02.07.83 Approach controlled 15mph and 10mph trainstops in platform. Signal ET5/6 relaxed to 5 second time release.

NEW CROSS GATE

13.01.75 Home signal NCG3 approach controlled on Southern Region resignalling of area.
09.02.86 Area taken over by London Transport from Southern Region. Home signal renumbered ET303.
09.10.88 2 fixed red lights and fixed trainstop in bay platform and home signal ET303 has 15-second time release.

NORTHFIELDS

19.11.78 2 fixed red lights and fixed trainstop at end of No.7 siding. Approach controlled 15mph trainstop entering No.7 siding.

NORTHOLT

17.01.80 2 fixed red lights and fixed trainstop at end of siding. Approach controlled 15mph trainstop entering siding.

OAKWOOD

25.01.82 Track circuit interrupters commissioned in shunting neck and No.13 points ex-depot (west end).

ONGAR

28.01.76 2 fixed red lights and fixed trainstop in platform. Berth reduced to 228ft.

PARSONS GREEN

08.07.79 2 fixed red lights and fixed trainstop at end of No.23 siding. Approach controlled 15mph trainstop entering No.23 siding.
20.01.80 Approach controlled 15mph trainstop to WF12. No.26 siding removed.

PLAISTOW

28.11.75 Signal FC11^{C}/8^{B} 15 second time release into bay platform.
05.03.77 2 fixed red lights and fixed trainstop at end of bay platform.
27.11.83 Approach controlled 15mph trainstop in bay platform and approach controlled speed on signal FC11^{C}/8^{B} relaxed to 20mph. Track circuit interrupter commissioned.

PUTNEY BRIDGE

27.07.75 Signal WG150 4½ second time release. Signal WG15 approach

---

[5] Platform 1 at New Cross became platform D from 2 May 1977 when letters replaced platform numbers.

controlled.

31.07.77 2 fixed red lights and fixed trainstop at end of bay platform.

06.05.84 2 approach controlled 10mph trainstops in platform.

QUEEN'S PARK

07.11.76 2 fixed red lights and fixed trainstop at end of 22/23 sidings.
Approach controlled 15mph trainstops in 22/23 sidings.
New approach controlled draw-up signals BB260^{A} (15mph) and BB260^{B} (10mph) southbound on 24 road.
New approach controlled draw-up signals BB400^{A} (15mph) and BB400^{B} (10mph) in northbound platform.
Track circuit interrupters commissioned at end of 22/23 sidings.

16.02.92 Fixed trainstops at end of 25/26 sidings in south shed. Two approach controlled trainstops (15mph and 10mph) on both roads in south shed.

QUEENSWAY

22.03.64 *Yellow warning lights installed in siding.*

25.06.76 Shunt signal CE4 ex-eastbound platform to siding will only clear with platform track occupied.

RAYNERS LANE

25.02.79 Shunt signal P22H ex-westbound platform to siding, platform track occupied for 15 seconds.
2 fixed red lights and fixed trainstop at end of siding.
Approach controlled 15mph trainstop entering siding.

RICHMOND (Southern Region)

24.02.80 Southern Region resignalling. Home signal red/yellow aspects only.

08.91 Fixed trainstops installed at ends of platforms 4-7.

06.98 20mph approach control on home signal GB17. Approach controlled 15mph and 10mph trainstops in platforms 4-7.

SHOREDITCH

29.01.76 2 fixed red lights and fixed trainstop at end of platform.

09.05.78 2 fixed red lights and fixed trainstop moved 28ft north.

STANMORE

27.06.76 2 fixed red lights and fixed trainstop at end of each platform.
Approach controlled signal changed from MK8/9 to MK8^{B}.

15.04.84 Area resignalled. Home signal JL42 20mph approach controlled.
Approach controlled 15mph and 10mph trainstops in both platforms.
Track circuit interrupters installed both platforms.

TOOTING BROADWAY

06.11.60 Sand drag installed at end of siding following previous collision.

01.10.61 Yellow warning lights installed in siding.

20.08.72 Shunt signal W200 entering siding with 15mph approach controlled trainstop.

09.03.73 Shunt signal W200 removed but 15mph approach controlled trainstop remains.

TOWER HILL

21.01.68 Signal EJ100 clears when approaching train is travelling 20mph or less (when bay platform commissioned).

27.11.76 2 fixed red lights and fixed trainstop at end of bay platform.
06.05.84 Approach controlled 15mph and 10mph trainstops in platform.
Approach speed on signal EJ100 relaxed to 20 mph.
Track circuit interrupter commissioned.

UPMINSTER

13.07.80 Fixed red light by shunt signals FM19/20/21 to reception roads from platforms 3/4/5.
Approach controlled 15mph trainstop ex-depot approaching signals FM1/2/3.
Shunt signals FM4/5/6 approach controlled 4½ second time release.

UXBRIDGE

08.02.76 Shunt signal MW58 20 second time release.
MW9/10/11 4½ second time release.
MW16/17/24 approach controlled.
28.08.77 2 fixed red lights and fixed trainstop at end of each platform.
08.03.81 Approach controlled 15mph trainstop approaching signal MW53.
2 fixed red lights and fixed trainstop east of signal MW53.
Approach controlled 15mph trainstop approaching signal MW52.
23.02.84 Track circuit interrupters commissioned all platforms.
26.02.84 Approach controlled 15mph and 10mph trainstops in each platform.

VICTORIA (Victoria Line)

16.09.74 2 fixed red lights at end of each siding.

WALTHAMSTOW CENTRAL

15.06.75 2 fixed red lights at end of each siding and speed entering sidings restricted to 15mph in coded manual.
24.01.79 Fixed red light by shunt signals to sidings.

WATFORD

05.12.75 Home signal JP134 15 second approach controlled time release into platforms.
07.02.77 2 fixed red lights and fixed trainstop at end of each platform.
22.06.80 2 fixed red lights and fixed trainstop at end of 21/24 siding roads.
Approach controlled 15mph trainstop approaching signal JP125 on No.24 road.
17.11.83 Track circuit interrupters commissioned both platforms.
11.12.83 Approach controlled 15mph and 10mph trainstops in bay platform and approach controlled speed on signal JP134 relaxed to 20mph.

WEMBLEY PARK

05.02.78 2 fixed red lights and fixed trainstop at end of Bakerloo Line siding.
11.11.79 Shunt signal MG16^{A} in northbound platform to 31 siding, platform track occupied for 15 seconds.
Approach controlled 15mph trainstop entering siding.
Approach controlled 15mph trainstop approaching MG20A with 4½ second time release.
Approach controlled 15mph trainstop approaching MG32 with 4½ second time release.

WEST HAMPSTEAD

25.05.79 Approach controlled 15mph trainstop entering (Jubilee Line) siding.
30.09.84 2 fixed red lights and fixed trainstop at end of siding. Track circuit interrupter commissioned.

WEST RUISLIP

11.01.76 Signal CS16^{A}/^{B} 4½ second time release into platforms.
08.02.77 2 fixed red lights and fixed trainstop at end of each platform.
13.05.79 Approach controlled 15mph trainstop entering each platform.
CS16^{B} relaxed to 20mph approach controlled.
03.02.80 Track circuit interrupters commissioned and speed of trains entering station relaxed from 10mph to 15mph.
28.09.80 2 fixed red lights and fixed trainstop at end of No.23 road.
Approach controlled 15mph trainstop No.24 road approaching CS42.
2 fixed red lights and fixed trainstop at end of No.25 road.
Approach controlled 15mph trainstop No.26 road approaching CS43.

WHITE CITY

07.12.80 2 fixed red lights and fixed trainstop at end of west siding.
Approach controlled 15mph trainstop in west siding.
Approach controlled 10mph trainstop approaching depot outlet signal CG25.
Approach controlled 15mph trainstop approaching depot outlet signal CG26.

WILLESDEN GREEN

20.02.78 2 fixed red lights and fixed trainstop at end of siding.
01.04.79 Approach controlled 15mph trainstop entering siding.

WIMBLEDON (Southern Region)

04.11.79 Clear signal aspect changed from ‘green’ to ‘yellow’ at home signal WH6.
30.10.91 Fixed trainstops installed in platforms 1-4.
11.05.97 Approach controlled 15mph and 10mph trainstops in platforms 1-4 and two fixed red lights in each platform between stopping mark and existing single fixed red lights. Both C and D Stock berth at same point and new “Train Ready To Start” plungers provided at east end of each platform for shorter C Stock trains.

WOODFORD

02.02.77 2 fixed red lights and fixed trainstop at end of bay road platform 1.
21.12.78 Approach controlled 15mph trainstop entering No.21 siding.

WOOD GREEN

16.07.64 Yellow warning lights installed in siding.
18.05.75 2 fixed red lights and fixed trainstop at end of siding.
Approach controlled 15mph trainstop entering siding.
31.10.80 Repeating shunt signal commissioned in siding.

POST-MOORGATE MATTERS

As we have seen, London Transport took all possible steps to prevent another “Moorgate” which it has so far achieved with complete success. However, having overcome one unexpected but very serious problem, other totally unexpected problems pop up from time to time which similarly involves a great deal of time, effort

and money after the event. Two of these include SCAT[6] (speed control after tripping) and CSDE[7] (correct side door enable), both of which have been previously described in Piers Connor's Train Equipment articles.

However, another unexpected 'surprise' was a train that ran back in the wrong direction between Chalk Farm and Belsize Park towards the end of traffic on 8 July 2000 (see *Underground News* No.465, September 2000, page 339). This resulted in "run-back detectors" having to be designed, trialled and then fitted to conventionally-driven stocks (i.e. all of them apart from on the Central and Victoria lines which already had run-back detectors as part of the ATO package), which was another time-consuming and costly process.

But, of course, 'runaway' trains aren't new, although fortunately they usually don't occur on the main running lines. One that did was in the early hours of 19 February 1984 when a Bakerloo Line train (of 1959 Tube Stock) stabled overnight in the southbound platform at Queen's Park ran away, probably around 03.00. Being down hill all the way, it is assumed that the train must have rolled back and forth in a 'pendulum' effect before stopping just south of Regent's Park, which is on the level. At that time it was a requirement that all four handbrakes on such stock were required to be applied. In fact, only two were applied and one of those was defective and thus totally ineffective, even though a 'rail anchor' had been correctly applied at the south end of the train. Of course the air brakes had been applied when stabling, but these leak off after while, hence the need for handbrakes and (on a gradient) rail anchor. But with little effective (hand) braking and the weight of the train pushing south on the down gradient, the rail anchor snapped and the train rolled away.

Because there was then no continuous illuminated diagram of the line available to signalmen or controllers, once the train left the confines of the Queen's Park signalman's diagram, the next manned control point was Piccadilly Circus (which also monitored the Bakerloo-Jubilee connections at Baker Street). No train was observed there and the night duty signalman had not noticed any train in the Baker Street area. The only way to locate the train was for staff to go out and 'find it'. Because of the downhill gradient, thoughts were that it would have gone several stations – and several stations it indeed had. It was finally found south of Regent's Park, which is where the line levels out, momentum having run out. Whilst this incident had a relatively happy ending (apart from the disciplinary procedures against the train crew and rolling stock staff involved) it could have resulted in a major catastrophe. It was so fortunate that there were no track workers in the tunnel at the time, no rails were in the process of being renewed, and no engineer's train in the way. Now, of course, handbrakes on trains (parking brakes as they are called) are much stronger and just one is capable of holding a train on the steepest gradient. Existing rail anchors were given a new stress test – and trains no longer stabled overnight in the platforms at Queen's Park (except in an extreme emergency).

---

[6] SCAT was provided in response to several 'stop-and-proceed' collisions, where motormen had driven their trains too fast during signal failures, colliding with the train ahead. The then "stop and proceed" rule required drivers to proceed at a slow walking pace, so as to stop short of any obstruction – clearly these requirements weren't followed in the two collisions at Leyton, for example. The 1973 Tube Stock was the first new stock to be fitted with SCAT and existing stocks were retrofitted.

[7] CSDE was provided in response to the increasing instances of train doors being opened on the wrong side by Train Operators, which was often being blamed on the pressures of OPO working.

Trains have also run away in depots but are usually non-service affecting. It goes without saying that the depots built with an exit on a gradient are fair game when shunting a train or unit with a defect. Put into context, these are, of course, very rare events and are protected by catch points, which divert such trains away from the main running line, but become embarrassing when passenger trains pass by a train embedded in a sand drag or around the buffer stop with a plethora of engineering staff in hi-vi's around the miscreant unit trying to recover it. The east end of Northfields depot has had two runaways in recent years, that on 12 December 1990 involved unit 204, which was subsequently scrapped. The east end of Ealing Common depot has also had its fair share, the latest incident being as recent as 31 May 2008, when DM 7005 ended up in the sand drag at the bottom of the gradient (see *Underground News* No.560, August 2008, page 551).

Another incident that affected the Underground network-wide was the death of a passenger who was innocently being overcarried into the sidings at Liverpool Street (Central Line) on Saturday 12 February 2000. On realising that he wasn't heading where he wanted to go – east towards Bethnal Green (and beyond) – he tried to leave the train via the communicating doors and then between the carriages themselves, whilst the train was on the move, falling down between them. This resulted in an immediate requirement for every train reversing in a siding or going to depot to be physically checked that it was empty of passengers. If any were missed this was then required to be reported in writing to Her Majesty's Railway Inspectorate – in London Underground speak they were classed as "incomplete detrainments" rather than "passengers overcarried"! In times past with a terminating train, a public address announcement to detrain sufficed, and if someone got overcarried into a siding, then they were brought out on the same train when it began its next trip. If a depot was involved, the depot staff or even the train crew would escort the person(s) off the premises – and that was that!

Two major elements came out of the Liverpool Street incident. Although no new costly equipment was necessary (inter-car barriers were in the process of being installed, but ironically the Central Line was the last to have them – after this incident!), it was imperative to provide many extra staff for the detraining process, itself an expensive operation. Initially the extra detrainment staff were obtained from 'volunteers' from all grades, which turned out to be an even costlier exercise (because higher grades also volunteered for this and were, of course, paid on overtime rates) until permanent detrainment staff (of Station Assistant grade) could be recruited. Although the Train Operator can (and often does) detrain a train on his/her own, this takes time to check every carriage of, say, an eight-car train. Detrainment staff weren't provided at every reversing point, of course, and generally only when a reversing service was scheduled on a frequent basis. At many locations, the Train Operator and one member of the station staff can do the job between them – and still do very effectively – with no undue delay.

The greatest problem was on the Bakerloo Line, where (LU) detrainment staff were required at Queen's Park, Stonebridge Park and Harrow & Wealdstone, all of which were then 'main line' managed stations. Initially, detraining at Stonebridge Park was done during the rush hours only. This was far from satisfactory because there was no accommodation for the detraining staff at Stonebridge Park during inclement weather (apart from a small shelter to be shared with the passengers that they had detrained!).

During off-peak times Stonebridge Park trains were detrained at Queen's Park, with trains then having to run empty northbound between Queen's Park and Stonebridge Park. This also wasn't good for passengers either, having boarded a Stonebridge Park train and then having to leave it prematurely at Queen's Park. A sort of compromise was then reached where accommodation was provided for LU detrainment staff at Willesden Junction, enabling Stonebridge Park trains to detrain there and then run empty northbound for two stations instead of four. The train description system was also altered so that Stonebridge Park-bound trains actually showed Willesden Junction on the platform dot matrix indicators.

Now that London Underground manages all the stations between Queen's Park and Harrow & Wealdstone (except Willesden Junction, which is London Overground territory) reversing at Stonebridge Park was reinstated from the new Bakerloo Line timetable on 18 May 2008, for which LU staff accommodation has been provided, albeit nothing much more than a small 'box'.

The other implication of every terminating train bound for a siding or depot to be checked that it was empty of passengers was on the service. No longer could terminating trains be allocated the normal station-stop time (or dwell time in current language). Therefore, at intermediate reversing points, an extra minute 'stand time' had to be built into the timetable, thus reducing train throughput even more.

Another unexpected "this can't happen" was the instance of a Piccadilly Line train being driven in the wrong direction from King's Cross on 12 March 1990 (see *Underground News* No.557, May 2008, page 388), which at the time resulted in 50 other emergency reversing locations being identified where such an event could occur again.

Within days, fixed red lights or white-on-red 'stop' boards were installed just beyond the ends of selected platforms which could be construed as a 'reversing' point where such a mistake could be made again. This was another knee-jerk reaction and rather rushed affair but it was thought at the time that all loopholes had been dealt with. Red stop boards additionally appeared at such places as the north end of the southbound at Marylebone, which is questionable as to its relevance in a 'reversing' context, but still, better more than not enough. Fixed red lights without trainstops also sprang up, at the west end of the eastbound at Ickenham, for example. For a train to reverse east to west in the Ickenham area, the train would have to proceed eastbound all the way to Ruislip siding, east of the crossover, and then back onto the westbound line once the signal clears. This one takes reversing possibilities to its extreme, although it may just be possible that a driver would change ends in Ickenham eastbound platform and head back west …...

Of more relevance are the fixed red lights at places such as Totteridge (north end of the southbound), East Finchley (south end of the northbound) and King's Cross SSL (west end of the eastbound). Surprisingly, there isn't one at the east end of the westbound platform at Moorgate (SSL), which is equally 'vulnerable'. The list can really be endless and a decision has to be made as to where the line must be drawn.

To install fixed red lights and working trainstops took longer to commission as they had to work in conjunction with the signalling system – the trainstop had to lower for an approaching train, and then return to the 'up' position after the train had passed it. During February 1993 the following locations were equipped with a fixed red light and trainstop, as follows:

BAKERLOO LINE

Paddington — South end of northbound platform
03.02.93

Piccadilly Circus — South end of northbound platform
04.02.93

Oxford Circus — North end of southbound platform ‡
05.02.03

Waterloo — North end of southbound platform
09.02.93

PICCADILLY LINE

Holborn — West end of eastbound platform
10.02.93

Hyde Park Corner — West end of eastbound platform
11.02.93

Wood Green — West end of eastbound platform ‡
12.02.93

Green Park — East end of westbound platform ‡
13.02.93

CENTRAL LINE

Holborn — East end of westbound platform
16.02.93

Tottenham Court Road — West end of eastbound platform
17.02.93

NORTHERN LINE

Charing Cross — South end of northbound platform
18.02.93

King's Cross — South end of northbound platform
19.02.93

Kennington — North end of southbound City platform
20.02.93

Kennington — North end of southbound Charing Cross platform
23.02.93

Stockwell — South end of northbound platform.
24.02.93

Tooting Broadway — North end of southbound platform.
25.02.93

JUBILEE LINE

Finchley Road — South end of northbound platform.
26.02.93

‡ It appears that there are only fixed red lights at these sites today. (Tottenham Court Road was removed when ATP/ATO was commissioned).

Enter now the Camden Town 'wrong road' incident on 10 June 2007 (see *Underground News* No.557, May 2008, page 387), which opened up a whole new can of worms. The result of this incident is that additional fixed red lights are now being installed at places hitherto thought unnecessary and to that end these have already been installed at –

08.05.08 – Tower Hill (west end of eastbound platform and east end of westbound platform).

09.05.08 – Mansion House (west end of eastbound platform and east end of westbound platform).

It will be interesting to see which other locations are so treated in time but it still begs the question – “will every station have to have a red light or ‘stop’ disc affixed at the opposite end to the normal direction of travel at the end of the day?”. ATO probably negates this need, but there again there is ATO only on the Victoria and Central lines at present.

OTHER VULNERABLES ?

One potential human error that doesn’t seem to have been catered for so far is in defining a definite ‘limit of shunt’ for trains using little-used and emergency crossovers. It is true that most such sites have stopping marks on the track or on the side of the tunnel – where the Train Operator should stop his/her train when performing the shunting move. However, where these are not backed up by a controlled signal showing a red aspect at the limit of shunt, there is nothing to stop a Train Operator from missing the stop mark and continuing all the way to the next station, changing ends and then returning ‘wrong road’ to complete the shunt move. This has certainly happened in the past at Whitechapel, where a Hammersmith & City train being reversed via the crossover east of the station went all the way to Stepney Green, reversed and then went all the way back wrong line to the crossover just east of Whitechapel! It was fortunate that the signalman at Whitechapel spotted what had happened and prevented the next eastbound District Line train departing and going to meet it – head on. It may have happened elsewhere and at the moment there is no apparent reason why it couldn’t happen again somewhere.