

Grenfell Tower – fire safety investigation:
The fire protection measures in place on the night of the fire, and conclusions as to:

The extent to which they failed to control the spread of fire and smoke;
The extent to which they contributed to the speed at which the fire spread.

Phase 1 Report – Section 13

Critical times during the fire event

REPORT OF

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Fire Safety Engineering

24th October 2018

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On behalf of	:	Grenfell Tower Inquiry
On instructions of	:	Cathy Kennedy, Solicitor, Grenfell Tower Inquiry
Subject Matter	:	To examine the circumstances surrounding the fire at Grenfell Tower on 14 th June 2017
Inspection Date(s)	:	6 th October, 1 st November, 7-9 th November 2017

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13 Critical times during the fire event

13.1 Purpose of this Section

13.1.1 In this section, I have created a time line of the relevant events and conditions on the night of the fire. This is to provide context for later sections of my report, which contain a more detailed analysis of the conditions on the stairs and lobbies and external firefighting.

13.1.2 In Section 12, I explained the consequences of the external wall fire and how the Stay Put strategy for the residents of Grenfell Tower was no longer viable in the circumstances. Specifically, I mean that:

- a) the LFB was not in a position, on the night of the fire, to control or extinguish the fire once it exited the window of Flat 16 which it did very early in the Flat 16 pre-flashover fire event (as explained in section 7);
- b) the fire became a severe multi-storey multi compartment fire within 20 minutes (the timing of fire spread to each elevation has been set out in Section 5); and
- c) the active and passive systems in the building were designed as part of a defend in place firefighting strategy (internal only), assuming a single internal compartment fire (as I explained in Section 3).

13.1.3 I have provided a description of Stay Put and Defend in Place in Section 3.

13.1.4 In Section 14, I will explain how:

- a) the single stair was the only means of escape for all residents;
- b) that same stair was the only means of access for the fire fighters to go up to any floor and control or extinguish the fire beyond their bridgehead;
- c) the stairs and the lobbies are intended to be a safe place of work for the fire brigade – to set up a bridgehead with safe air, and to deploy fire fighters with breathing apparatus to the seat of the fire, and set up the Fire, Search and Lobby Sectors; and
- d) that same stair was the only means for the fire brigade exiting downwards with rescued residents, casualties or the deceased.

13.1.5 Once the external wall had ignited, the fire and smoke was spreading rapidly through the external wall (as shown in section 5). This then caused an increasing number of internal building fires (as shown in Section 12). The external wall fire and the internal building fires meant that the required performance of the lobbies, which protect each storey of the single protected stair, became the most critical life safety feature at Grenfell Tower.

13.1.6 In order to understand the conditions in the lobbies and so the conditions in the stairs, I have assembled a time line of critical events, as context.

13.1.7 Therefore, in this Section 13 I set out a timeline of critical events, based on the following:

- a) The LFB decisions log LFB00000003 which sets out when key decisions were made on the night;

I have subsequently received and reviewed the LFB Short Incident Log Report (MET00013830), which is the original evidence upon which the LFB decision log (LFB00000003) is based. The LFB decision log appears to be a concise and accurate reflection of the LFB Short Incident Log Report, therefore there has been no need to update the relevant references in this Section of my report.

- b) The LFB document “Operational Response to Grenfell Tower Version 0.1 – 00.50hrs – 02.00hrs (LFB00001914)
- c) The CCTV-Individual Exit Times and Location table prepared by the Metropolitan Police Service (MPS) identifying individuals leaving the Grenfell Tower by time and camera (MET000080463 and the updated version MET00016072);
- d) The breathing apparatus telemetry information submitted to the Inquiry by LFB (LFB00023326) to understand when specific fire fighters passed into the Fire Sector, and to inform my calculations of the total number of fire fighters present at any one time in the building;
- e) My analysis in Section 5 of when and how the fire spread to each elevation of Grenfell Tower;
- f) My analysis in Section 7 of when and how the fire broke out the window of Flat 16;
- g) LFB contemporaneous notes and witness statements provided to me at the time of writing (see Table 13.1);
- h) Transcripts of oral evidence from LFB personnel made between the 25th June 2018 and the 2nd October 2018 hearings; and
- i) The 999 call logs (LFB00004790)
- j) The smoke control system autodialler call log to Tunstall, a remote monitoring company (THL00000002).

13.1.8 I have included a list of resident witness statements that I have read in Section 14 of my report. I am aware that, at the time of writing, not all of those who escaped from Grenfell Tower on the night of the fire have provided witness statements to the Inquiry. Once these are available, where necessary, I will update my analysis to take into account their evidence.

Table 13.1: LFB witness statements and contemporaneous notes reviewed

Document reference	Fire Fighter
MET00010758	O'Neill
MET00010759	Goulbourne
MET00010080	Badillo
MET00010081	Moore
MET00010084	Foster
MET00010759	Goulbourne
MET00010820	Murphy
MET00010826	Tanner
MET00010828	Walton
MET00012492	Cotton
MET00005213	O'Loughlin
MET00005251	Daniel Brown
MET00005257	Graham
MET00005259	Spooner
MET00005264	Jones
MET00005299	Niblett
MET00005344	Peter Johnson
MET00005348	Badillo
MET00005384	Secrett
MET00005404	Roe log
MET00005413	Grey
MET00005474.	Vydelingam
MET00005528	Matthew Cook
MET00005530	St Aubin
MET00005533	Denny
MET00005676	Batterbee
MET00005700	Abell
MET00005712	Walton
MET00005756	Ellis log
MET00017428	Wolfenden
MET00007511	Batcheldor
MET00007512	Beale
MET00007513	Chisholm
MET00007515	Egan
MET00007693	Ellis
MET00007520	Roe
MET00007521	Roe
MET00007522	Roe
MET00007524	Upton
MET00007525	Welch

Document reference	Fire Fighter
MET00007657	Ogden
MET00007691	Ashman
MET00007692	Egan
MET00007693	Ellis
MET00007694	Gotts
MET00007695	Loft
MET00007696	Real
MET00007697	Reed
MET00007509	Ashman
MET00007760	Meyrick
MET00007761	Gary Moore
MET00007762	Adams
MET00007764	Heidi Fox
MET00007765	Flanagan
MET00007766	Smith
MET00007767	Coaker
MET00007768	George
MET00007781	Leaver
MET00007783	Myatt
MET00007785	Nelson
MET00007787	Duddy
MET00007860	Myatt
MET00007862	Yeoman
MET00007866	Prasad
MET00007882	Gareth Cook
MET00007890	Roberts
MET00007948	Matthew Cook
MET00008001	Archer
MET00008013	Desforges
MET00008019	Eden
MET00008025	Gillam
MET00008027	Hoare
MET00015882	May
MET000080584	Mills
MET000080591	O'Donoghue
MET000080592	O'Hanlon
MET000083292	Fernandes
MET000083294	Frost
MET000083296	Goodall
MET000083300	Hippel
MET000086037	Dorgu

Document reference	Fire Fighter
MET000086060	Merrion
MET00010105	Secrett
MET00010895	Sephton
MET00010915	Dowden
MET00012483	Stern
MET00012563	O'Loughlin
MET00012658	Broderick
MET00012663	Cornelius
MET00012797	Saunders
MET00012878	Cuthbert
MET00013967	O'Keeffe
MET00015709	O'Loughlin

13.1.9

I have reviewed the above information with a particular focus on:

- a) what critical command decisions were taken and when regarding firefighting access and facilities;
- b) how many occupants evacuated down the stairs before the stay put guidance to FSG callers was changed;
- c) how many occupants were able to evacuate after the stay put guidance to FSG callers, was changed;
- d) how many occupants did not evacuate from their flats; and
- e) comparing these points with the timings of how the fire spread externally.

13.3 LFB command decisions

The incident commanders during the course of the fire are shown in Table 13.2. This information is based on the LFB decision log (LFB00000003), LFB short incident log report (MET00013830) and oral evidence from O'Loughlin and Walton.

Table 13.2: LFB Incident Commanders at Grenfell Tower on 14 June 2017

Time	Incident Commanders	Operations officers	Bridgehead commanders	FSG Sector commanders
00:59	WM Michael Dowden	NA	CM Chris Secrett	NA
01:14			WM Brien O’Keeffe	SM Brett Loft
01:32				
01:57	SM Andrew Walton			
01:59	Overlap of ICs: DAC Andrew O’Loughlin (outside tower) GM Richard Welch (at CU8)			
02:04				
02.10				
02:11				
02:20	DAC Andrew O’Loughlin takes sole control as IC at CU8		GM Richard Welch, GM Patrick Goulbourne	SM Dan Egan, SM Tom Goodall
02:44	AC Andrew Roe	GM John Graham		
08:45				
10:00 (est)				
11:14	DAC Richard Ogden			
12:55		AC Dominic Ellis		

13.3.1 In Table 13.2 I refer to the Bridgehead Commanders. I understand from the fire service guidance for Incident Commanders (Fire and Rescue Manual: Volume 2: Fire Service operations – Incident Command 3rd edition), that a fire in a high rise building would typically have Fire Sector and Search Sector commanders. However, on the 14th June 2017, because the fire spread to all floors between the bridgehead and the top of the building, I understand that there was no separate Search Sector in this case (Goulbourne Transcript 12th September, p90). The Bridgehead commanders were, therefore, responsible for both firefighting and search and rescue operations on all floors above the Bridgehead.

13.3.2 At 00:54:29 the first call to the incident by LFB is recorded (LFB00000003)

13.3.3 At 00:55:01 the autodialler connected to the smoke control system is recorded as contacting Tunstall, the remote monitoring company (THL00000002).

13.3.4 At 00:55:14 LFB assigns three pump appliances to the incident.

- 13.3.5 At 00:57:44, the LFB Control received the second 999 call, which was from a remote monitoring company, Tunstall Response (LFB00001914).
- 13.3.6 At 00:59:12 a fourth pump appliance is assigned by Peter May when he manually changed the ITC record from A1 to A1HR, identifying the incident as involving a high rise building (MET00015882).
- 13.3.7 At 00:59:28 Appliance G271 arrives at Grenfell Tower. WM Dowden assumes role of Incident Commander (IC).
- 13.3.8 At approximately 01:03 CM Secrett establishes the Bridgehead on Level 2. Also at this time firefighters Bills and Abell connect the dry rising main to a fire engine pump.
- 13.3.9 The first firefighting crew entered Flat 16 by 01:07 (MET00006109).
- 13.3.10 By 01:08, the fire had reportedly already spread to the external building envelope (IWS00000051), at Column B5.
- 13.3.11 At 01:13 Brigade Control is contacted by radio from the fire ground to “*make pumps 6*”.
- 13.3.12 At 01:14 Brigade Control is contacted by radio from the fire ground to request an aerial appliance.
- 13.3.13 The firefighting crew in Flat 16 applied a firefighting jet to the fire in the kitchen by 01:14, as shown in Figure 13.1.
- 13.3.14 At approximately 01:14 WM O’Keeffe enters Grenfell Tower to take command of the bridgehead at Level 2, as instructed by the IC (WM Dowden).



Figure 13.1: Thermal image of flat 16 kitchen window after pulse sprays from firefighting jet, towards window at 01:14 [time adjusted] on 14 June 2017. (MET00006109)

- 13.3.15 By 01:15, a fire fighter outside the building was applying a firefighting jet to the external fire on the building's East elevation outside Flat 16; refer to Figure 5.7 in Section 5.
- 13.3.16 At 01:19 Brigade Control is contacted by radio from the fire ground to "*make pumps 8*".
- 13.3.17 At 01:21 CM Batterbee reports to the bridgehead by radio that the fire in Flat 16 has been extinguished.
- 13.3.18 Figure 13.2 is thermal image from LFB, which is described by MPS as "*kitchen window failed and molten dropped down outside*" at 01:21.



Figure 13.2: Thermal image of kitchen window. MPS description: “kitchen window failed and molten dropped down outside” at 01:21 [time adjusted] on 14 June 2017 (MET00006109)

- 13.3.19 At 01:24 Brigade Control is contacted by radio from the fire ground to “*make pumps 10*”.
- 13.3.20 At 01:27 Brigade Control is contacted by radio from the fire ground to “*make pumps 15*”. Additionally, the request for aerial appliances is increased to “*Aerials x2*”.
- 13.3.21 At 01:29 Brigade Control is contacted by radio from the fire ground to “*make pumps 20*”.
- 13.3.22 At 01:31 Brigade Control is contacted by radio from the fire ground to “*make pumps 25*”.
- 13.3.23 At approximately 01:57 SM Walton begins to take over as Incident Commander from WM Dowden.
- 13.3.24 At approximately 01:59 DAC O’Loughlin joins Walton and Dowden at the base of the tower and begins to take over as IC from Walton.
- 13.3.25 Separately, at 02:04, GM Welch begins to take over as IC at Command Unit CU8.
- 13.3.26 At 02:03 Brigade Control is contacted by radio from the fire ground to “*make pumps 40*” (MET00015882).

13.3.27 At 02:06, LFB GM Welch escalated the incident to a “major incident” (LFB00000003)

13.3.28 The Major Incidents Procedures Manual defines a Major Incident as follows:

“Typically, a Major Incident involves one or more of the following:

- *Involvement, either directly or indirectly, of large numbers of people;*
- *The rescue and transportation of a potentially large number of casualties;*
- *The large scale combined resources of Police, London Fire Brigade and London Ambulance Service;*
- *The mobilisation and organisation of the emergency services and support services, for example: local authority, to cater for the threat of death, serious injury or homelessness to a large number of people; and transport operators actively managing the road and rail networks to support emergency response;*
- *The handling of a large number of enquiries likely to be generated both from the public and the news media - usually made to the police.”*

13.3.29 Section 2.2 of the Manual states:

“2.2.1 A major incident may be declared by one or more emergency services, if any of the criteria outlined above has been satisfied. In certain circumstances, such as flooding, the local authority may declare a major incident.

2.2.2 Despite the fact that what is a major incident to one of the emergency services may not be so to another, each of the other emergency services will attend with an appropriate pre-determined response and notify relevant support organisations, such as Local Authorities or Transport operators. This is so even if they are to be employed in a standby capacity and not directly involved in the incident.”

13.3.30 This guidance closely aligns with the current National Operational Guidance for the fire service (<https://www.ukfrs.com/guidance/major-incidents>, published March 2018) which states:

“The definition of a major incident is “an event or situation with a range of serious consequences which requires special arrangements to be implemented by one or more emergency responder agency”. They are likely to be larger, more complex, endanger more people or threaten larger areas, and will require additional levels of command, control and co-ordination. This will be likely to involve many emergency services and other responding agencies in a long and high impact event. This fire and rescue service context guidance should therefore be read in conjunction with National Operational Guidance:

Incident command and the Joint Emergency Services Interoperability Principles.”

- 13.3.31 A Major Incident implements the “Bronze, Silver, Gold” emergency service command structure and requires close cooperation between all emergency services on site.
- 13.3.32 At approximately 02:11 DAC O’Loughlin moves to CU8 and takes over sole control of the incident as IC from Welch.
- 13.3.33 At approximately 02:17 Welch instructs that the bridgehead be moved from Level 2 to Level 3.
- 13.3.34 At 02:32 Brigade Control is contacted by radio from the fire ground to “*make aeriels x4*”.
- 13.3.35 While the precise timing and wording of the orders given by the relevant commanders will be a matter for the Chairman to consider (as well as what advice was actually given by CROs), the existing evidence indicates that at 02.35 Jo Smith instructed the control room officers to change advice to FSG callers from stay put to leave (Transcript of 11th/12th July 2018).
- 13.3.36 The available evidence also indicates that at or about 02.47 AC Roe, then the Incident Commander, also separately ordered that the advice from control room staff to FSG callers be changed to make best efforts to escape (MET00005404).
- 13.3.37 At 03:08 Goulbourne instructs the bridgehead to move to the Ground floor lobby because “*the smoke condition in the bridgehead was untenable for a bridgehead and we had to relocate.*” (Transcript 12th September, p141).
- 13.3.38 At 04:25 Welch confirmed to Wolfenden that fire fighters were not being deployed above Level 10.
- 13.3.39 At 04:30 this was changed to an attempt to get fire fighters to Level 15 to respond to FSG calls, however by 04:45 the order was again confirmed that no fire fighters were to be deployed above Level 10.
- 13.3.40 At 06:10 Roe recorded that “*No ops crews beyond 12th floor. Availability of water and advice from sector. No water above and confirmed not cleared yet.*”
- 13.3.41 At 08:07 the last resident was rescued from Level 11.
- 13.3.42 Between 08:30 and 09:00 the bridgehead was moved up to Level 4.
- 13.3.43 At 10:15, Roe records that he believes that there was “*still a chance of saveable life*”.
- 13.3.44 At 12:55 AC Roe completes his handover to AC Ellis, who become Incident Commander.
- 13.3.45 At 13:25 the bridgehead was moved up from Level 4 to Level 8.

- 13.3.46** At 19:55 the Incident Commander, AC Ellis, records that “*There is no longer any saveable life in the building*”. The site is then handed over to Major Incident Command.

13.4 Resident evacuation and movement in Grenfell Tower

- 13.4.1** In my analysis of resident evacuation, I am currently relying on the evidence of the MPS CCTV description tables, only: Individual Exit Times and Location (MET000080463); and CCTV Named Exits (MET00016072). These tables identify individuals leaving Grenfell Tower by time and camera. Therefore, should further evidence be provided I may need to revise my analysis of individual exit times from Grenfell Tower.
- 13.4.2** I am aware that that some individuals jumped or fell from the Tower. In my analysis these individuals are included in the count of fatalities that remain in the building. This is because I have relied on the MET’s CCTV analysis of people exiting the building, which does not record those individuals who jumped or fell from the tower.
- 13.4.3** Using the MPS CCTV-Individual Exit Times and Location - table identifying individuals leaving Grenfell Tower by time and camera (MET000080463, updated version MET00016072), I have calculated that before the stay put guidance began to change at 02:35, 177 occupants evacuated independently or with fire brigade assistance. At that time there were 117 occupants remaining in the building, noting some of those 117 occupants made one or more attempts to get out or down the stairs in that time period (e.g. Gomes IWS00001078 and Roncolato IWS00000894).
- 13.4.4** After the LFB began to change the stay put guidance, a further 46 occupants evacuated from Grenfell Tower. Based on resident witness statements (listed in Table 13.3), 11 of these residents were rescued by fire fighters, i.e. fire fighters came to their door and assisted in their whole journey out of the building. A further 33 residents decided themselves to leave their flat, although they may have then encountered fire fighters in the escape route and been assisted part of the way. I have no clear evidence on 2 residents (Hamide and Woledeslassie-Araya)

Table 13.3: List of statements relating to escape of final 46 residents

Resident	Statement reference
Neda	IWS00000886
Smith	IWS00000771
Gomes	IWS00001078

Resident	Statement reference
Macit	IWS00000904
Yahya	IWS00000498
Aboud	IWS00000130
Talabi	IWS00000851
Assefal	IWS00000891
Elcock	IWS00000312
Alhaj-Ali	IWS00000781
Roncolato	IWS00000894
Fairbairn	IWS00001025
Ross	IWS00001036

13.4.5 The last resident to be rescued left the building at 08:07.

13.4.6 Figure 13.3 shows the flow rate of occupants over time relative to the point at which Stay Put guidance began to change at 02:35. The number of occupants who evacuated before and after the cease of the Stay Put guidance is highlighted in green and blue, respectively.

13.4.7 I note that not all of the 117 occupants were consistently told to leave the building by control room staff, despite the policy having been formally changed (Darby, MET00013961).

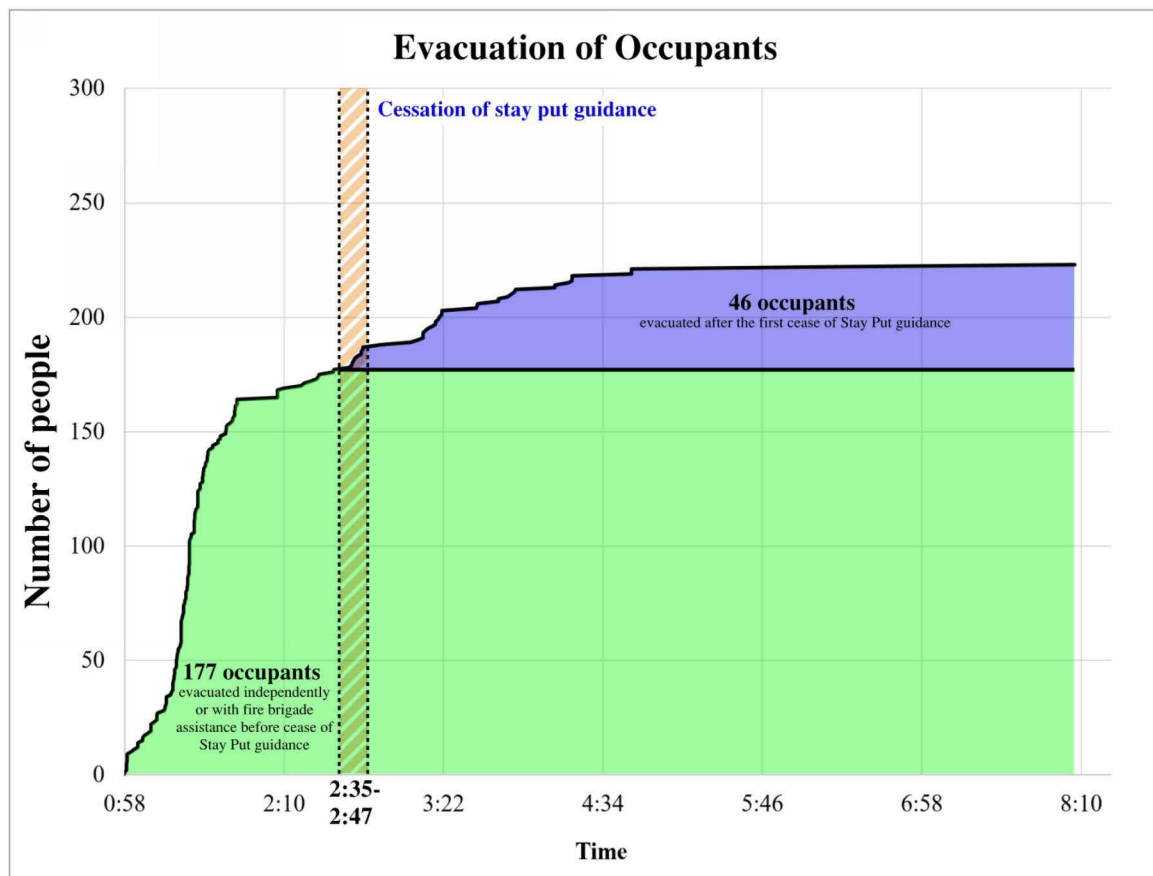


Figure 13.3: Evacuation of occupants at Grenfell Tower (based on data extracted from MET000080463)

13.4.8

A total of 70 persons (MET00012529) did not evacuate from the building (noting 2 persons who came out of the building later died). Some made several attempts to exit during the preceding time. Figure 13.4 shows the same data, but in a different way, with the number of remaining occupants in Grenfell Tower being shown over time relative to the Stay Put guidance beginning to be changed at 02:35.

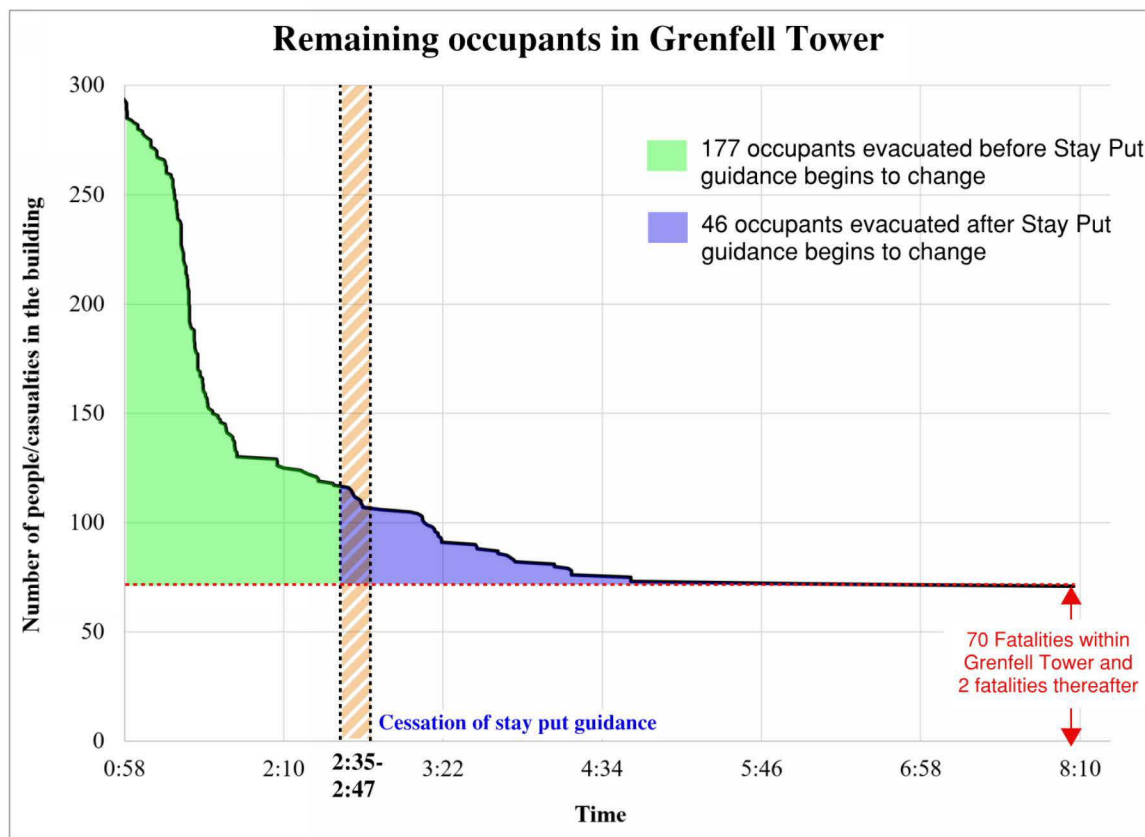


Figure 13.4: Remaining occupants in Grenfell Tower (based on data extracted from MET000080463, as updated in MET00016072)

13.4.9 As shown in Figure 13.5, the rate of occupants evacuating the building slowed down at approximately 01:49 (reference point A) and again at approximately 04:48 (reference point B), as demonstrated by the change in gradient of the graph.

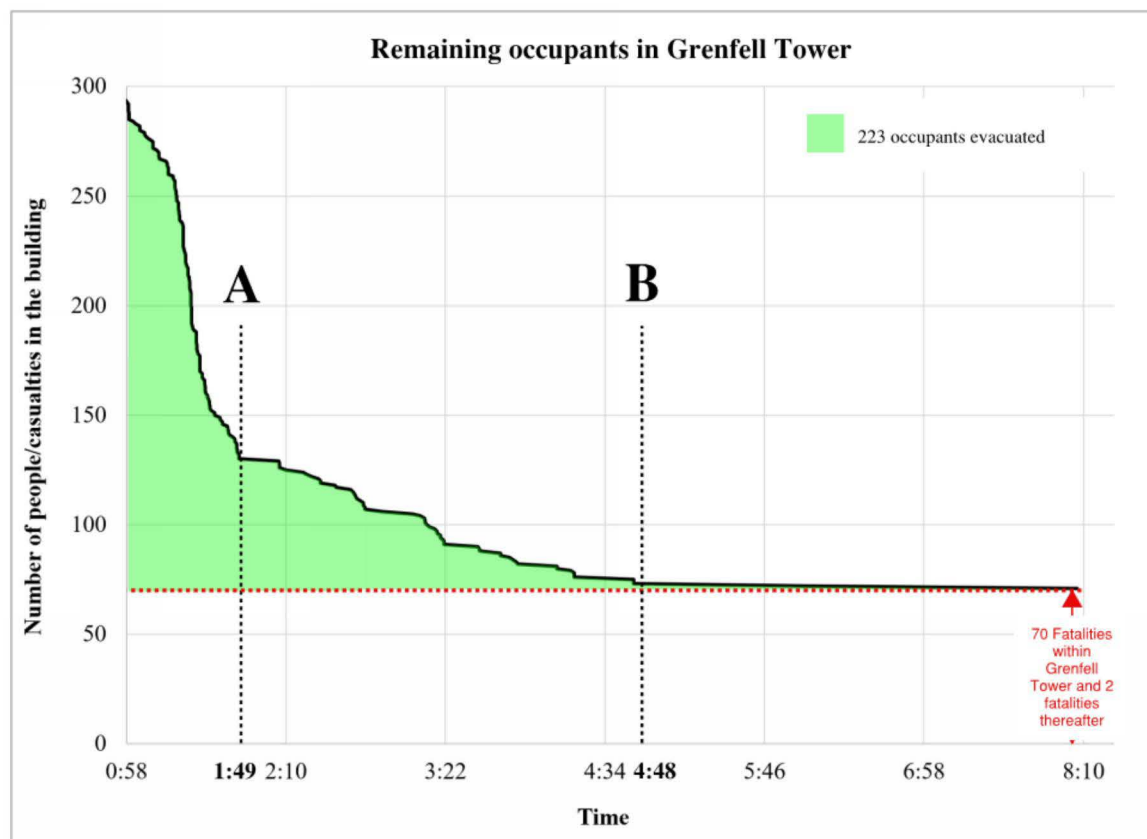


Figure 13.5: Remaining occupants in Grenfell Tower (based on data extracted from MET000080463, as updated in MET00016072)

13.5 Number of fire fighters present within the building over time

- 13.5.1** Figure 13.6 identifies the number of fire fighters that were recorded as being under air beyond the bridgehead at all times between 00:58 and 08:00 on the 14th June 2017. This graph is based on my analysis of the LFB BA telemetry data (LFB00023326).
- 13.5.2** In producing this graph, I have calculated at what time each fire fighter was present in the building by using the records of when fire fighters were logged onto the Entry Control Board and the “end of wear” time.
- 13.5.3** At any given time on the graph, this is the difference between the number of fire fighters that have been committed into the Fire Sector, and the number of fire fighters that have reached their “end of wear” time.
- 13.5.4** I am aware that several fire fighters made more than 1 entry into the building under air. The BA Telemetry identifies these individuals. In my analysis I have not differentiated between fire fighters entering for the first time and those entering for subsequent BA wears. Therefore, where I state the total number of firefighters having entered the building, this counts all instances of multiple wears as a “new” fire fighter.

13.5.5 I understand from the BA telemetry that the first instance of a “2nd wear” occurs at 04:04:00.

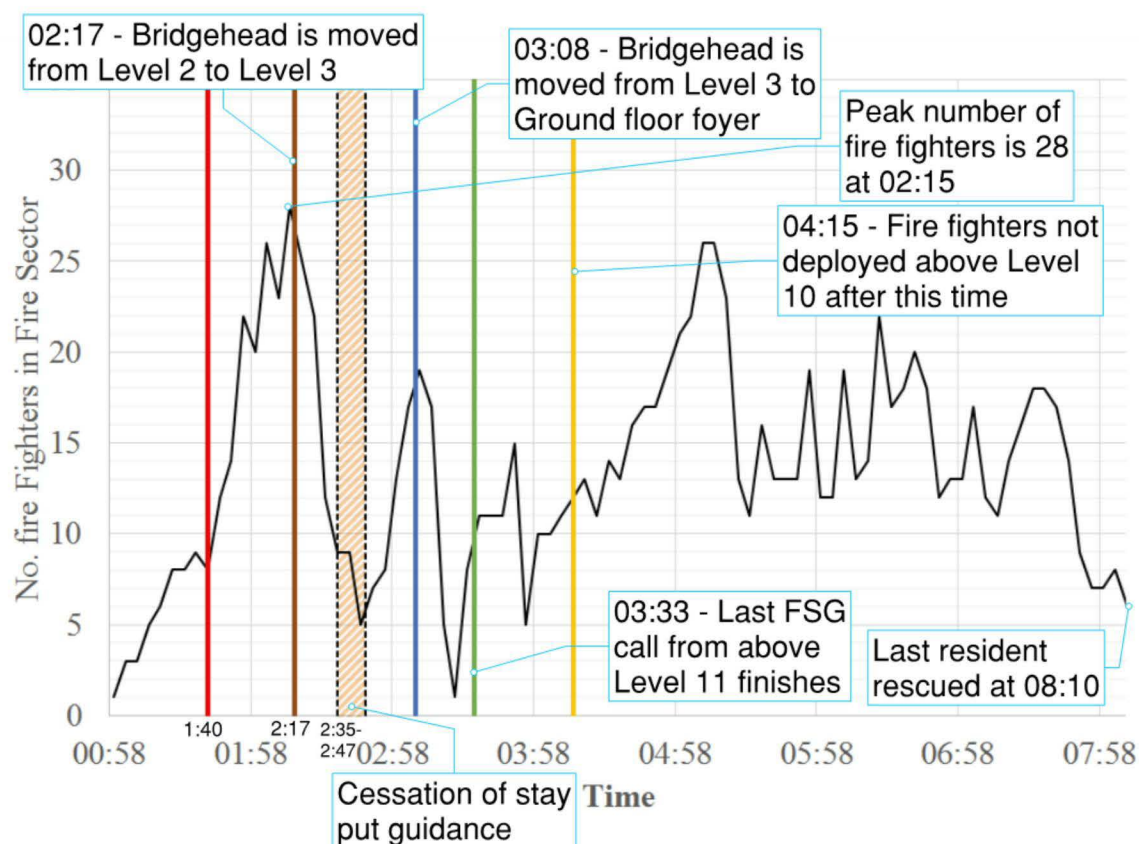


Figure 13.6: Number of fire fighters working beyond the bridgehead at each point in time (e.g. 28 fire fighters were working in the Fire Sector at 02:15)

- 13.5.6** Figure 13.6 therefore shows the active resources available to the LFB in the Fire Sector and therefore available for internal fire-fighting and search and rescue operations (i.e. operations beyond the Bridgehead).
- 13.5.7** I note that firefighters were committed in teams numbering between 2 and 5 fire fighters.
- 13.5.8** Between the initial arrival of fire fighters to Grenfell Tower at 00:58, and 01:40, a total of 14 fire fighters in BA were committed into the Fire Sector. Because of the working duration of BA sets, there were never any more than 9 fire fighters in the fire sector at any one time in this period.
- 13.5.9** Between 01:40 and 02:35 the number of fire fighters present in the Fire Sector rose to a peak of 28 at approximately 02:15, before dropping again to 9, by the time control room staff were beginning to change the advice being given to FSG callers at 02:35.
- 13.5.10** The peak of 28 at 02:15 represents the largest number of fire fighters present at one time in Grenfell Tower between 00:58 and 08:00.

- 13.5.11** By 02:35 a total of 63 fire fighters overall, had been committed into the Fire Sector, since the start of the fire.
- 13.5.12** Roe records in his oral evidence (Transcript 26 September, p70) an intention to “flood the building with firefighters” on taking over as IC at 02:44.
- 13.5.13** From 02:44 the number of fire fighters present in the building at the same time increases to 19 at approximately 03:08. At this time, the bridgehead was then moved from Level 3 to Ground floor. As a result, all fire fighters within the fire sector were signalled to evacuate by an alarm on their BA sets. The evacuation alarm is described by Hoare in his oral evidence (Transcript 10th September, p201) where he states:
- “There was also the warning -- the alarm was going off to tell us that we was being evacuated. I didn't hear it going off.*
- Q. If you can help us with that, the alarm that sounds that the building is going to be evacuated, that's a separate and distinct alarm, is it?*
- A. That's the ADSU that they can press that sets off your alarm to let you know it's being evacuated, yeah.*
- Q. And that makes a distinctive noise, does it, separate to the –*
- A. Yeah, than the actual ADSU, yeah.*
- Q. Does anything light up?*
- A. Yeah, it lights up as well.*
- Q. What lights up?*
- A. I think there's -- I can't even remember, either green lights or red lights that sort of flash.*
- Q. And your training is once that's activated, you're to get out?*
- A. Well, you're supposed to, yeah, but I didn't hear it going off because we were just breathing so heavy.”*
- 13.5.14** No new fire fighters were committed between 03:06 and 03:25 according to the BA telemetry data (LFB00023326). Therefore, the number of fire fighters working beyond the bridgehead drops to 1 in this time period.
- 13.5.15** With the bridgehead re-established at Ground floor and fire fighters once again being committed to the Fire Sector, the number of fire fighters present rises to a peak of 15, between 03:25 and 03:50.
- 13.5.16** By 04:05 an overall total of 104 fire fighters had been committed to the Fire Sector at Grenfell Tower, since the start of the fire.
- 13.5.17** After 04:05 the number of fire fighters being committed rises again, increasing the resources available in the Fire Sector. This resource peaks by approximately 05:10 with a total of 26 fire fighters being present at this time.
- 13.5.18** The number of fire fighters then drops to between 11 and 22 fire fighters present at any one time between 05:30 and the end of the data set at 08:00.
- 13.5.19** At approximately 04:04 Gallagher and Cook were tasked by Goulbourne with getting as far up the stairs as they could and reporting back to the Bridgehead on the conditions (Gallagher transcript 10th September 2018, p31). They

returned at approximately 04:15 and reported that any fire fighters passing beyond Level 12 were unlikely to return, due to the conditions in the stairs and the lobbies.

- 13.5.20** Wolfenden records a discussion with Welch at approximately 04:25 (Transcript 11 September, p231) identifying that crews were not being committed above the 11th floor. Welch identifies (Transcript of 18 September, p196) that his order to not progress beyond the 11th floor was based on information from returning crews. I assume this includes the specific conditions reported by Gallagher and Cook.
- 13.5.21** As a result of the discussion, an attempt appears to have been made to push crews up to the 15th floor, however Wolfenden then records that at 04:45 “*BA crews only committed up to 11th floor*”.
- 13.5.22** Therefore, I have concluded that the fire fighters recorded after 04:00 were present only up to level 11.
- 13.5.23** My analysis of the data in the BA telemetry record therefore concludes that, between 00:58 and 08:00, a total of 220 fire fighters were committed into the Fire Sector at Grenfell Tower. This includes 29 instances of fire fighters making a “2nd wear” entry.
- 13.5.24** However, because each fire fighter was limited in the time they could spend in the Fire Sector, the maximum number of fire fighters available at any one time, between 00:58 and 08:00, was 28.
- 13.5.25** Additionally, this peak in resource occurred at 02:15, approximately half an hour before AC Roe becomes IC.
- 13.5.26** Between 0140 and 0243, a total of 55 fire fighters were committed above the bridgehead. An average of approximately 22 fire fighters were present at any one time during the period of 0200 – 0230.
- 13.5.27** This data also indicates considerable disruption in resources in the Fire Sector between 02:35 and 04:05. The last FSG call from the Tower, above Level 11, was around 03:33am.

13.6 Involvement of each building envelope compared with resident movements

- 13.6.1** The involvement of the building envelope is presented here and compared with the number of people remaining within the building.
- 13.6.2** I have compared the time at which each external wall elevation was first ignited and the number of remaining occupants in Grenfell Tower over time in Figure 13.7. I have continued the graphs in this section until 08:10, at which point no further residents escaped or were rescued from Grenfell Tower.

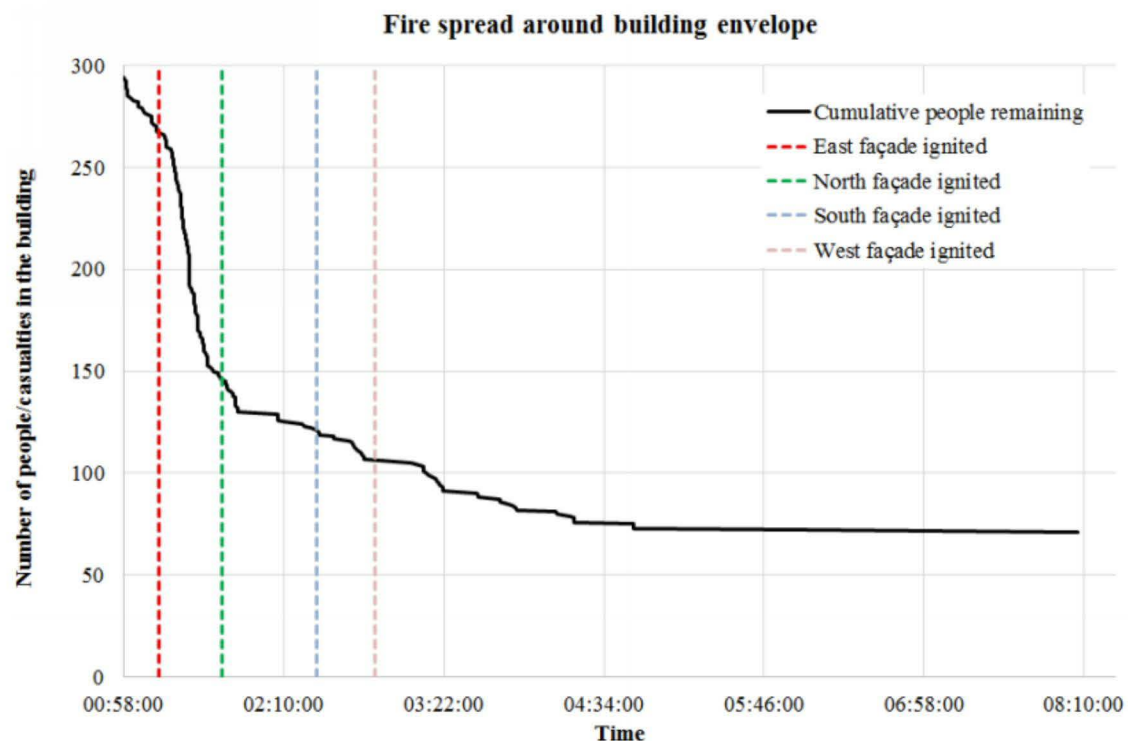


Figure 13.7: Critical times of fire spread around building envelope and remaining occupants in building (based on data extracted from MET000080463, updated in MET00016072 and MET00012593)

13.6.3

I have then compared the time each external wall elevation ignited and the time that elevation was fully involved in fire to the number of remaining occupants in Grenfell Tower in Figure 13.8. The solid coloured bars on the top of the figure represent the duration from ignition of an elevation to its full involvement.

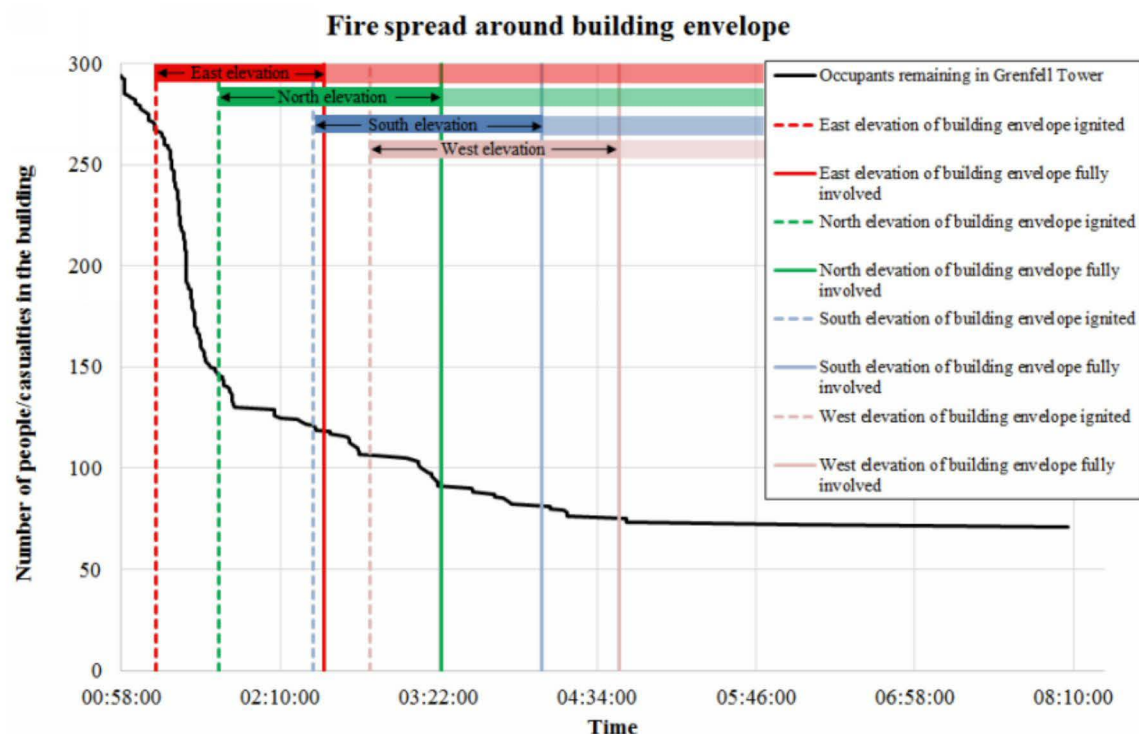


Figure 13.8: Critical times of fire spread around building envelope and remaining occupants in building (based on data extracted from MET000080463, updated in MET00016072 and MET00012593) at those times

13.6.4 The rate of occupants evacuating the building slowed down at 01:49 (reference A) and again at 04:48 (reference B). These times are shown in Figure 13.9 with the time each external wall elevation ignited. By 01:49 (reference A), the East and North elevation of the building envelope had ignited. By the time of this second slowdown in evacuation, 04:48, the fire had spread around the complete perimeter, that is all four elevations of the building.

13.6.5 Figure 13.9 and Figure 13.10 include visual representations of each external wall elevation ignition and full involvement, based on the data presented in Figure 13.8.

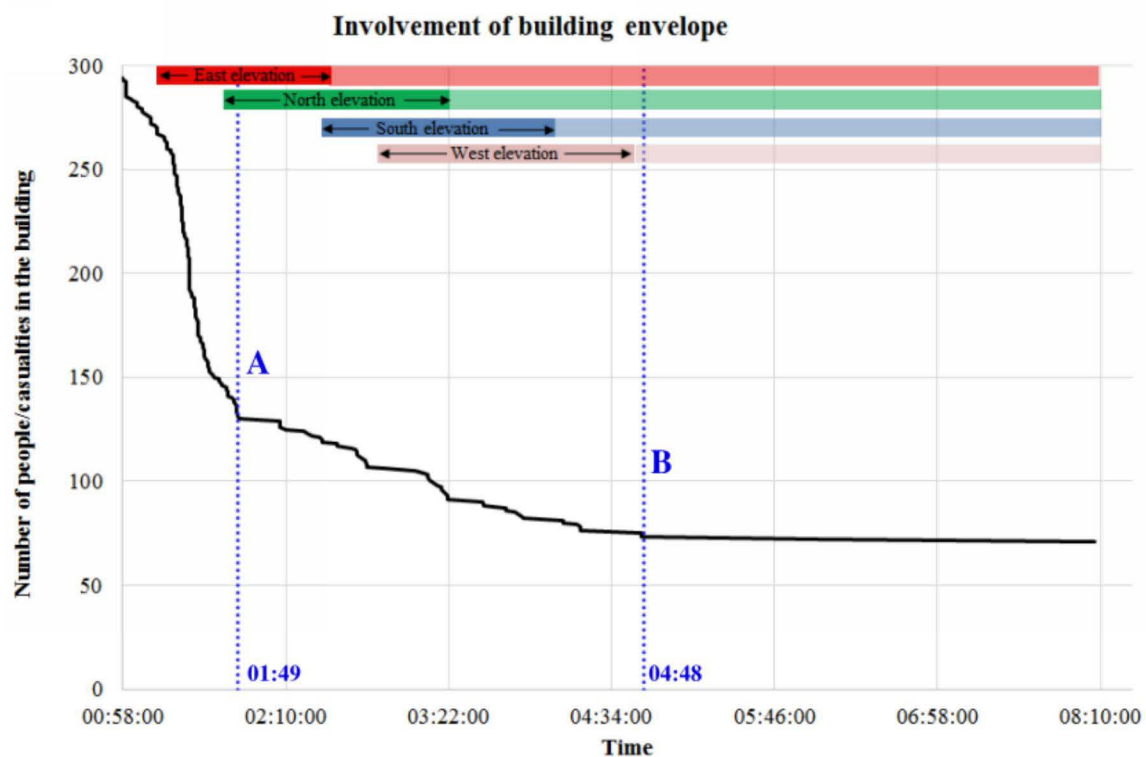


Figure 13.9: Critical times of fire spread around building envelope and remaining occupants in building (based on data extracted from MET000080463, updated in MET00016072 and MET00012593)

13.6.6 At 02:06, a Major Incident was declared by the LFB. At that time, both the East and North elevation had ignited and 164 occupants, approximately 56% of the total building occupants, had evacuated. Refer to Figure 13.10 for a visual comparison of the cumulative number of occupants in the building at the time of the Major Incident declaration and the involvement of the building envelope.

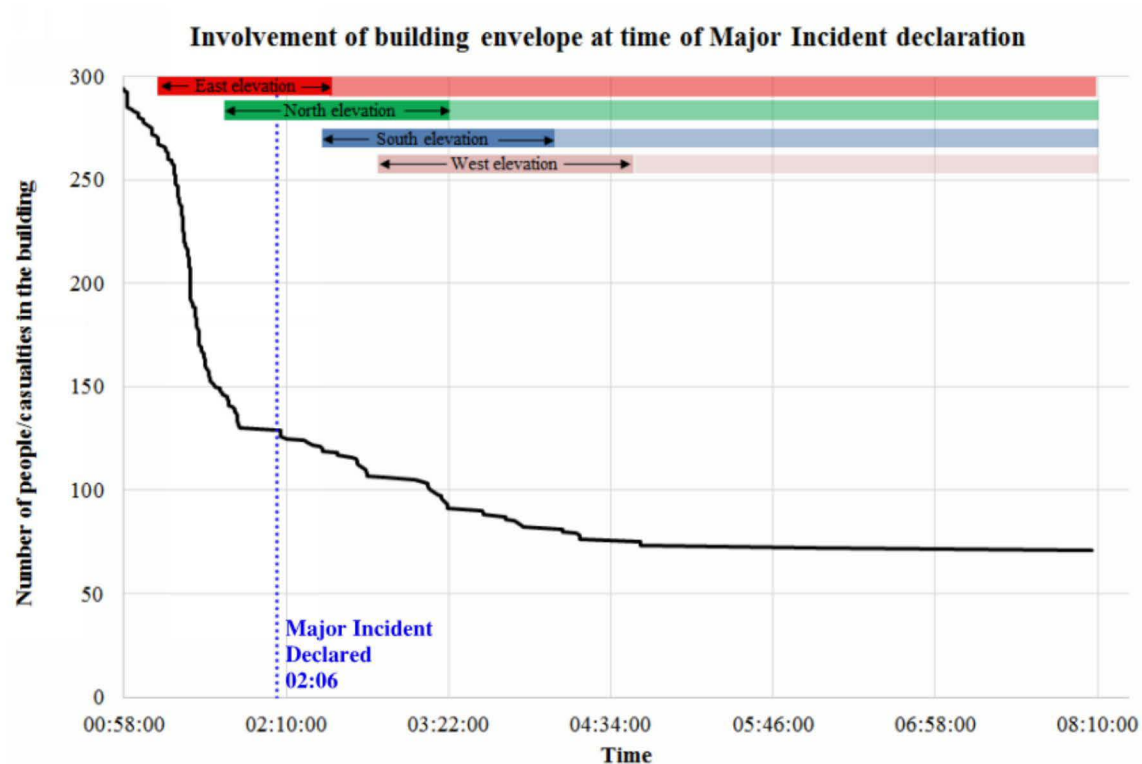


Figure 13.10: Involvement of building envelope and evacuation status at time of Major Incident declaration (based on data extracted from MET000080463, updated in MET00016072 and MET00012593)

- 13.6.7 At 02:35, LFB began to change guidance for people still within Grenfell Tower from “stay put” to “evacuate if possible”.
- 13.6.8 At that time, the East elevation was fully involved and the North and South elevation had ignited. Approximately 60% of the total building occupants, or 177 occupants, had evacuated.
- 13.6.9 Please refer to Figure 13.10 for a visual comparison of the cumulative number of occupants remaining in the building at the time of (i) the Major Incident declaration, (ii) the beginning of the change in stay put guidance and (iii) the involvement of the building envelope.

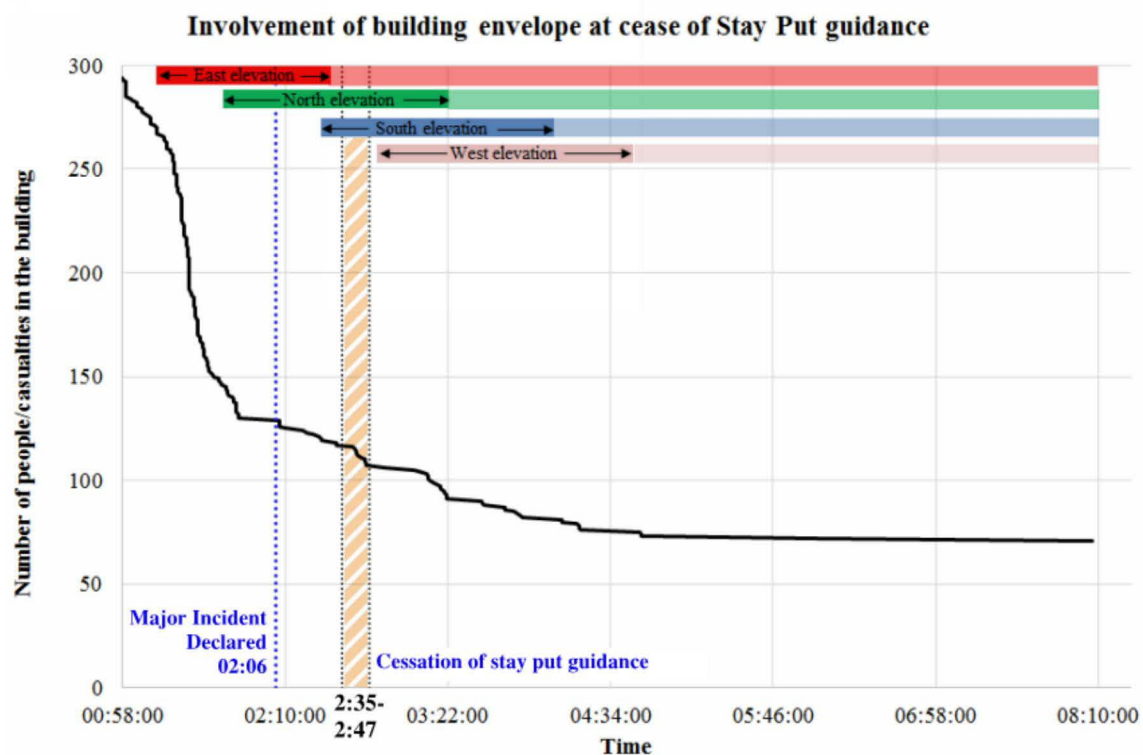


Figure 13.11: Involvement of building envelope and evacuation status at time of Major Incident declaration and as the stay put guidance begins to change (based on data extracted from MET000080463, updated in MET00016072 and MET00012593)

13.7 External firefighting timing

13.7.1 In Figure 13.12, I have compared the LFB “make-up” requests with the cumulative number of occupants remaining in the building. The LFB “make-ups” are the requests to change the number of appliances in attendance at the site. For example, “Make pumps 6” is a request to increase the total number of pumping appliances on site to 6.

13.7.2 It is of note that 40 pumps and 2 aerial appliances had been assigned to the incident by the time a Major Incident was declared. An additional 2 aerial appliances were requested by the time the Stay Put guidance to residents of Grenfell Tower began to change.

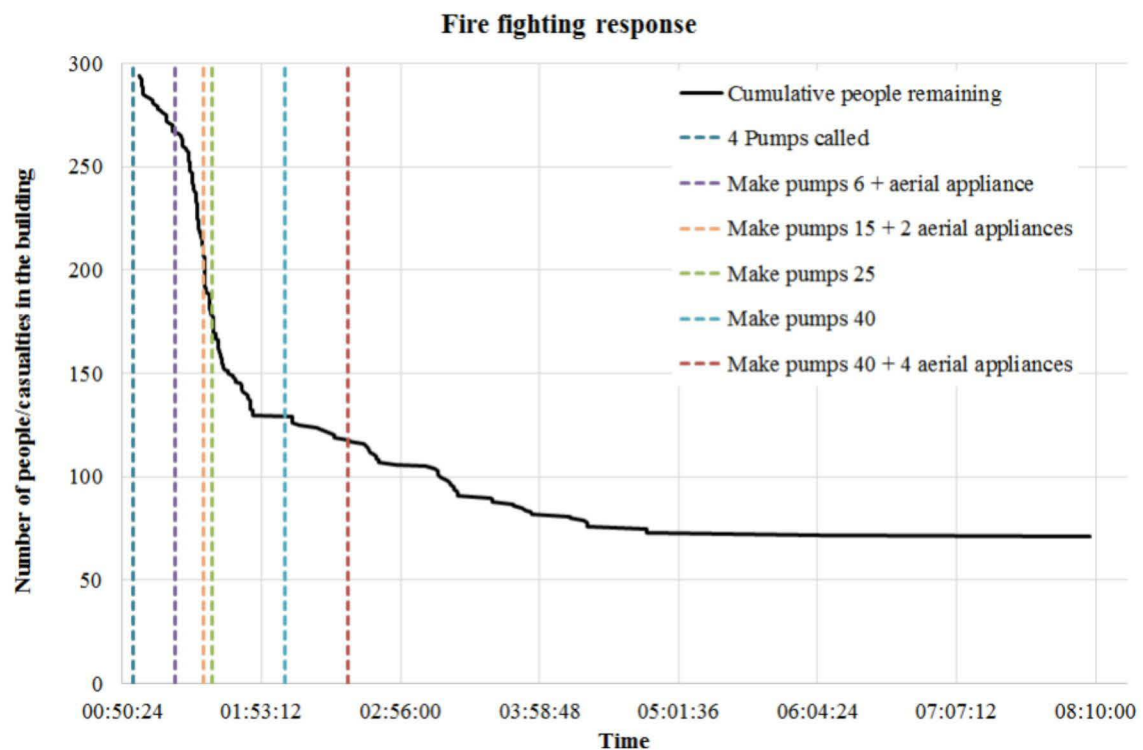


Figure 13.12: Firefighting response and evacuation status (based on data extracted from MET000080463, updated in MET00016072 and LFB000000003)

13.7.3

Visual representations of each elevation ignition and full involvement, based on the data from the MPS *“Aid to interpretation of evidence report – Operation Northleigh”* (MET00012593), are presented alongside the LFB “make-ups” and cumulative number of occupants remaining in the building in Figure 13.13.

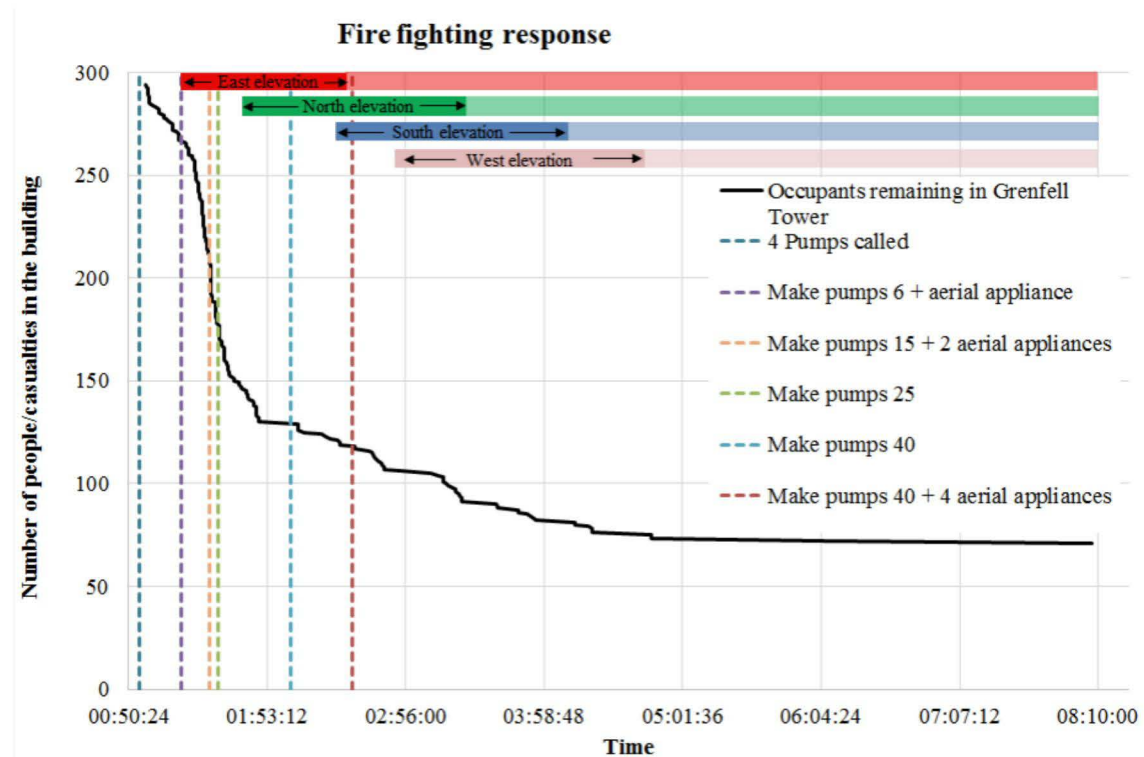


Figure 13.13: Firefighting response, evacuation status, and involvement of the building envelope (based on data extracted from MET000080463 and LFB00000003)

- 13.7.4** I have provided my detailed analysis of external firefighting, along each elevation, in Section 17.
- 13.7.5** In summary, based on my analysis of MPS and media images available from the fire, the four most consistent jets applied to Grenfell Tower on 14th June 2017 are evidenced in Figure 13.14 and Figure 13.15 below.

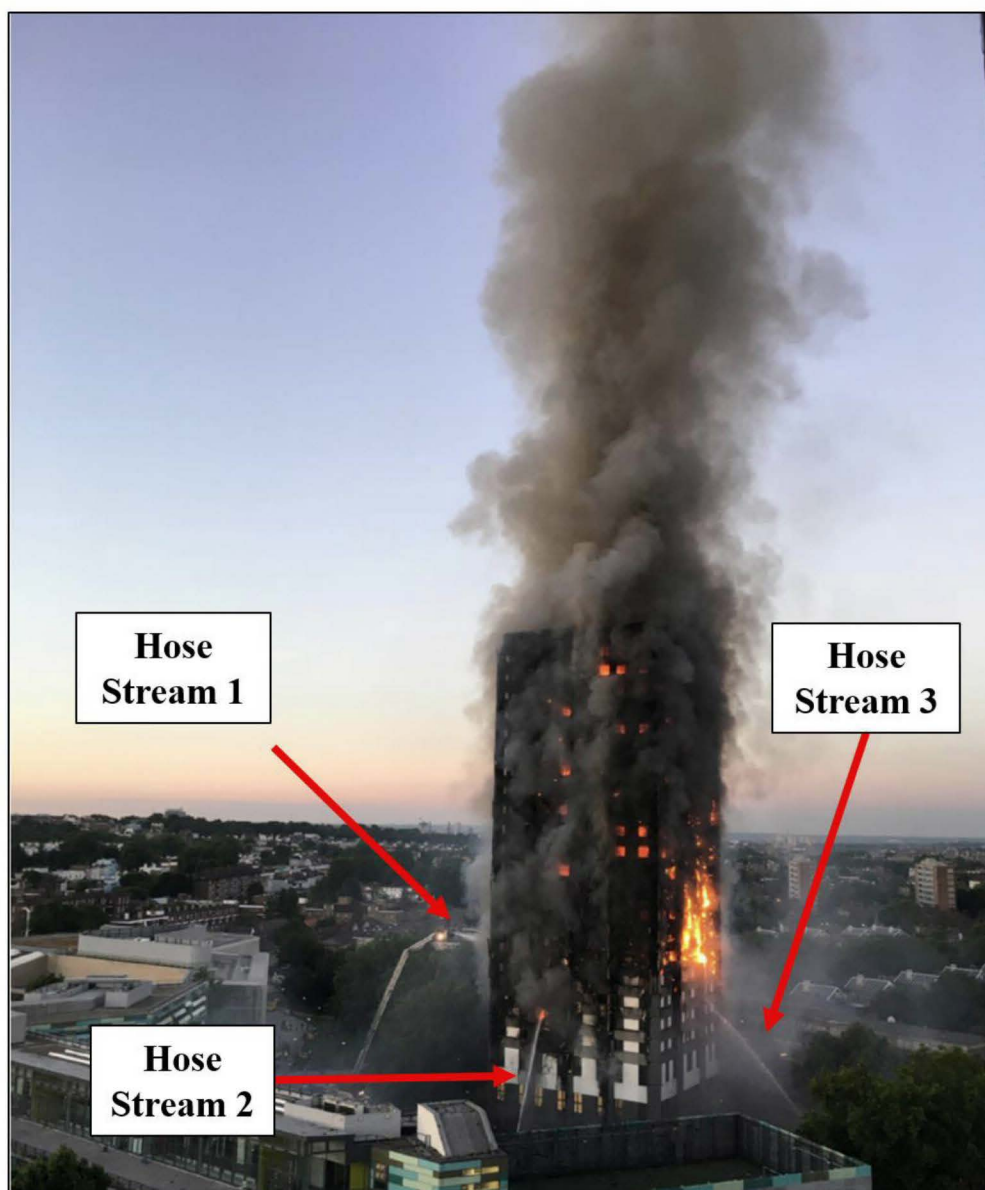


Figure 13.14: Firefighting jets on building envelope - East, North, and West elevations - at 04:43 on 14 June 2017 (MET00012593)



Figure 13.15: Firefighting jets on building envelope - North and South elevations on 14 June 2017¹.

¹ <https://www.standard.co.uk/news/london/individuals-may-face-criminal-grenfell-charges-says-prosecutor-a3605581.html>

13.8 Timing of fire brigade movement in the stairs and the lobbies including the location of the Bridgehead

13.8.1 The times at which LFB were required to move their operational positions within the building is relevant evidence of the conditions within the stairs and lobbies of Grenfell Tower. The internal fire-fighting control point is called the Bridgehead.

13.8.2 According to the *Fire and Rescue Manual: Volume 2 - Fire Service operations - Incident Command* (3rd edition, 2008), a Bridgehead is defined as

“A central and advanced point for occasions where it is necessary for BA [Breathing Apparatus] to be started up at a distance from the original point of entry to risk area, whilst remaining in a safe air environment”.

13.8.3 A Bridgehead may also be a forward command post, which is defined as a

“point, near the scene of operations, where the officer delegated responsibility for command in that area is sited”.

13.8.4 I have explained in detail how I derived the location of the Bridgehead in Section 14 of my report. In summary, at Grenfell Tower, LFB initially established the Bridgehead at Level 2. By 02:17, they moved it up to Level 3. But by 03:08, they were forced to move it down to the Ground Level. Please refer to Section 14 for additional information on the Bridgehead and the reasons it had to be moved during the fire event.

13.8.5 By approximately 08:30, LFB were able to move the Bridgehead to Level 4, and it was reported to be at Level 8 by 13:25 (Figure 13.16).

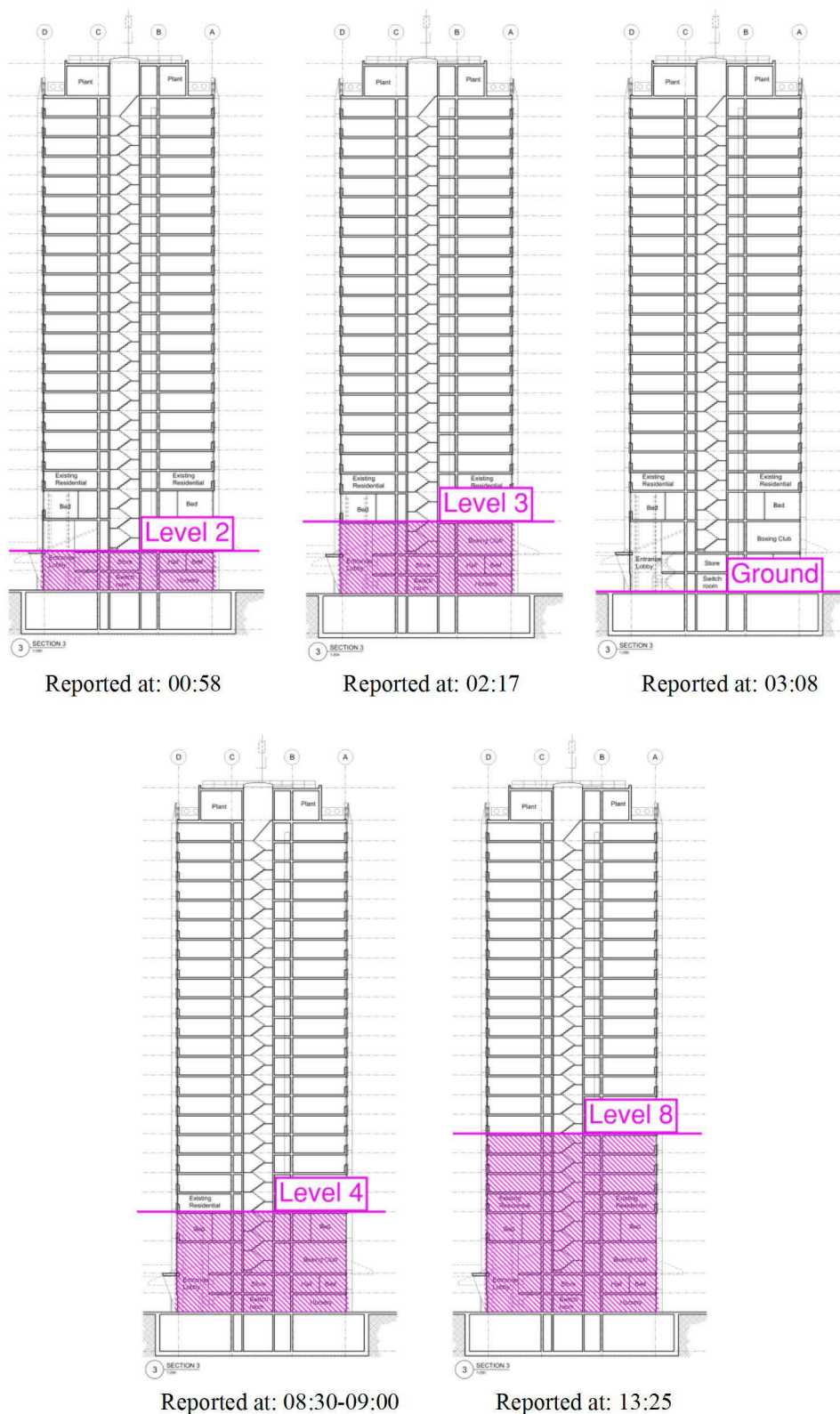


Figure 13.16 Position of the Bridgehead as recorded in the LFB witness statements (See Section 14)

13.9 Final timeline of critical times

Table 13.4: Key-timed events

Time	Event	Evidence
00:54	First call to incident (fire in Flat 16)	LFB00000003
00:55	Pre-determined attendance assigns 3 pumps to attend the incident.	LFB00000003
00:55	Smoke control system autodialler contacts Tunstall system	THL00000002
00:57	Second call to incident from a remote monitoring company, Tunstall Response	LFB00001914
00:59	WM Michael Dowden is Incident Commander upon arrival	MET00013830
00:59	A fourth pump appliance is manually assigned to the incident by Peter May	MET00015882
01:00 (approx.)	Fire fighter observes visibility in stair and Level 4 lobby good	MET00005677 (Batterbee)
01:03 (approx.)	Bridgehead at Level 02. CM Secrett becomes Bridgehead Commander.	MET00005251 (Brown)
01:07	Fire fighters enter Flat 16	MET00006109
01:08	First verified image of fire taking hold outside Flat 16 (East elevation)	IWS00000051
01:13	"Make pumps six"	LFB00000003, MET00013830
01:14	First request for Aerial Appliance	LFB00000003, MET00013830
01:14	Fire fighters put water on fire in Flat 16	MET00006109
01:14	WM O'Keeffe enters Grenfell Tower to take over from Secrett as Bridgehead Commander	Transcript 6 th July p7
01:15	First confirmed time external fire-fighting jet from ground	MET000083359
01:19	"Make pumps eight"	LFB00000003, MET00013830
01:21	CM Batterbee reports by radio to the Bridgehead that the fire in Flat 16 is extinguished	Transcript 28 June p106
01:24	"Make pumps ten"	LFB00000003, MET00013830
01:27	"Make pumps 15, Aerials X2"	LFB00000003, MET00013830
01:28	"Persons reported"	LFB00000003, MET00013830
01:29	"Make pumps 20, fire rescue units X2"	LFB00000003, MET00013830
01:31	"Make pumps 25"	LFB00000003, MET00013830

Time	Event	Evidence
01:32	SM Loft assigned as FSG Sector Commander by IC Dowden	Transcript 5 th September, p133
01:35 (approx.)	Fire fighters informing residents on Level 16 or 17 to stay in their flats	MET00007765 (Flanagan)
01:42	North elevation ignited	MET00012593
01:52	Aerial appliance active close to East elevation	YouTube video ²
01:57	Station Manager Walton made Incident Commander	LFB00000003
01:57	Fire fighters sent to the roof (reached Level 22)	Transcript of 23 rd July 2018, p125
01:59	DAC O'Loughlin takes over as IC from Walton at base of Grenfell Tower	Transcript of 24 th September, p83
02:00	Fire fighters sent on reconnaissance to Level 20	MET00008019 (Eden)
02:03	"Make pumps 40"	LFB00000003
02:04	GM Welch sends a radio message to declare that he is taking over as IC, noting that DAC O'Loughlin has taken over as IC separately from SM Walton	Transcript of 18 September, p39
02:06	LFB message from incident "CU8 from GM Welch this is a major incident"	LFB00000003, MET00013830
02:10 (approx.)	SM Egan instructed by GM Welch to take over as FSG Sector Commander	
02:10	Dry rising main operated by fire fighters on Level 20. Pressure sufficient to fill hose, but not to provide a firefighting jet.	MET00008019 (Eden)
02:10	GM Welch enters Grenfell Tower to take over as Bridgehead commander from O'Keeffe	Transcript of 18 th September p125
02:11	DAC O'Loughlin sends radio message from CU8 confirming his position as IC	Transcript of 24 th September, p183
02:15	Greatest number of fire fighters in the Fire Sector recorded. 28 fire fighters present at this time.	LFB00023326
02:17	Bridgehead Moved to Level 03	MET00007882, MET00007525, Transcript of 24 th July 2018, p197
02:17	First request for "Dangerous structure engineer, gas and electricity board and local authority liaison officer"	LFB00000003, MET00013830
02:20 (approx.)	Goulbourne moves to Bridgehead to assist GM Welch as Bridgehead Commander. SM Goodall instructed by DAC O'Loughlin to take over as FSG Sector Commander	Transcript 12 th September, p92. Transcript 3 rd September, p19

² <https://www.youtube.com/watch?v=z8wIbhf7NL4>

Time	Event	Evidence
02:23	Radio message from CU7 “run all FSG calls via CU7”.	MET00013830
02:25	South elevation ignited	MET00012593
02:30	East elevation fully involved	MET00012593
02:32	“Make Aerials X4”	LFB00000003, MET00013830
02:35	Stay put advice begins to change	MET00007766; Jo Smith evidence, Transcript 12 July 2018 p.132
02:42	LFB informative message states that 5 firefighting jets were established.	LFB00000003
02:44	Assistant Commissioner Roe is now Incident Commander. DAC O’Loughlin assigned as Operations Commander.	LFB00000003, MET00013830
02:47	AC Roe records decision for FSG advice from control staff to “advise people to make efforts to leave the building”	MET00005404
02:51	West elevation ignited	MET00012593
03:08	Bridgehead moved to ground Level	MET00010759
03:23	North elevation fully involved	MET00012593
03:24	Number of fire fighters in the Fire Sector drops to lowest level recorded with only 1 fire fighter being present.	LFB00023326
03:33	Last FSG call concluded from above Level 11	LFB00004790
03:47	2no. residents from Flat 133 (Level 16) evacuate	MET000080463 MET00016072
03:55	Last member of group from Flat 183 (Level 21) evacuates	MET000080463 MET00016072
04:09	South elevation fully involved	MET00012593
04:12	2no. residents from Flat 74 (Level 10) evacuate	MET000080463 MET00016072
04:20	Group of residents from Flat 73 (Level 10) evacuates	MET000080463 MET00016072
04:25	No fire fighters to be deployed above the 10 th floor	Transcript of 24 th July 2018, p106
04:44	West elevation fully involved	MET00012593
04:47	3 rd last resident evacuates (group from Flat 82 Level 11), end of main evacuation)	MET000080463 MET00016072
06:05	2 nd last resident evacuates from Level 10	MET000080463 MET00016072
06:10	Roe decision: “No ops crews beyond 12 th floor. Availability of water and advice from sector. No water above and confirmed not cleared yet.”	MET00005404

Time	Event	Evidence
08:07	Last recorded resident evacuates from Level 11	MET000080463 MET00016072
08:30 (approx.)	Bridgehead moved to Level 04	Transcript of 24 th July 2018, p234
08:45 (Approx.)	GM Ashman takes over from Egan and Goodall as FSG Sector Commander	MET00007691
10:00 (approx.)	GM Graham takes over from Goulbourne and Welch as Bridgehead Commander	MET00005404
10:15	Roe states “Still a chance of saveable life”	MET00005404
11:14	DAC Ogden takes over as Operations Commander from O’Loughlin	MET00005404
12:55	Assistant Commissioner Ellis is now Incident Commander	LFB00000003
13:25	Bridgehead moved to Level 08	MET00005756
14:19	LFB command transcript states that 6 firefighting jets were established.	LFB00000003
19:55	Incident Commander Ellis records “There is no longer any saveable life in the building”	LFB00000003
20:00	LFB hands over active control of the site to the Major Incident Command	LFB00000003