



Rail Accident Investigation Branch

# Collision at London Waterloo and loss of corporate memory

Paul Tickner

Inspector of Rail Accidents

13 November 2019







# Background of the project



## Rail industry

### Major rail disruption in August as stations are

Network Rail plans biggest ever bank holidays, while Waterloo will be half closed

### London Waterloo platform Summer disruption warned

26 January 2017 | London



Passengers are being advised to make it as possible

Hundreds of thousands of passengers have been warned to expect disruption this summer at

## METRO NEWS



### Waterloo station closure: What's happening and how long will it last?



Waterloo – the UK's busiest station – will be partially closed for most of August (Picture: Waring Abbott/Getty Images)

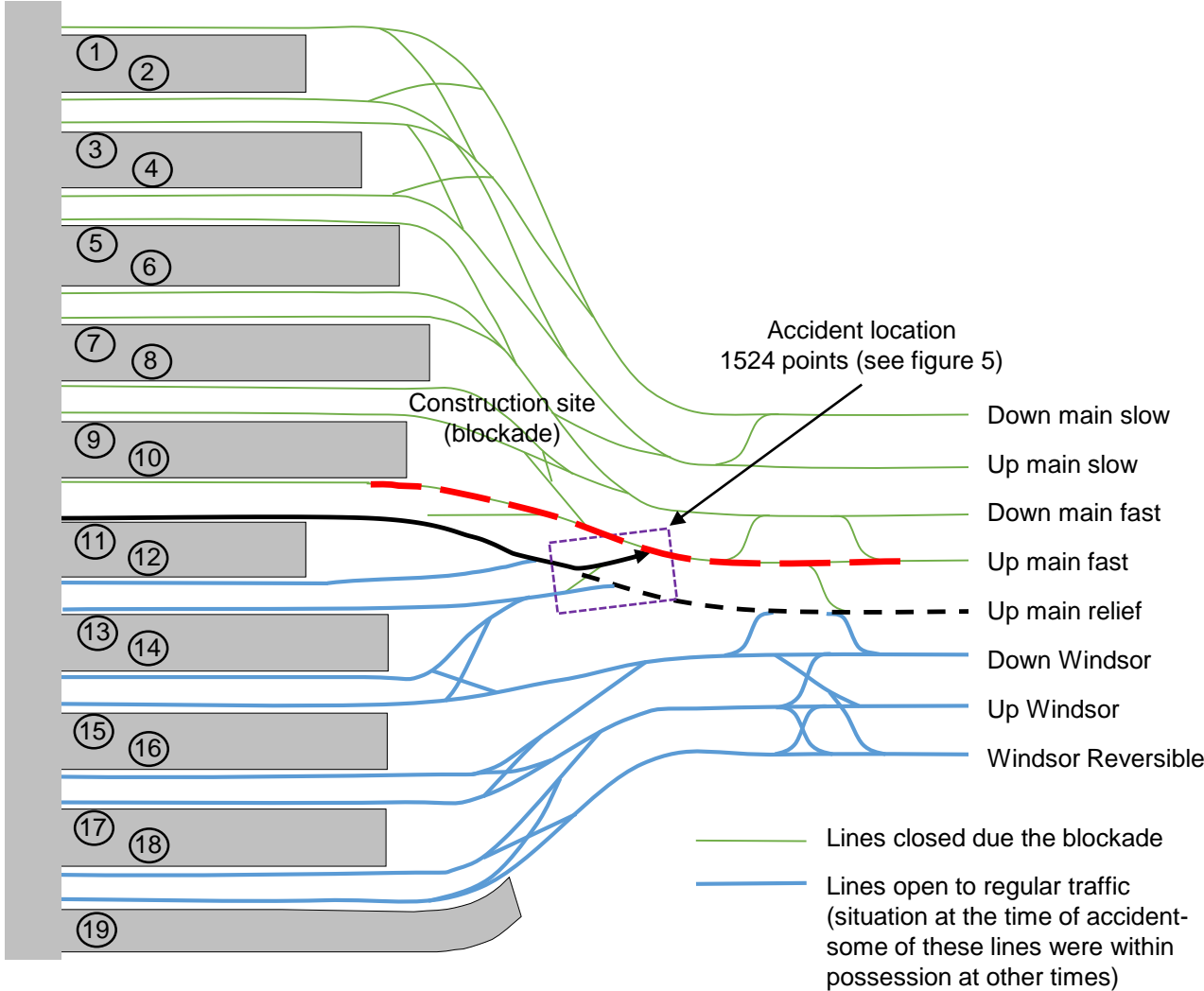
# The accident,

- The accident happened as the 05:40 service from Waterloo to Guildford was departing from platform 11
- Points 1524A were in a mid position and the train took went left rather than following its intended route
- It collided with an engineering barrier train which was in use, primarily for protection purposes by the project
- It was a low speed collision but still caused some damage to the trains
- From an operational point of view, caused the loss of a further 3 platforms, resulting in more disruption





# Waterloo layout

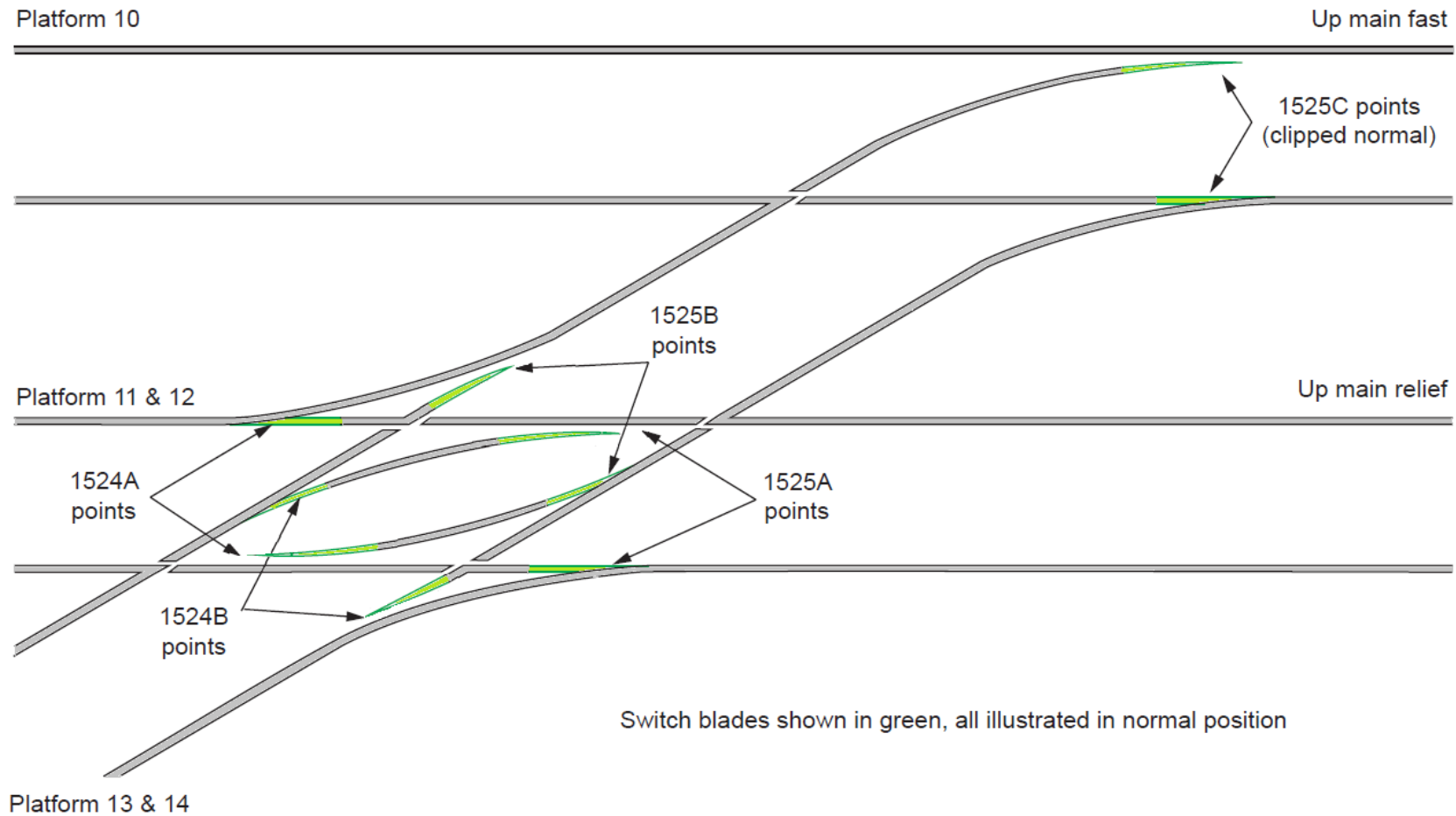


Notes:  
 Layout shown before modifications to platforms 1 to 4  
 Sidings not shown

- Lines closed due the blockade
- Lines open to regular traffic (situation at the time of accident—some of these lines were within possession at other times)
- Route of train 2D03
- - - Intended route of train 2D03
- - - Engineering train
- ① Platform number, former international platforms (20 to 24) not shown

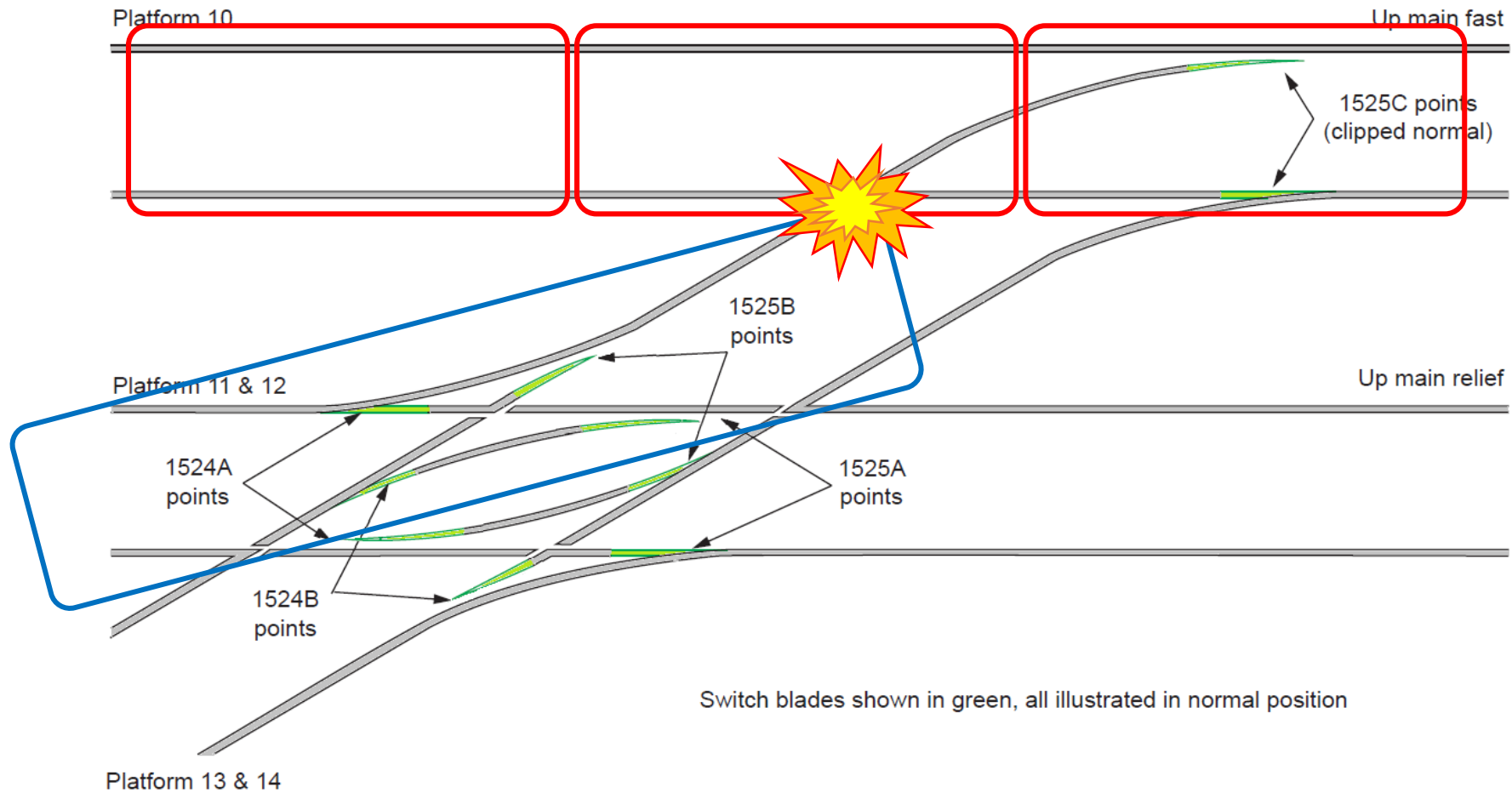


# Waterloo layout



Switch blades shown in green, all illustrated in normal position

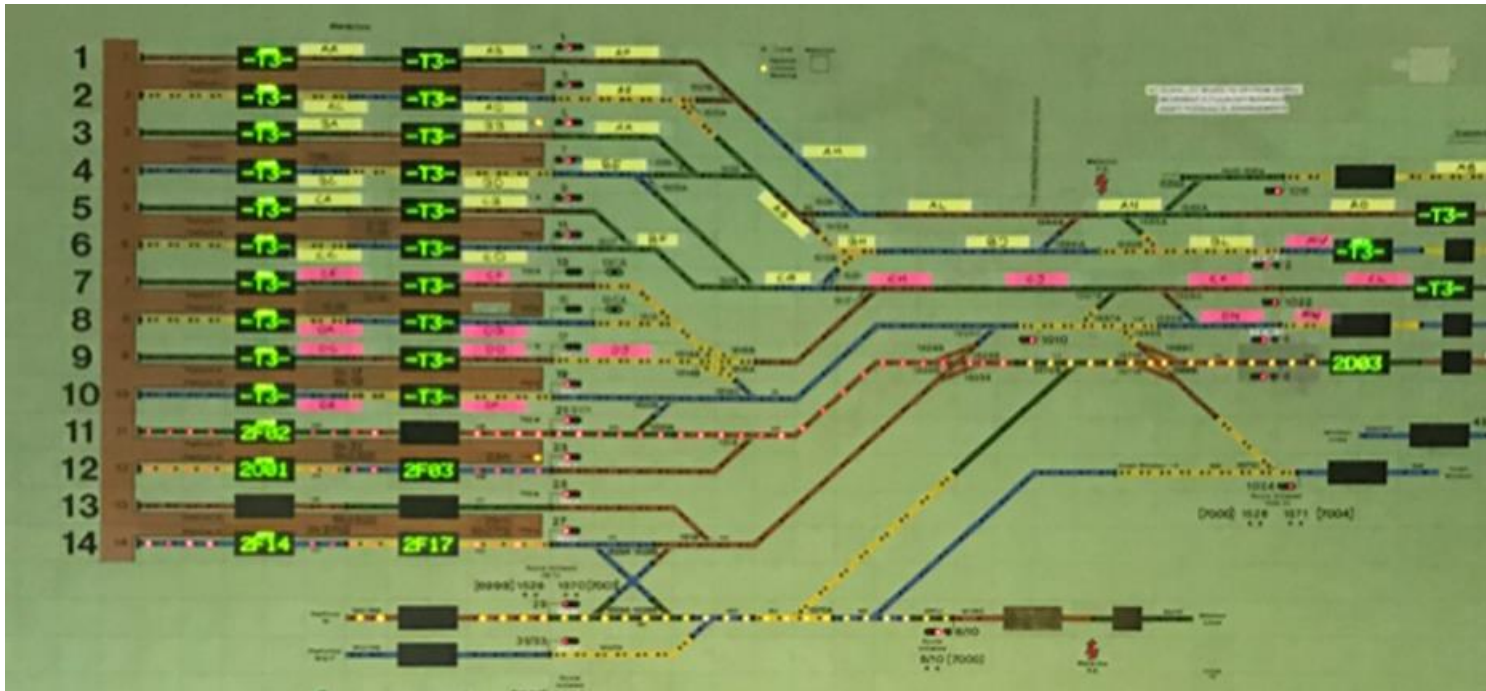
# Waterloo layout



Switch blades shown in green, all illustrated in normal position

# The deployment

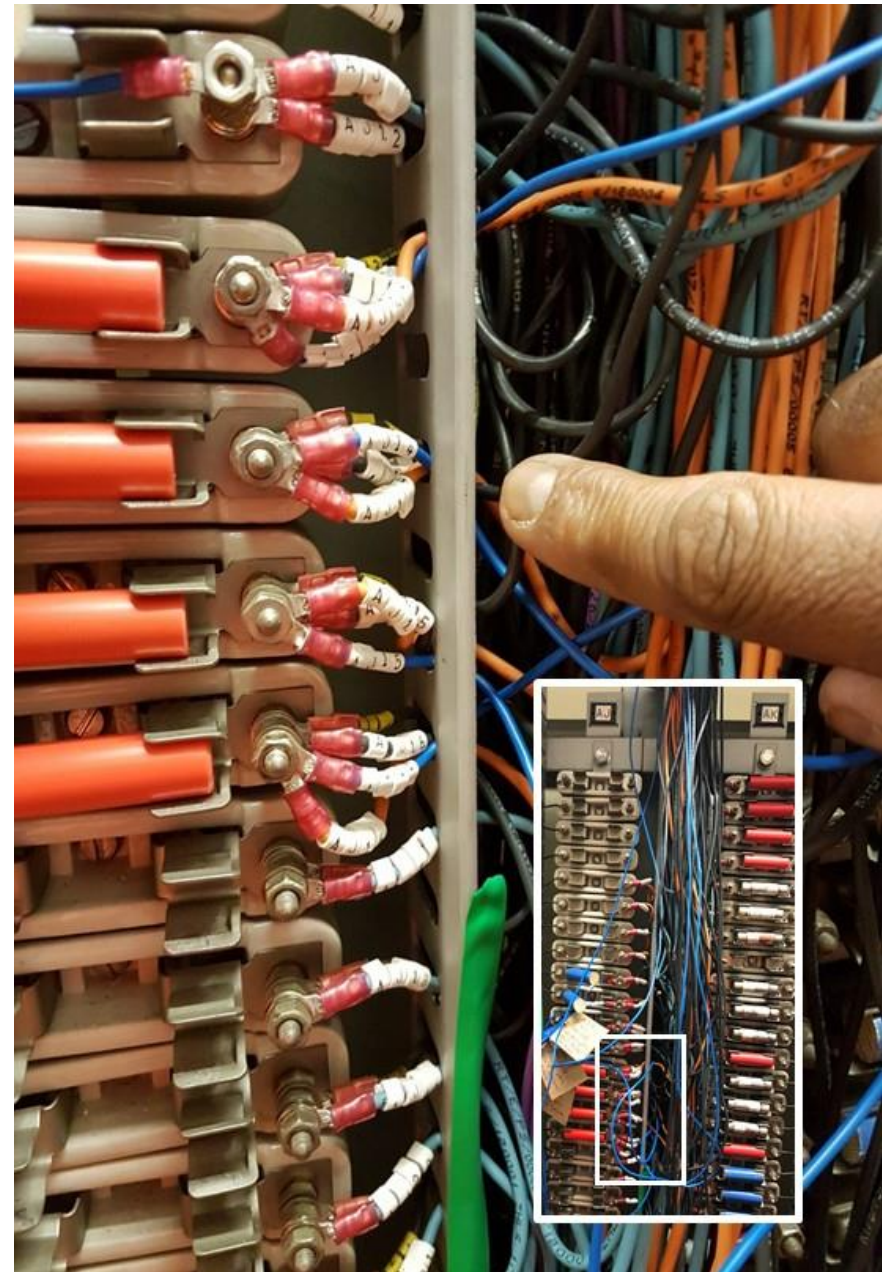
- One inspector travelled to Waterloo by train to examine site and secure evidence
- Two inspectors took the RAIB vehicle to Wimbledon signalling centre
- Examined the route set for the train and determine what work had been ongoing during the night's possession
- Talked to witnesses, seized voice recordings and photographed the panel
- Reports of 'unusual' wiring at Waterloo relay room began filtering through





# Initial findings

- Waterloo relay room secured by BTP as sabotage had not been ruled out
- Lots of coloured wiring, not unusual for relay room mid-commissioning
- Most additional wiring related to test desk, but another eight lengths of blue wire were found
- The blue wires did not appear on wiring schedules, all had been made with crimped terminations, collar IDs and were tucked away in wire trays
- Four of the blue wires had cardboard 'baggage' labels which showed their purpose, those attached to 1524 points did not have these.



# Collecting evidence – at the scene, on the day

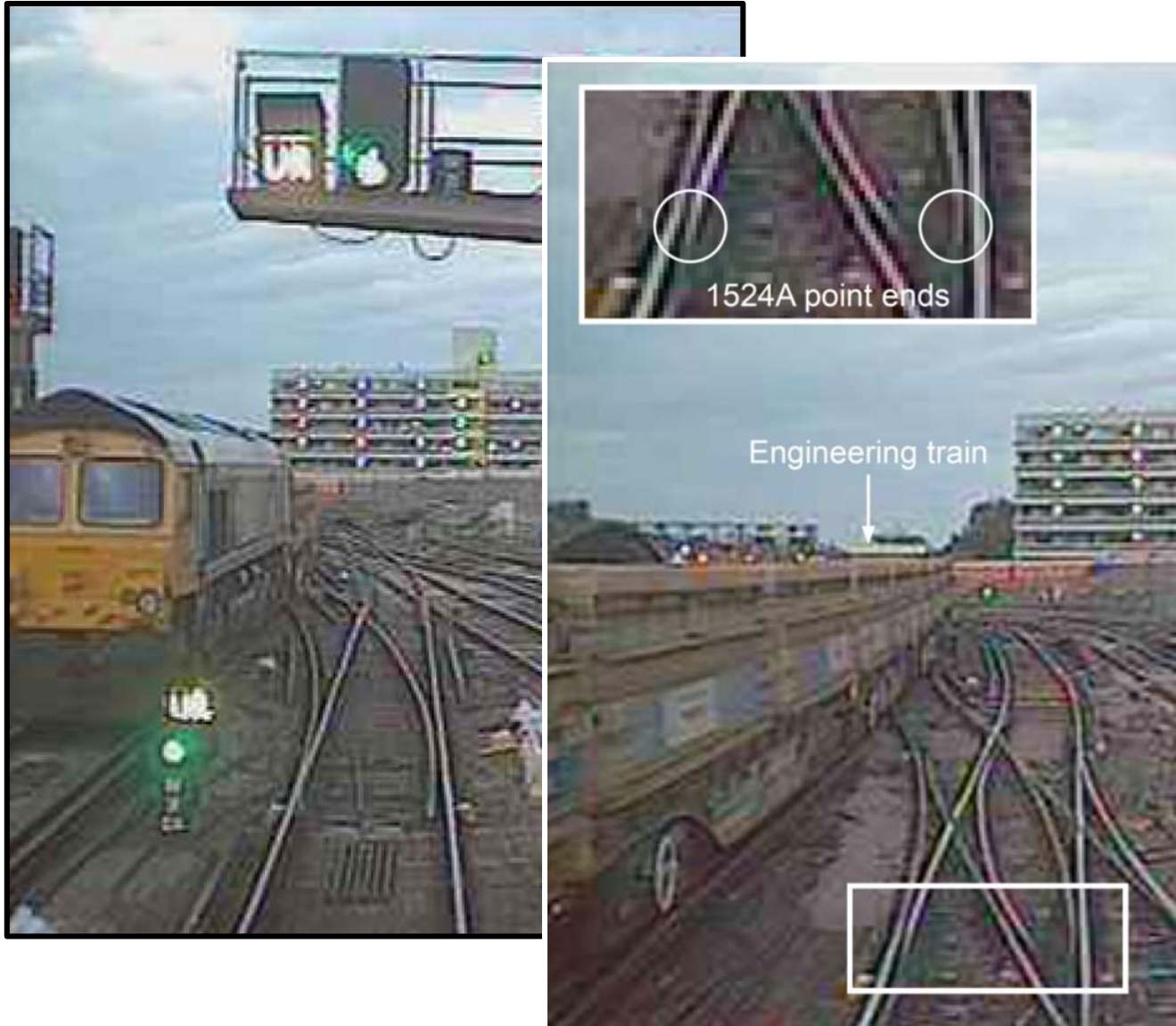
- Securing evidence as soon as possible, commissioning sites are very dynamic!!
- Gathered evidence included
  - First accounts from people involved on the night
  - Data loggers from the infrastructure- signalling, remote condition monitoring
  - CCTV from trains, both the incident service and others that passed through the area
  - Copies of testing prints of the signalling design- particularly urgent as the testing would need to restart when we left site
  - The blue wiring!!

# The Waterloo investigation- challenges

- Unravelling the relationships between Waterloo Capacity Alliance and contractors
- Understanding the stages of complex RRI signalling design
- Reviewing project documentation, including roles and responsibilities
- Volume of interviews at all grades:
  - Testers
  - Project managers
  - Project engineers
  - Designers
  - Installers
  - Design managers
  - Responsible design engineers and
  - Company management



# Immediate cause



- The train was signalled to run over a set of points which were not correctly positioned.
- The driver had authority to proceed out of platform 11 and along the up main relief line, the line running alongside the engineering train.
- Images from the passenger train's forward facing CCTV show a green signal with a 'UR' indication and 1524 points in an intermediate position.

# Uncontrolled wiring & incomplete design process

- Uncontrolled wiring was added to points detection circuits, such that the position of 1524 points was incorrectly detected.
- The uncontrolled wiring was added during testing when a test desk was found to no longer simulate the detection of 1524 points correctly, a consequence of an incomplete design process.

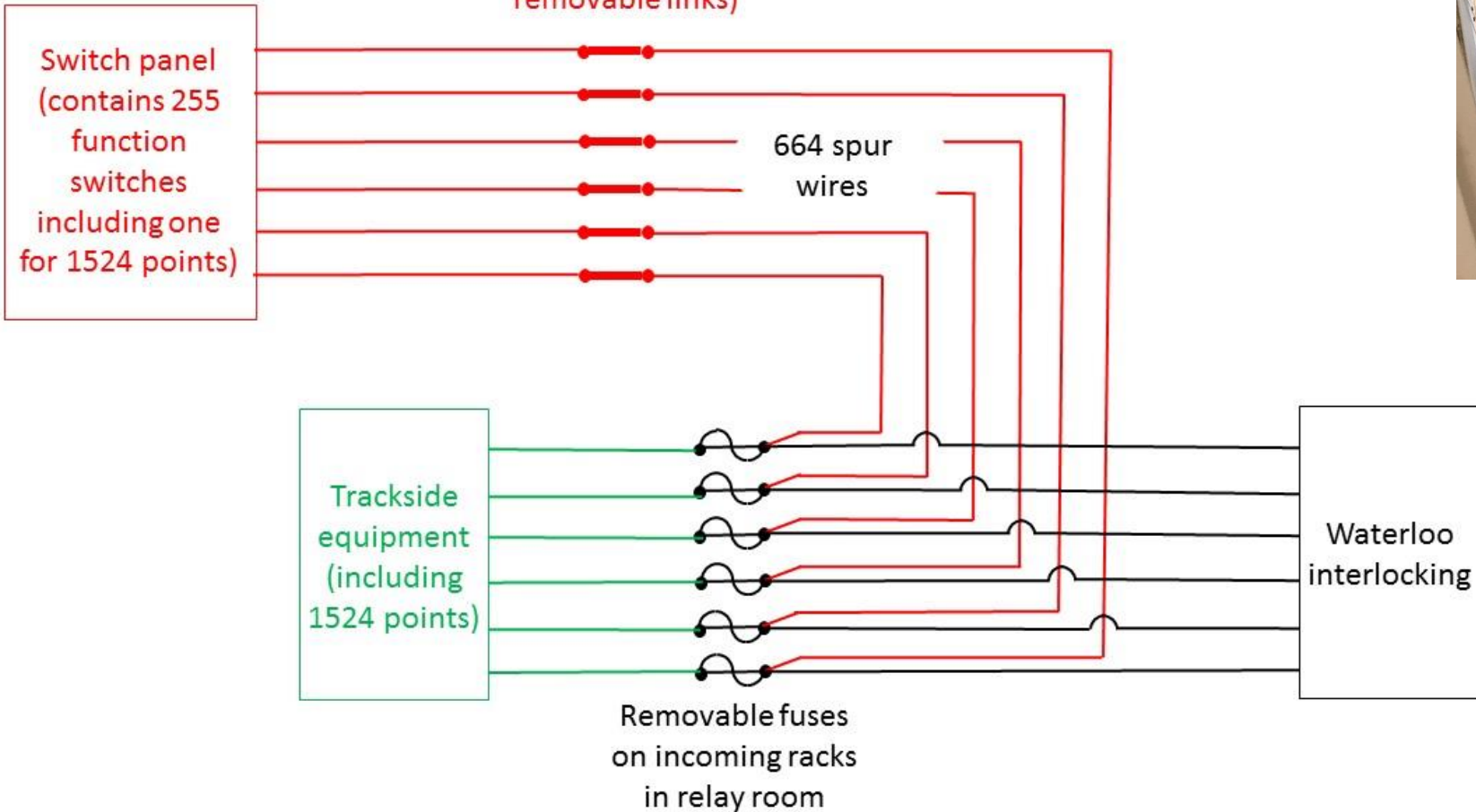
In particular:

- the test desk design did not allow for later changes to the interlocking design;
- temporary spur wires for the test desk were not shown on the interlocking drawings, an omission which probably led to a lack of recognition that the test desk design needed updating; and
- no risk assessment was prepared for the temporary spur wiring.

# Test desk concept



The test desk comprised the spur wires, isolation rack, switch panel and connections between the rack and panel.





# Incomplete design process

- The uncontrolled wiring was added during testing when a test desk was found to no longer simulate the detection of 1524 points correctly, a consequence of an incomplete design process. In particular:
  - the test desk design was prepared based on the existing circuitry before the commissioning;
  - This single stage design did not allow for later changes to the interlocking design, it relied on testers fixing problems as they arise during the commissioning;
  - temporary spur wires for the test desk, although connected to the 'live' railway between possessions, were not shown on the interlocking drawings;
  - This omission probably led to a lack of recognition that the test desk design needed updating; and
  - no risk assessment was prepared for the temporary spur wiring.

# Incomplete design process

- The project CRE did not introduce a process to ensure the test desk wiring was kept up to date with the emerging project design.
- The NR project engineer recognised the absence of a process to manage this discrepancy, but was assured by the CRE that any issues would be the responsibility of the tester in charge.
- The project engineer, CRE and testing management staff were aware that test desk wiring would potentially be out of step with the interlocking design, but none took steps to control this risk.

# Incomplete design process

- The test desk spur wires were not shown on the interlocking design.
- Had this been so, it is likely that signalling engineers modifying the interlocking design would have realised the test desk wiring would no longer be valid.
- Test desk wiring did not appear on the analysis sheets, so additional wires appeared on terminals included within the wire count process.
- No test logs for additional wiring were raised during the commissioning, indicating that testers were excluding the test desk wiring.
- The CRE stated that he believed the 664 wires attaching the test desk to the operational railway would be removed and reinstated for each possession change.



# Actions not inline with SWTH

- During principal testing, the test desk failed to simulate 1524 points correctly.
- The functional tester was tasked with finding a solution and was in the relay room when the test desk began operating correctly.
- The functional tester requested copies of the design, but while waiting, conceived a solution based on another test desk modification on points 1514.
- The functional tester did not realise that 1514 points would remain within the blockade and a test log had been raised for its removal prior to the handback.
- The functional tester did not appreciate 1524 points would be returned to operational service before the blockade was removed.

# Actions not inline with SWTH

- The functional tester was undertaking tester led changes with two installers at the time the issue was raised.
- The functional tester stated that he had asked the installers to install the uncontrolled blue wiring. There is conflicting evidence of this instruction.
- The two installers normally took breaks together and site records indicate one had signed out for lunch, it is likely that the installers were not present at the time the uncontrolled wiring was installed.
- There is no evidence that the blue wiring was checked or tested as required under tester led changeover as no design details exist for the wiring.
- The functional tester stated that he made no record of this wiring as he had previously installed similar wiring on other projects without record.

# Actions not inline with IRSE competence

- The functional tester's actions fell outside that allowed by his IRSE licence:
- Carrying out a redesign of the test desk wiring
- Undertaking both design, installation and test of the uncontrolled wiring
- Witness evidence showed that the functional tester:
- Had a poor understanding of how testing processes interacted with design
- Did not fully consider the potential consequences of adding uncontrolled wiring
- Was keen to find a solution which would extend beyond his working shift
- Did not understand the rationale for the use of testing straps

# Electrical disconnection and securing of points

- The commissioning plan for the works required the disconnection and securing of points 1524.
- This requirement was developed after a review of the potential risk to the operational railway from the commissioning works ongoing during 'live' periods.
- The need for precautionary points securing was included within the test plan to be implemented by the tester in charge.
- The tester in charge did not instruct this to be carried out, assuming that possession staff would apply this protection.
- The tester in charge did not check, or instruct anyone else to check, the points had been secured.



# What we didn't find

- No evidence that the project had been planned or implemented in an unsafe manner
  - single big block possession strategy had been proposed and adhered to by signalling teams
- No evidence that contract pressure had led to corner cutting
  - the failure to show the wires on drawings was months before the accident
  - Testers and installers reported that work in the relay room was steady.
- No evidence that fatigue was an issue in the commissioning team

Clapham Junction	Waterloo	Cardiff
Working practices were permitted to slip to unacceptable and dangerous standards.	Documented processes for controlling design modifications and testing were not used when uncontrolled wiring was installed	The project team had developed a work group culture that led to insular thinking about methods of work and operational risk.
Full documentation was not available.	Out of date maintenance drawings in the relay room were not identified as superseded	<p>Individual signalling stage scheme plans had not been produced for the sub-stages of the stage 5 works.</p> <p>There was no single project document with a complete list of all the points that required securing.</p>
The quality of testing did not meet standards set by BR.	<p>The testing led changeover process was not followed.</p> <p>Information for a reliable wire count was not available as the spur wires were not recorded on the interlocking detailed design documents.</p>	The tester in charge signed a form confirming that he had received confirmation that all out of use points were safely secured and padlocked on the basis that the senior construction manager had confirmed that the points had been secured.
There was no effective control over the Design Office to ensure that the workforce were supplied with drawings which accurately reflected the work to be done.	The effect of the interlocking design changes on the test desk was not apparent because the spur wires (temporary works) were not recorded on the interlocking detailed design documents.	<p>There was no document with a complete list of all the points that required securing.</p> <p>Signalling stage scheme plans had not been produced for the sub-stages of the works.</p>
Failure to communicate effectively both up and down the lines of management.	Testers were aware, shortly before commissioning, that the test desk might not function correctly, but the necessary management actions were not communicated to relevant staff.	Briefings contained a considerable amount of information, much of which was superfluous to many of the attendees. Attendees said they had difficulty filtering out the information that was relevant to them.
	No one was allocated the task of securing points outside the blockade although this task was listed in the test plan and discussed at a risk workshop	The designated project engineer had removed the responsibility for checking the securing of points from the TIC, but did not allocate the responsibility to anyone else.

# Clapham Junction 12 December 1988

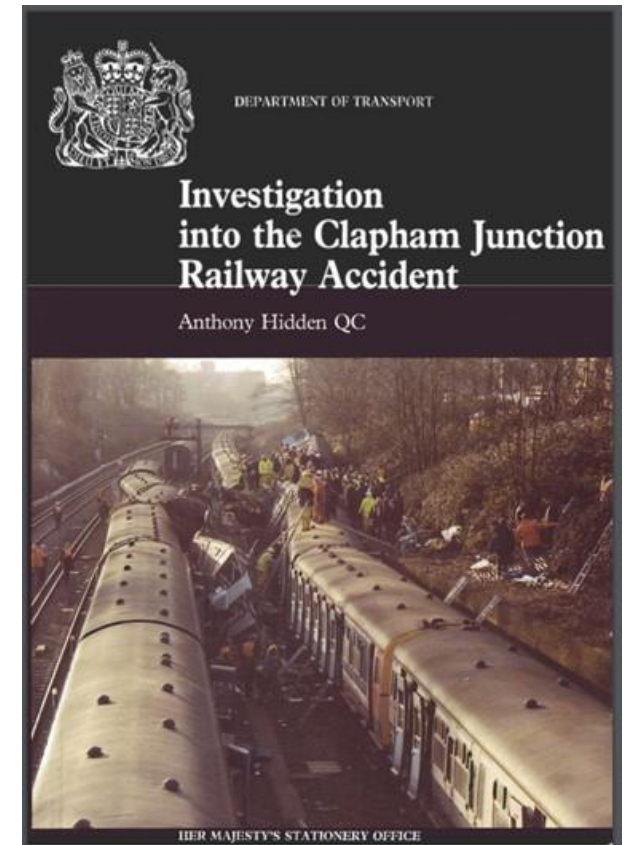
- 35 people killed
- 484 injured

## Hidden found:

- concept of absolute safety acknowledged time and again;
- however, despite such expressions of concern for safety, the evidence demonstrated beyond dispute two things:
  - there was total sincerity from all who spoke of safety in this way; but nevertheless
  - there was failure to carry those beliefs through from thought into deed.

## Hidden stated:

- *'The concern for safety was permitted to co-exist with working practices which were positively dangerous.'*



# What we found

- Without exception, irrespective of their level within the organisation, everybody wanted to get the job done on time, safely.
- This reflects what Hidden found 30 years previously:

*The vital importance of this concept of absolute safety was acknowledged time and again in the evidence which the Court heard. This was perfectly understandable because it is so self-evident. The problem with such expressions of concern for safety was that the remainder of the evidence demonstrated beyond dispute two things:*

*(i) there was total sincerity on the part of all who spoke of safety in this way; but nevertheless*

*(ii) there was failure to carry those beliefs through from thought into deed... The concern for safety was permitted to co-exist with working practices which... were positively dangerous.*



How can organisations ensure that lessons from events that happened outside the personal experience of present-day railway people are taught and retained?

Compliance with a standard comes more naturally to people when they understand the purpose of the requirement, and the consequences that may arise from disregarding it.

(CI RAIB 2018)

