

Grenfell Tower Inquiry

GRENFELL TOWER INQUIRY: PHASE 1 REPORT

REPORT of the PUBLIC INQUIRY into the
FIRE at GRENFELL TOWER
on 14 JUNE 2017

Chairman: The Rt Hon Sir Martin Moore-Bick
October 2019

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Part I

Background matters

Chapter 1

Introduction

- 1.1 In the early hours of Wednesday 14 June 2017 a fire broke out in the kitchen of Flat 16 Grenfell Tower, a high-rise residential building in North Kensington, West London. Grenfell Tower was owned by the Royal Borough of Kensington and Chelsea (RBKC) and managed by the Royal Borough of Kensington and Chelsea Tenant Management Organisation (the TMO). Kitchen fires are not uncommon and in terms of its origin and magnitude this one was nothing out of the ordinary. However, the fire, which should have been contained within the confines of Flat 16, escaped from the kitchen into the external envelope of the building. The building was constructed of reinforced concrete, to which there had recently been added a cladding system comprising insulation boards attached to the outside of the concrete structure and protected from the weather by aluminium composite material rainscreen panels. The rainscreen panels contained a polyethylene core. Polyethylene is a highly combustible substance. The material from which most of the insulation boards were made, polyisocyanurate foam, is also combustible.¹
- 1.2 Firefighters from the London Fire Brigade (LFB) attended the fire and within minutes of their arrival had extinguished the fire within the kitchen of Flat 16, but by that time the fire had already escaped into the cladding where they were unable to fight it successfully. Once established within the cladding the fire spread rapidly up the outside of the building. Within 20 minutes a vertical column of flame had reached the top of the building on the east side from where it progressed around the rest of the structure, so that within a few hours it had engulfed almost the whole of the building.
- 1.3 The fire claimed the lives of 71 people who were present in the tower that night, including the life of Logan Gomes, a child who was stillborn shortly after his mother had escaped and had been admitted to hospital. Another resident who had escaped from the building, Maria del Pilar (Pily) Burton, died seven months later. Although she had been seriously affected by smoke inhalation, her death was not directly caused by the fire, but she is mourned by her husband and friends as another victim of a terrible tragedy which affected the close-knit community living in and around the tower. A total of 227 people in all (residents and visitors) escaped from the tower.
- 1.4 On the morning after the fire the Prime Minister announced that there would be a public inquiry into the circumstances surrounding the fire and on 28 June 2017 I was appointed to act as its chairman. On 15 August 2017 the Inquiry was formally set up under the Inquiries Act 2005 (the Act); its Terms of Reference can be found in Appendix 1 to this report. As is clear from those Terms of Reference, the primary focus of my task was to investigate the cause and origin of the fire, the means by which it was able to spread throughout the building and how the building came to be in a condition which allowed that to happen. Related matters, such as the response of the LFB, the scope and effectiveness of building regulations and the response of central and local government to the disaster also form part of my Terms of Reference.
- 1.5 A senior civil servant, Mr Mark Fisher, was appointed Secretary to the Inquiry. Ms Caroline Featherstone, a senior solicitor from the Government Legal Department was appointed Solicitor to the Inquiry and Mr Richard Millett QC was appointed Counsel to the Inquiry. They

¹ A small number of insulation boards were made of phenolic polymer foam, which is also combustible.

have been ably supported by the members of their teams and I cannot speak highly enough of their dedication to the work of the Inquiry and the assistance I have received from every one of them. It has been, and continues to be, a great pleasure to work with them.

- 1.6 Pursuant to section 11 of the Act I appointed three assessors to advise me, Ms Joyce Redfearn, a highly respected former local authority Chief Executive, having served with Monmouthshire County Council, Gloucestershire County Council and Wigan Metropolitan Borough Council; Mr Joe Montgomery, an experienced housing professional who has more than 30 years' experience leading large-scale housing, infrastructure and regeneration programmes in both the public and private sector; and Professor David Nethercot, a distinguished engineer and former Head of the Department of Civil Engineering at Imperial College, London. Other assessors may be appointed as the Inquiry progresses. I have had the benefit of discussing the evidence and my findings with the assessors and have found their contributions very helpful, although responsibility for the findings and conclusions rests entirely with me.
- 1.7 Although there was much public speculation at the time about the origin of the fire and the role played by the cladding in its spread, it seemed to me that the first step must be to find out as far as possible exactly what happened during the early hours of 14 June 2017. Only when that had been done would it be possible to focus attention on the underlying causes and the decisions that gave rise to them. I therefore decided that the Inquiry should be conducted in two phases. Phase 1 would identify exactly how the fire started, how it escaped from the flat of origin and how fire and smoke was able to spread throughout the building in a manner and at a speed that prevented many people from escaping, despite the prompt attendance of the emergency services. Phase 1 would also examine the response of the emergency services so far as it bore on the decisions made and actions taken on the night of the fire. Phase 2 would ascertain the underlying causes of the disaster, including the decisions made in relation to critical aspects of the design and construction of the cladding system, the adequacy of the regulatory regime and the response of central and local government.
- 1.8 The Inquiry is proceeding concurrently with an investigation by the Metropolitan Police Service (MPS) into whether any criminal offences have been committed by (among others) those who were responsible for the design, maintenance or construction of the building. The Inquiry's task is to find out what happened and why. Section 2 of the Inquiries Act specifically precludes me from determining any person's civil or criminal liability, but it also provides that I am not to be inhibited in the discharge of my functions by any likelihood of liability being inferred from the facts I find or the recommendations I make. The role of the Inquiry is, therefore, different from that of the police, but to the extent that each is carrying out an investigation into the same events, the two may be seen as complementary. The MPS have provided the Inquiry with every assistance and will no doubt continue to do so. In so far as there was concern on the part of the police that the Inquiry's investigations might interfere with their own investigations, I believe that we have managed to find ways in which we can assist each other without compromising our respective functions. I am certainly very grateful for the way in which we have been able to work together in the public interest.
- 1.9 Between 20 June and 22 November 2017 Her Majesty's Senior Coroner for London (Inner West), in whose jurisdiction Grenfell Tower is situated, opened 70 separate inquests into the deaths of those who perished in the fire. She subsequently suspended those inquests pending the outcome of this Inquiry and, if necessary, that of the police investigation. I decided that, in discharging my Terms of Reference, I should carry out, as far as I properly could, an investigation into the deaths caused by the fire corresponding to that which the coroner would be required to undertake in order to discharge her responsibilities. By doing

so I hoped to minimise as far as possible the need for her to re-open any of the inquests and thereby to spare the relatives of those who died the need to endure further proceedings in relation to the deaths of their family members.

- 1.10 The Inquiry is unusual in the number of its core participants. I have received applications for core participant status from 768 individuals, companies and institutions, most of which have been granted. Applications continue to be made from time to time, but at the end of September 2019 the number of core participants stood at 619. Most of the individuals who have been granted core participant status had either lived in the tower or were related to someone who had died in the fire, or had lived in one of the buildings adjacent to the tower known as “the walkways”, which were evacuated during the fire. Most of the applications were considered and determined during the latter part of 2018, but further applications have been received at intervals up to the present day. The bulk of the corporate and institutional core participants were involved in one way or another in the refurbishment or maintenance of the tower between 2012 and the present day, but they also include the LFB and three government departments, the Ministry of Housing, Communities and Local Government (MHCLG), the Home Office and the Cabinet Office. A current list of core participants is published on the Inquiry’s website.
- 1.11 In keeping with the public nature of the Inquiry, arrangements were made for the hearings to be accessible to all who wished to follow them. All witness statements and documents put in evidence during the course of the hearings were published on the Inquiry’s website. For the convenience of those who live in the area surrounding the tower the proceedings were streamed live to the Methodist Church in North Kensington by kind permission of the minister, the Reverend Dr Michael Long. They were also streamed live on the internet. In addition, arrangements were made for the proceedings to be video-recorded and transcribed and for access to both the video-recording and the transcript to be available through the Inquiry’s website.
- 1.12 The Inquiry was formally opened on 14 September 2017 in the Connaught Rooms, London WC2. Although I had hoped to be able to begin hearing evidence in late 2017 or early 2018, it soon became apparent that the volume of material that had to be collected, assimilated and digested would make that impossible. In the event, I was able to begin taking evidence on 21 May 2018 at the Millennium Gloucester Hotel in Kensington, when over a period of two weeks those who had lost friends and relatives in the fire described the people they had known and loved. This was above all a human tragedy which affected not only the lives of those who lived in the tower and its immediate surroundings but also many who lived at a greater distance, not only in this country but also abroad. The moving and dignified descriptions of the lives and personalities of those who had died, and of the community to which they belonged, brought the human dimension to the fore and ensured that it will never be lost to sight amid the many issues of a technical nature with which the Inquiry inevitably has to grapple.
- 1.13 Between 4 June and 23 November 2018 the Inquiry sat for a total of 88 days at Holborn Bars, London WC2, during which I heard evidence from many of those who had been directly involved in the fire or the circumstances surrounding it. They included former residents of the tower who had survived the blaze, firefighters, control room officers and senior officers from the LFB, two officers of the MPS, one of whom was on duty at the scene during much of the night, the Director of Operations of the London Ambulance Service (LAS), many of whose members attended to treat casualties, and employees of RBKC and the TMO.

- 1.14 The evidence of the survivors and the firefighters has been of particular importance, not least because they were able to describe conditions within the building at different times and in different places. In that way they provided an important part of the foundation on which the expert witnesses instructed to assist the Inquiry were able to base their opinions. No less important was the evidence given by the survivors of their experiences as the fire developed. In many cases they escaped due to their courage and determination in the face of daunting conditions and many provided statements describing their experiences in detail. A list of those who provided statements is set out in full in Appendix 2. Their testimony, which has proved to be of great assistance, stands as a permanent record of their individual and collective response to an overwhelming tragedy. The accounts given by many of the firefighters demonstrate that they displayed a remarkable degree of courage and devotion to duty. In many cases individual firefighters entered the burning building on several occasions in disregard of their own safety in an attempt to rescue those who were trapped. I am grateful to all those who gave evidence, both those called to give evidence in person and those who provided written statements but were not called. All the statements received by the Inquiry have been published on its website and form part of its formal record. As such they will be permanently available to those who may wish to read them.
- 1.15 The Inquiry was fortunate in obtaining the assistance of a number of leading experts in a wide range of fields, whose evidence is referred to in detail later in this report. Some of them gave initial presentations in June 2018 in order to provide a context for the subsequent evidence of the firefighters and survivors, but their formal evidence was reserved until after the close of the factual evidence. Between 20 and 29 November 2018 I heard evidence from the experts, which has proved invaluable in helping me to understand the nature and characteristics of the building, the development of the fire and the wider course of events surrounding it.
- 1.16 Given the complexity of the disaster, it is unlikely that it will ever be possible to establish with complete certainty some of the details of what occurred at Grenfell Tower during the early hours of 14 June 2017. Many of the experts who have given evidence to the Inquiry have indicated that they intend to carry out further research of one kind or another to validate or refine the conclusions they have reached at this stage. However, I am satisfied that there is enough information already available to enable findings to be made about the central events of the night with sufficient confidence to make recommendations at this stage and to set the direction for the investigation which the Inquiry will undertake in Phase 2. On the whole there have been fewer significant conflicts of evidence than might have been expected and most of those that have arisen can be attributed to differences in individual judgement, perception or recollection. It has been necessary to resolve such differences in the relatively few cases in which a definitive finding is required, but in many cases the differences can be noted without the need for me to decide which of two or more competing accounts is to be preferred.
- 1.17 Since the Inquiry is inquisitorial in nature, there is no burden of proof and no fixed standard by reference to which findings of fact must be made. I have therefore adopted the flexible approach that has been followed in many other inquiries. That allows me to express my conclusions in terms of the likelihood that an event did or did not occur. In some cases I have been left in no doubt that an event occurred; in others, I think it more likely than not that it did; in others, that it is possible, and so on. In my view that is likely to be more helpful and to assist the reader to understand the complex factual circumstances which the Grenfell Tower fire presented.
- 1.18 Some areas of investigation have given rise to clear conclusions, sometimes without any serious dispute. In such cases I have generally not thought it necessary to describe the evidence in great detail, since I do not think there is anything useful to be gained by doing

so. That is particularly so in cases where the evidence is of a highly technical nature and has been explained by one of the expert witnesses. All the evidence on which my conclusions are based has been published on the Inquiry's website, where it remains available to anyone who is interested in examining it. In some cases, however, public interest in the matter under consideration is such that a fuller description of the evidence is required, even though the conclusion to be drawn is clear and relatively uncontroversial. Other areas of investigation have given rise to more complex questions and in those cases I have examined the evidence in greater detail in order to explain clearly the basis of my conclusions. Again, the relevant evidence is available on the Inquiry's website.

- 1.19 One purpose of this report is to set out in definitive terms, as far as is currently possible, the course of events at Grenfell Tower between 00.54 when the fire in Flat 16 was first reported to the LFB and 08.07 on 14 June 2017 when the last survivor escaped from the tower. That can best be done by providing a chronological narrative of events. Part II of the report contains that narrative. However, in order to enable the narrative to be properly understood, it is necessary first to describe certain aspects of the background to the events of the night, principally the building itself and the organisation of the LFB. My report therefore adopts that approach.
- 1.20 In Part III of the report I set out my analysis and conclusions in relation to the origin and development of the fire and the response of the emergency services, principally the LFB, to the disaster. In the course of doing so I identify a number of serious shortcomings in the response of the LFB, both in the operation of the control room and on the incident ground, and to a lesser extent in that of the MPS, the LAS, RBKC and the TMO. My criticisms are inevitably grounded in my findings about how various individuals acted during the course of that night, but it is right to recognise that those shortcomings were for the most part systemic in nature. I am acutely conscious that those who were on duty that evening were faced with an unprecedented situation for which they were not properly prepared and that both personnel and systems were overwhelmed by the scale of the disaster. It is right to say at the outset that those in the control room and those deployed on the incident ground responded with great courage and dedication in the most harrowing of circumstances.
- 1.21 I have also kept in mind the danger of judging with the benefit of hindsight the actions of those who were confronted on the night with a situation none of them had previously encountered. It is important to remember that they could only make use of the equipment and information available to them and were forced to respond to a situation with which, in many cases, they were ill-equipped to deal. I have been careful, therefore, to examine their response from the perspective they had of an unexpected and rapidly developing situation of a kind which none of them had previously encountered.
- 1.22 Part IV of this report is a summary of the evidence I heard in May 2018 at the commemorations of the lives of most of those who died at Grenfell Tower. As a summary it self-evidently can never do them full justice, but it is right that the memories of those who knew and loved them stand as a permanent public record of who each of them was in life.
- 1.23 Phase 2 of the Inquiry will involve investigating the underlying causes of the tragedy, but as is the case with any analysis of complex events, the distinction between the tragedy and its underlying causes is not easy to identify with precision. Much depends on the level of generality adopted. For that reason I have recognised throughout the hearings that the boundary between Phase 1 and Phase 2 should be kept flexible and, in particular, that it should be understood that much of the evidence given in the course of the Phase 1 hearings is likely to be as relevant, if not more relevant, to the issues that fall for consideration in Phase 2. That evidence has, however, been captured and will be considered in the context of the

Phase 2 investigations. In this report I have tried not to trespass more than necessary on the issues that will fall for consideration in Phase 2 and I have therefore refrained from making findings on some of the matters on which evidence was given during the hearings.

- 1.24 Rule 13(3) of the Inquiries Rules 2006, which govern the procedure to be adopted in conducting public inquiries, prevents me from including any explicit or significant criticism of a person in my report unless I have sent that person a warning letter and he or she has been given a reasonable opportunity of responding to it. The rules do not explain what is meant in this context by the expression “explicit or significant”, but I have taken the view that it should be interpreted generously in order to ensure that anyone whose conduct might be considered to have been the subject of criticism should have a chance to respond. Accordingly, in July 2019, the Inquiry’s solicitors wrote to 41 individuals and organisations informing them of the specific criticisms that I proposed to make of them and providing them with the relevant sections of the draft report which identified the evidence on which they were based.
- 1.25 In August 2019 the Inquiry received responses from all those to whom warning letters had been sent. I have considered each of those responses with care and whenever appropriate I have reconsidered the evidence on which the particular criticism was based. In many cases I have modified my provisional conclusions in the light of the responses I received, in order to avoid any unfairness. I have not, however, taken into account fresh evidence or new arguments that could have been, but were not, put forward during the hearing. It is not the purpose of rule 13 to provide those who may be criticised with an opportunity to re-open the proceedings in order to justify their conduct. Although a public inquiry is an investigative, rather than an adversarial, process, which at one level must always be open to new insights, there must be a degree of finality if the process is to reach a conclusion within a reasonable time. Rule 13 itself recognises that in so far as it provides an opportunity to respond to criticism based on the material already before the Inquiry. I hope that this will be borne in mind as the Inquiry moves into Phase 2.
- 1.26 I am conscious that the Inquiry’s hearings have been followed closely by commentators in the media as well as the public at large. Some of my conclusions are therefore likely to come as no surprise to many, although others may be more unexpected. In either case, however, I hope it will be clear that this stage of the Inquiry’s investigations has been detailed and thorough and that every avenue of inquiry relevant to this stage of the process has been fully explored. A tragedy of these dimensions deserves no less.

Chapter 2

Executive Summary

Overview

- 2.1 This first report of the Grenfell Tower Inquiry is divided into six parts. **Part I** contains a broad introduction to the events that took place during the early hours of 14 June 2017. It contains a description of Grenfell Tower itself and of the organisation of the London Fire Brigade (LFB) and sets the scene for **Part II**, which contains a detailed narrative account of the fire and the steps taken in response to it. **Part III** contains my conclusions about the origin and development of the fire and my analysis of the response of the LFB and the other emergency services which attended the incident. The hearings commemorating those who died constituted an important part of the Inquiry's proceedings. A summary of the tributes paid to their loved ones by their families and friends is contained in **Part IV**. **Part V** contains recommendations arising out of the findings made earlier in the report and **Part VI** looks ahead to identify some matters of particular importance on which the Inquiry will concentrate its attention in Phase 2.
- 2.2 I am grateful to all those who gave evidence, both those called to give evidence in person and those who provided written statements but were not called. I am very conscious that many of those who gave evidence found it a challenging and emotional experience.

Part I: Background matters

- 2.3 **Chapter 1** of the report contains a general introduction to the Inquiry. In it I explain why I decided to conduct the Inquiry in two phases and how the Phase 1 hearings were organised, beginning with commemorations of those who lost their lives in the disaster. I draw attention to the fact that the Inquiry is being conducted in parallel to investigations being carried out by the Metropolitan Police Service (MPS) and Her Majesty's Coroner for Inner London (West), Professor Fiona Wilcox.
- 2.4 **Chapter 3** describes Grenfell Tower itself, completed in 1974, and the changes that were subsequently made to the building and its immediate surroundings, culminating in the tower's most recent refurbishment, which was completed in 2016. It explains the mix of rental and leasehold properties in the tower, the community which lived there, and the different functions of the Royal Borough of Kensington and Chelsea (RBKC) as owner of the building and the RBKC Tenant Management Organisation (TMO) as its manager.
- 2.5 In **Chapter 4** there is an explanation of the principles underpinning fire safety in high-rise residential buildings, such as Grenfell Tower, which have led to the adoption of the "stay put" strategy in response to fires occurring within individual flats.
- 2.6 A summary of the primary and secondary legislation relevant to the original construction and the later refurbishment of Grenfell Tower is to be found in **Chapter 5**, together with a reference to certain aspects of the relevant guidance on methods of complying with the legislative requirements.

- 2.7 **Chapter 6** provides an overview of the refurbishment. It contains a description of the new cladding system, associated changes to the windows and their surrounds, and the addition of an architectural crown, as well as other features of the building that were intended to promote safety in the event of a fire.
- 2.8 The structure and organisation of the LFB, including its statutory responsibilities, the principles which govern its operations (particularly in relation to fighting fires in high-rise buildings) and the equipment at its disposal, are described in **Chapter 7**. That chapter also contains a description of the control room and its method of working. The chapter concludes with a description of some of the equipment used by the LFB to which reference is made in subsequent chapters.
- 2.9 **Chapter 8** refers to the Lakanal House fire, which represents an important aspect of the background to the Grenfell Tower fire. On 3 July 2009 a fire broke out on floor 9 of Lakanal House, a 14-floor building in Southwark. The fire spread rapidly to other floors and smoke affected large parts of the building. Six people died. The coroner made a number of recommendations for change following the fire, some of which were directed at the LFB. The LFB undertook a detailed internal review of its practices and policies relating to 999 call-handling in general and to those calls requiring potentially life-saving fire survival guidance (FSG calls) in particular. The review questioned whether the control room should assume that fire crews would reach FSG callers quickly and whether in general it correctly balanced the risk of staying put against the risk of attempting to escape. Despite changes in policy, similar shortcomings were displayed by the control room when responding to callers from Grenfell Tower.

Part II: The events of 14 June 2017

- 2.10 **Chapters 9 – 20**, which make up **Part II** of the report, contain a detailed narrative of the events organised into 11 separate periods between 00.54, shortly before the control room received the first call concerning a fire at Grenfell Tower, and 08.10, when the last survivor left the tower. The account relies on the evidence of survivors and firefighters, source material such as records of 999 calls, and the evidence of expert witnesses called to assist the Inquiry. Each period covers the behaviour of the fire, the events at the incident ground and in the control room, the conditions in the tower itself, the movement of the occupants, and the actions of the MPS, the London Ambulance Service (LAS), RBKC and the TMO. Annex A to Part II contains a list of those who were present in the tower as at 00.54 and the times at which they left the building.
- 2.11 The following key events form the backbone of the Narrative:
- 00.54** Behailu Kebede calls 999 to report a fire in Flat 16, floor 4 Grenfell Tower.
 - 00.59** First firefighters reach the tower.
 - 01.09** Fire breaks out of Flat 16 into exterior cladding and starts to climb the east facade rapidly.
 - 01.14** Firefighters enter the kitchen of Flat 16 for the first time.
 - 01.21** First 999 call to the control room from an occupant in the tower (Naomi Li, Flat 195, floor 22).
 - 01.25** First 999 call to report smoke coming into flat from lobby (Denis Murphy, Flat 111, floor 14).

- 01.26** MPS declares a Major Incident.
- 01.27** Fire reaches the roof and starts to spread horizontally.
- 01.29** WM Michael Dowden, the LFB incident commander, makes pumps 20 (having made up from 4 to 6, to 8, to 10 and to 15 between 01.13 and 01.28).
- 01.30** First 999 call reporting fire penetrating a flat (Mariem Elgwahry, Flat 196, floor 22).
- 01.31** WM Dowden makes pumps 25. By this time 110 out of 297 occupants have escaped; the fire starts to spread to the north elevation of the tower.
- 01.42** The LAS declares a Significant Incident.
- 01.45** First NPAS (police) helicopter arrives at the scene.
- 01.50** WM Dowden hands over incident command to SM Andrew Walton. By this time 168 of 297 occupants had escaped.
- 01.58** SM Walton hands over incident command to DAC Andrew O’Loughlin.
- 02.00** Flames travel across the north and east elevations of the tower, and start to spread around the crown and diagonally across the face of the building, affecting flats in the south-east and north-west corners.
- 02.04** GM Richard Welch declares himself incident commander, not knowing that DAC O’Loughlin has already assumed command.
GM Welch makes pumps 40.
- 02.06** GM Welch declares a Major Incident.
- 02.11** DAC O’Loughlin takes handover from GM Welch.
- 02.15** SOM Joanne Smith arrives at the control room.
- 02.17** Bridgehead moves from floor 2 up to floor 3.
- 02.20** Flames start to spread to south elevation.
- 02.26** The LAS declares a Major Incident
- 02.35** Control room decides to revoke the “stay put” advice and tell all occupants calling 999 to leave the tower.
- 02.44** AC Andrew Roe takes over incident command from DAC O’Loughlin.
- 02.47** AC Roe revokes the “stay put” advice.
- 02.50** Fire spreads horizontally across the south elevation at the crown.
Commissioner Dany Cotton arrives at Grenfell Tower.
- 03.00** Fire starts to spread across the west elevation of tower, from north to south.
- 03.08** Bridgehead relocates to ground floor lobby.
- 03.20** First Tactical Co-ordination Group (TCG) meeting.
- 03.30** Flames continue to spread across the south and west elevations of the tower.

- 04.02** Fires on the south and west elevations start to converge at the top of the southern corner of the west face.
- 08.07** Elpidio Bonifacio, the last survivor to leave the tower, is evacuated.

Part III: Conclusions

The cause and origin of the fire and its escape from Flat 16

- 2.12 In **Chapter 21** I consider the cause and origin of the fire and find that it was started by an electrical fault in a large fridge-freezer in the kitchen of Flat 16, for which Behailu Kebede bears no blame. I have not been able to establish the precise nature of the fault in the fridge-freezer, but consider that to be of less importance than establishing how the failure of a common domestic appliance could have had such disastrous consequences. That question is pursued in **Chapter 22**, in which I find that:
- a. The fire is most likely to have entered the cladding as a result of hot smoke impinging on the uPVC window jamb, causing it to deform and collapse and thereby provide an opening into the cavity between the insulation and the ACM cladding panels through which flames and hot gases could pass. It is, however, possible (but less likely) that flames from the fire in the fridge-freezer passed through the open kitchen window and impinged on the ACM cladding panels above.
 - b. The fire had entered the cladding before firefighters opened the kitchen door in Flat 16 for the first time at 01.14.
 - c. A kitchen fire of that relatively modest size was perfectly foreseeable.

The subsequent development of the fire

- 2.13 The progress of the fire after it had entered the cladding is considered in **Chapter 23**. Once the fire had escaped from Flat 16, it spread rapidly up the east face of the tower. It then spread around the top of the building in both directions and down the sides until the advancing flame fronts converged on the west face near the south-west corner, enveloping the entire building in under three hours. I find that:
- a. The principal reason why the flames spread so rapidly up, down and around the building was the presence of the aluminium composite material (ACM) rainscreen panels with polyethylene cores, which acted as a source of fuel. The principal mechanism for the spread of the fire horizontally and downwards was the melting and dripping of burning polyethylene from the crown and from the spandrel and column panels, which ignited fires lower down the building. Those fires then travelled back up the building, thereby allowing the flame front to progress diagonally across each face of the tower.
 - b. The presence of polyisocyanurate (PIR) and phenolic foam insulation boards behind the ACM panels, and perhaps components of the window surrounds, contributed to the rate and extent of vertical flame spread.
 - c. The crown was primarily responsible for the spread of the fire horizontally, and the columns were a principal route of downwards fire spread.

The loss of compartmentation and the spread of fire through the tower

- 2.14 In **Chapter 24** I consider the evidence relating to the penetration of the building by fire and smoke and the rapid loss of compartmentation. The fire on the outside of the building quickly entered many flats and smoke spread rapidly through the interior of the building. As a result, effective compartmentation was lost at an early stage. Compartmentation failed because:
- a. The intensity of the heat was such that the glass in the windows inevitably failed, allowing the fire to penetrate flats.
 - b. Extractor fan units in the kitchens had a propensity to deform and become dislodged, providing a point of entry.
 - c. A number of key fire protection measures inside the tower failed. Although some fire doors held back the smoke, others did not. Some were left open and failed to close because they lacked effective self-closing devices; others were broken down by firefighters or wedged open with firefighting equipment.
- 2.15 The spread of fire and smoke within the tower is described in **Chapter 25**. Many lobbies had started to fill with smoke by around 01.20 and some were significantly smoke-logged by 01.40. By 02.00 a significant number were heavily smoke-logged. Until around 01.50 there was less smoke in the stairs; by then 168 people had been able to escape. After that time the stairs started to fill with smoke, particularly at lower levels. At some levels the smoke was thick and the heat considerable. By 02.20 the smoke in the stairs did pose a risk to life, but the stairs were not absolutely impassable to all even after that time.

Compliance with the Building Regulations

- 2.16 It was not my original intention to include in Phase 1 of the Inquiry an investigation into the extent to which the building complied with the requirements of the Building Regulations. However, as I have explained in **Chapter 26**, there was compelling evidence that the external walls of the building failed to comply with Requirement B4(1) of Schedule 1 to the Building Regulations 2010, in that they did not adequately resist the spread of fire having regard to the height, use and position of the building. On the contrary, they actively promoted it. It will be necessary in Phase 2 to examine why those who were responsible for the design of the refurbishment considered that the tower would meet that essential requirement.

The LFB: planning and preparation

- 2.17 Planning and preparation by the LFB for fires in high-rise buildings is examined in **Chapter 27**. National guidance requires fire and rescue services to draw up contingency evacuation plans for dealing with fires in high-rise buildings that spread beyond the compartment of origin causing a “stay put” strategy to become untenable. They should understand, for any given high-rise building in their area, when a partial or full evacuation might become necessary and provide appropriate training to incident commanders.
- 2.18 The LFB’s policy for fighting fires in high-rise buildings, PN633, envisages that evacuation of a high-rise residential building may be necessary and suggests that during familiarisation visits officers consider evacuation arrangements. However, the LFB’s preparation and planning for a fire such as that at Grenfell Tower was gravely inadequate. In particular:
- a. The otherwise experienced incident commanders and senior officers attending the fire had received no training in the particular dangers associated with combustible cladding, even though some senior officers were aware of similar fires that had occurred in other

- countries, and of the fact that construction materials and methods of construction were being used in high-rise building facades with a limited understanding of their behaviour and performance in a fire.
- b. LFB incident commanders had received no training in how to recognise the need for an evacuation or how to organise one.
 - c. There was no contingency plan for the evacuation of Grenfell Tower.
 - d. Although the LFB purports to maintain an operational risk database (ORD) for buildings in London and has a risk assessment policy (PN800) accessible by all operational firefighters at an incident, the entry on the ORD for Grenfell Tower contained almost no information of any use to an incident commander called to a fire. Such information as was contained in the ORD was many years out of date and did not reflect the changes made by the refurbishment.
 - e. In some cases, basic information relating to the tower held by the LFB was wrong and in others it was missing altogether.

The LFB: at the incident ground

- 2.19 My findings about operations on the incident ground are to be found in **Chapter 28**. The firefighters who attended the tower displayed extraordinary courage and selfless devotion to duty, but the first incident commanders, although experienced, were of relatively junior rank. They were faced with a situation for which they had not been properly prepared. In particular:
- a. None of them seem to have been able to conceive of the possibility of a general failure of compartmentation or of a need for mass evacuation; they neither truly seized control of the situation nor were able to change strategy.
 - b. Once it was clear that the fire was out of control and that compartmentation had failed, a decision should have been taken to organise the evacuation of the tower while that remained possible. That decision could and should have been made between 01.30 and 01.50 and would be likely to have resulted in fewer fatalities. The best part of an hour was lost before AC Roe revoked the “stay put” advice.
 - c. The LFB continued to rely on the “stay put” strategy in place for Grenfell Tower which was not questioned, notwithstanding all the early indications that the building had suffered a total failure of compartmentation.
 - d. No systematic arrangements were made for information about the number and source of FSG calls to be communicated to the incident commanders. Similarly, information about the internal spread of the fire and the results of rescue operations was not effectively shared with incident commanders; pictures from the police helicopter were not available to them.
 - e. There were serious deficiencies in command and control. Although additional resources arrived swiftly, some senior officers failed to give sufficient practical support or inform themselves quickly enough of conditions and operations within the building.
 - f. Many of the physical or electronic communication systems did not work properly, such as the command support system (CSS) on the command units.

The LFB: in the control room

- 2.20 **Chapter 29** contains my findings about the operation of the control room. The control room staff faced an unprecedented number of 999 calls relating to the fire which posed a challenge wholly outside their long experience and training. Control room staff undoubtedly saved lives, but a close examination of the control room's operations has revealed shortcomings in practice, policy and training. In particular:
- a. LFB policy on handling FSG calls requires control room operators (CROs) to stay on the line with callers until they are rescued or can otherwise leave the building, but the number of FSG calls received during the fire far exceeded the number of CROs available, putting them in an invidious position.
 - b. Neither the application of the "stay put" policy nor the specific requirements that have to be followed if an FSG caller is to escape from a burning building are properly set out in the LFB policy documents.
 - c. CROs did not always obtain necessary information from callers, such as flat numbers, the number of people present, or whether people were disabled; nor did they always assess conditions at the callers' locations and hence the possibility of their escape.
 - d. CROs had not been trained to handle numerous simultaneous FSG calls, on the implications of a decision to evacuate, or on the circumstances in which a caller should be advised to leave the building or stay put. They were not aware of the danger of assuming that crews would always reach callers, which was one of the important lessons that should have been learnt from the Lakanal House fire. As a result, they gave assurances which were not well founded.
 - e. When the "stay put" advice was revoked and occupants were to be told to leave the building, the CROs did not all understand that they had to give that advice in unequivocal terms so that the caller would know that they had no choice but to leave the building.
 - f. Channels of communication between the control room and the incident ground were improvised, uncertain and prone to error. CROs did not therefore know enough about conditions in the tower or the progress of responses to individual FSG calls, so they lacked a sound basis for telling callers whether help was on its way.
 - g. Those on the incident ground did not have access to valuable information from the control room. The very fact that CROs had to terminate FSG calls in order to answer new calls ought to have alerted more senior control room officers to the fact that it had become impractical to give proper FSG advice.
 - h. There was no organised means of sharing information obtained from callers among the CROs, and little access to information from other sources. As a result, CROs had no overall picture of the speed or pattern of fire spread. Early on in the incident CROs told occupants that the fire was still confined to floor 4 when in fact it had reached the top of the tower.
 - i. Although the LFB has arrangements in place for handling a large number of 999 calls, routing them to other fire and rescue services, they do not provide for sharing information about conditions at the incident itself. Differing advice was given at important moments.
 - j. There were weaknesses in the supervision of control room staff. Supervisors were under the most enormous pressure, but the LFB had not provided its senior control room staff

with appropriate training on how to manage a large-scale incident with a large number of FSG calls.

- k. Mistakes made in responding to the Lakanal House fire were repeated.

The response of the other emergency services, RBKC and the TMO

2.21 The response of the other emergency services, RBKC and the TMO is considered in **Chapter 30**, which describes the standing arrangements and protocols for joint operations between London's emergency services. It is clear that although in some respects they were implemented successfully (for example, the management of the security cordon by the MPS), the response was unsatisfactory in other respects. The evidence does not show that any death or injury resulted from these failures but they contain important lessons for future major disasters in London. In particular:

- a. The MPS declared a Major Incident at 01.26 without telling the LFB or the LAS. The LFB declared a Major Incident at 02.06 without telling the MPS or the LAS; and the LAS declared a Major Incident at 02.26 without telling the LFB or the MPS. RBKC was not told about any of these declarations until 02.42. This lack of communication was a serious failure to comply with the joint working arrangements and protocols designed for major emergencies in London.
- b. The consequence of failing to share the declarations of a Major Incident meant that the need for a properly co-ordinated joint response between the emergency services was not appreciated early enough. That in turn led to a lack of shared understanding of the nature and effect of the fire. The conversations that should have taken place between the supervisors of the different control rooms did not happen.
- c. Communication between the emergency services on the night of the fire, both remotely and on the incident ground itself, did not meet the standards required by the protocols. A single point of contact in each control room and direct communication between control room supervisors should have been established.
- d. The heli-tele downlink (the communication link with the police helicopter overhead) failed to function, which adversely affected LFB operations.

2.22 RBKC is subject to certain obligations under the Civil Contingencies Act 2004 and had a formal "Contingency Management Plan" setting out what needed to be done in the event of an emergency. The TMO had no obligations under that plan. It had its own emergency plan, but it was not activated and was in any case fifteen years out of date. As RBKC's response to the fire relied on key information held by the TMO, its plan was in certain respects ineffective. One particular cause for concern is the delay in obtaining the attendance of a Dangerous Structures Engineer (DSE), despite numerous requests from the LFB; another is the delay in obtaining plans of the building, which were not on site, not on the LFB's ORD and not available to the LFB until around 08.00.

Shutting off the supply of gas to the tower

2.23 **Chapter 31** describes the steps taken to isolate the tower from the main gas supply. Gas was supplied to the tower by Cadent Gas Ltd (Cadent). Cadent had a legal obligation to help the LFB, and had reported to the incident ground before 05.00. Fortunately, a key Cadent engineer, Jason Allday, who knew the area well, subsequently arrived unprompted, took charge, and stayed for 24 hours. Shutting off the gas to the tower ultimately involved Cadent's

cutting and capping off three substantial pipes under nearby streets supplying gas to the whole area. The work was completed by 23.40 and the remaining flames in the tower died down almost immediately.

Part IV: Remembering those who died

- 2.24 **Chapter 32** contains a summary of the tributes paid to those who died in the fire at the commemoration hearings with which the Inquiry opened. The Inquiry started its Phase 1 hearings at the Millennium Gloucester Hotel in Kensington with commemorations of all those who died and a celebration of their lives. This part of the report names each of those who died and, drawing on the evidence given by loved ones and friends, provides a brief summary of their lives.

Part V: Recommendations

- 2.25 Although Phase 1 of the Inquiry has been limited to investigating the course of events during the night of 14 June 2017 and much work remains to be done, it has already become clear that some important steps need to be taken to improve fire safety, including the response of the LFB and other fire and rescue services to major disasters, including fires in high-rise residential buildings. **Chapter 33** therefore contains recommendations arising out of the evidence heard in Phase 1 and the findings of fact based on it. It would not be appropriate to make recommendations at this stage in relation to matters that have not been the subject of investigation, such as the regime surrounding the testing and certification of building materials, even though there are grounds for thinking that changes may need to be made.
- 2.26 Chapter 33 does not lend itself to being summarised. It should be read in full, because it sets out my recommendations in detail and explains the basis on which they are being made (or in some cases why certain recommendations are not being made). In summary, however, I make recommendations for change in relation to the following matters:
- a. The information made available to fire and rescue services about the materials and methods of construction used in the external walls of high-rise residential buildings.
 - b. The arrangements made by the LFB to discharge its duties under section 7(2)(d) of the Fire and Rescue Services Act 2004.
 - c. The availability of plans of high-rise residential buildings to local fire and rescue services and the provision of premises information boxes in high-rise residential buildings.
 - d. The regular inspection and testing of lifts designed for use by firefighters.
 - e. Communication between the LFB control room and the incident commander.
 - f. The way in which fire and rescue services handle emergency calls.
 - g. The LFB's command and control procedures and use of resources, in particular the capture of information from crews returning from deployments and the sharing of information between the LFB control room, the incident commander and the bridgehead.
 - h. The communication equipment available to the LFB for use by crews deployed in firefighting and rescue operations in high-rise buildings.
 - i. The evacuation of high-rise residential buildings, including the provision of equipment enabling firefighters to send an evacuation signal to the whole or a selected part of the building.

- j. The provision of fire safety information to residents of high-rise residential buildings and the marking of floor levels in lobbies and staircase landings.
- k. The inspection of fire doors and self-closing devices.
- l. Aspects of co-operation between the emergency services.

Part VI: Looking ahead to Phase 2

- 2.27 In Phase 2 the Inquiry will seek to answer the various questions set out in the List of Issues which appears on its website, but as a result of what has been learnt from the work done in Phase 1, some questions have assumed greater prominence than had previously been thought and others have receded in importance. Accordingly, in the final chapter of the report, **Chapter 34**, there is a pointer to those aspects of the Inquiry's investigations on which, in the light of Phase 1, particular attention will need to be focused in Phase 2.
- 2.28 The first matter concerns the deceased. An important element of Phase 2 will be to complete the investigation of the circumstances in which those who died in the fire met their deaths. Many of the findings that are required by the coroner have been made in this report, but there remains the need for an investigation into the wider circumstances that can only be satisfied by the evidence that will emerge during the proceedings in Phase 2. In due course there will be an opportunity for the bereaved to draw together the threads of the evidence relating to those who died in order to enable the necessary findings of fact to be made.
- 2.29 Other matters of particular concern include:
- a. The decisions relating to the design of the refurbishment and the choice of materials.
 - b. The regime for testing and certifying the reaction to fire of materials intended for use in construction.
 - c. The design and choice of materials.
 - d. The performance of fire doors in the tower, in particular, whether they complied with relevant regulations, their maintenance and the reasons why some of the self-closing devices do not appear to have worked.
 - e. The organisation and management of the LFB, in particular in relation to the formulation of policy in the light of experience, the arrangements for training firefighters and control room staff, and the arrangements for sharing information about the particular problems associated with fighting fires in high-rise buildings.
 - f. The warnings of potential fire hazards given by the local community.
 - g. The authorities' response to the disaster.
- 2.30 It has now become clear that some aspects of the building which were at one time thought to require careful investigation did not play a significant role in the disaster and will not therefore require further examination. They include:
- a. The width of the stairs.
 - b. The supply of gas.
 - c. The supply of electricity and the history of electrical surges.

Chapter 3

Grenfell Tower and the Surrounding Area

The tower

- 3.1 Grenfell Tower is a residential tower block built in 1974. It is located in the Lancaster West Estate in North Kensington, London W11. The Lancaster West scheme was designed by the architects Clifford Wearden & Associates in the late 1960s and consisted of Grenfell Tower itself and three low-rise residential blocks, sometimes referred to as “finger blocks”, but known locally as “the walkways”. The tower was built by contractors A. E. Symes of Leyton, London; building work commenced in 1972 and was completed by 1974. Grenfell Tower is owned by RBKC.

The walkways

- 3.2 The walkways extend 150 metres south from the tower and enclose two green spaces. They are Testerton Walk, Hurstway Walk and Barandon Walk. The original design concept for Grenfell Tower was to keep vehicle and pedestrian access separate and hence there was a walkway level running above the ground level and linking the low-rise blocks to the tower. However, in the early 1990s the estate was changed to create a series of independent blocks, each with their own secure entrance and the walkway connection to Grenfell Tower was closed off by the construction of an office. Thereafter, the only access to the tower for residents was through the entrance at ground level on the south side.¹

The surrounding area

- 3.3 RBKC is an inner London Borough providing the majority of local government services. Although geographically one of the smallest boroughs in London, it is one of the most densely populated areas in Europe.
- 3.4 Grenfell Tower is located at the northern end of the Lancaster West estate. Grenfell Road runs up from the south and along the east side of Barandon Walk, towards the south-east corner of the tower. As Grenfell Road approaches the tower it turns to the west and runs towards the entrance to the tower, underneath the elevated concrete walkway which runs above the roadway. To the immediate east of the tower is Lancaster Green. To the north of the tower is Silchester Road running east-west, which joins Lancaster Road heading north-east. To the west there is a pedestrian walkway, Station Walk, which runs parallel to the underground railway line (70 metres from the tower) running south-west to north-east. Blechynden Street is also to the west and runs east-west, beyond the railway line. Latimer Road tube station is to the south-west on Bramley Road, which runs north-south and is approximately 200 metres' walking distance from the entrance to the tower.
- 3.5 This is a map of the area around Grenfell Tower at the time of its construction:

¹ Stage D Design Report Studio E, August 2013 [CCL00000028] paragraph 4.2.



Figure 3.1

The residents of the tower

- 3.6 The vast majority of the residential flats in the tower were part of RBKC's provision of social housing within the borough. As at 14 June 2017 there were 14 leaseholders of flats within the tower; the remaining flats were home to social housing tenants.
- 3.7 The occupants of the tower were a diverse group of people of all backgrounds, ages, ethnicities and origins. Some had grown up in North Kensington and had lived there all their lives. Others had come to this country as refugees, in many cases from North Africa, the Middle East, Afghanistan or further afield. Yet others had come to this country from Europe to enjoy living and working in London. Many were employed in the surrounding area or elsewhere in the capital and some had built up their own thriving businesses. No one who was present at the commemoration hearings or who read or heard their evidence to the Inquiry could fail to be impressed by their courage, their resilience and their regard for their neighbours. Together they formed a vibrant community with a strong sense of identity and considerable social cohesion.

Management of the tower

- 3.8 The TMO is a company limited by guarantee, incorporated on 20 April 1995. On 28 February 1996 RBKC entered into a Management Agreement with the TMO, under which it appointed the TMO to carry out certain housing management functions. Thereafter further agreements were entered into between RBKC and the TMO,² including Modular Management Agreements in 2006 and 2015. At all relevant times the TMO's housing management functions extended to Grenfell Tower.

² A Deed of Variation dated 7 November 2002; a Modular Management Agreement entered into on 12 June 2006; a Deed of Variation dated 1 April 2010 and a Modular Management Agreement entered into on 26 November 2015; RBKC's position statement dated 9 February 2018.

The tower on completion of construction

- 3.9 Grenfell Tower is just over 67 metres tall and has 25 storeys, including a basement and ground floor to floor 23.³ It has a plan floor area of approximately 22 metres by 22 metres. It has a central reinforced concrete core, reinforced concrete floors and perimeter reinforced concrete columns. These columns appear at each corner of the building, with two internal columns on the east and west faces and three internal columns on the north and south faces. The perimeter columns have been rotated by 45 degrees and appear as diamonds in plan. On their outer surface the columns have a ridged facing, which is a pre-cast concrete “biscuit”. This facing is permanently connected to the columns through the provision of metal wires embedded in the concrete of the columns.⁴
- 3.10 At the time of construction the exterior of the building comprised horizontal structural concrete spandrel panels, sliding aluminium-framed windows and a number of non-structural white window infill panels.⁵ The spandrel panels were solid concrete with no cavities and had an outer surface of washed aggregate. This is a photograph of the external wall of the tower before the 2012-2016 refurbishment project:⁶



Figure 3.2

³ The original building elevations appear at Fig. 4.14 of Dr Lane’s supplemental report [BLAS0000004] p. 16.

⁴ Dr Lane supplemental report at 3.1.13 [BLAS0000003] p. 4.

⁵ The material for these infill panels is currently unknown, but possibly consisted of asbestos bearing cementitious materials: Dr Lane supplemental report at 8.4.7 [BLAS0000008] p. 6.

⁶ Dr Lane supplemental report [BLAS0000008] p. 6 Fig. 8.2 (and Stage D Report by Studio E, August 2013 [RBK00018840]).

- 3.11 The following figure shows Grenfell Tower during construction, including the craning-in of the pre-cast “biscuit” cladding to the columns, the reinforced concrete columns and the horizontal structural spandrel panels:⁷

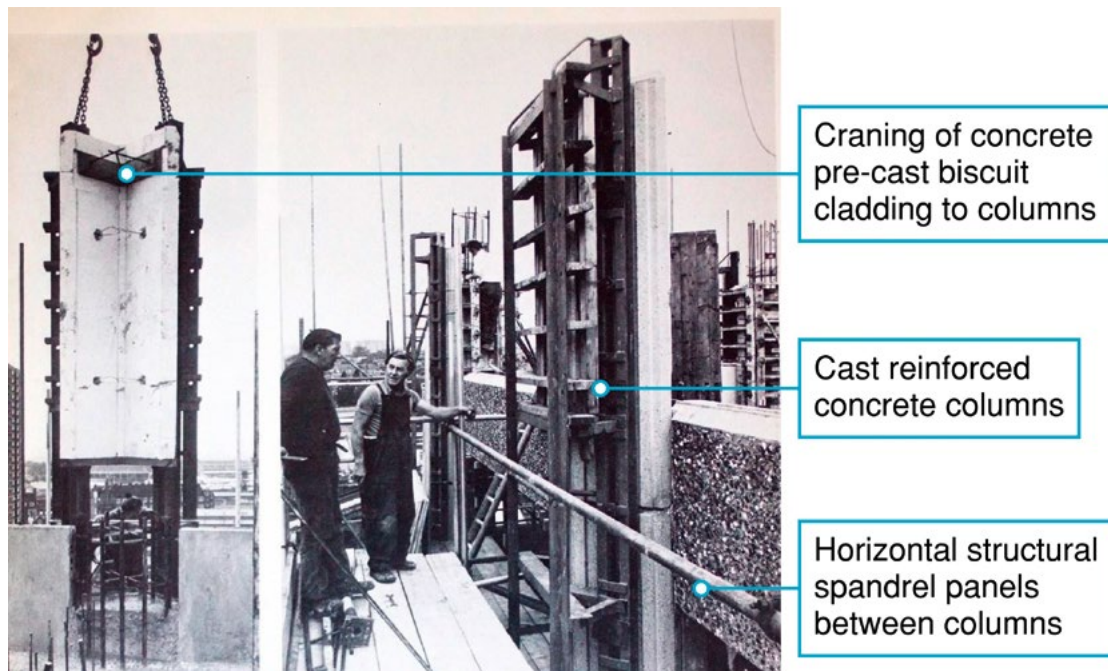


Figure 3.3

- 3.12 At the top of the building is a pre-cast architectural “crown” which consists of tapered pilasters at the tops of the columns and a ring of perforated freestanding concrete beams.⁸
- 3.13 Floors 4 to 23 were designed to accommodate residential flats, with six flats on each floor. Separating each flat at these levels are reinforced concrete cross-walls.⁹ The lower levels of the building were designed to provide more flexible community spaces, which subsequently accommodated a nursery, offices and a community health centre on the ground floor and floors 1 and 3.¹⁰ Floor 2 was originally left open as a continuation of the walkway connecting to the adjacent finger blocks.
- 3.14 The basement is a large, open plan space, 5.3 metres high, which extends over the whole footprint of the building. It also has five small blockwork inner rooms and a central concrete core area.¹¹
- 3.15 Each storey in Grenfell Tower is 2.6 metres high (floor to floor), except for floor 2, which is 4.3 metres high, and floor 3, which has a height of 3.9 metres.
- 3.16 The structural stability of the tower is achieved in a manner common to most conventional concrete buildings, with a lateral stability core in the middle of the building and concrete columns around the perimeter supporting gravity loads. Each floor has a flat, reinforced concrete slab transferring the floor loading directly to the core. At the outside of the building

⁷ Dr Lane supplemental report at 8.4.1 [BLAS0000008].

⁸ The original perforated concrete beams around the crown can be seen in Fig. 35 of Professor Bisby’s supplemental report [LBYS0000001] p. 63.

⁹ The original plan for residential levels 4-23 appears at Fig. 4.13 of Dr Lane’s supplemental report [BLAS0000004] p. 15.

¹⁰ The original plans for levels 1-3 appear at Figs. 4.10-4.12 of Dr Lane’s supplemental report [BLAS0000004] pp. 12-14.

¹¹ The original basement plan appears at Fig. 4.8 of Dr Lane’s supplemental report [BLAS0000004] p. 10.

loads are transferred into the columns directly by the floor and by the pre-cast perimeter spandrel panels. Additional support to the floor is provided by the concrete cross-walls between the flats.¹²

- 3.17 The original windows were aluminium-framed and were single glazed with a sliding opening. The metal window frames were fixed directly to the concrete structure on three sides and to the window infill panel on the fourth side. The original window sills, jambs and heads were lined in timber. Above and below the windows were panels of “Purlboard”, a product manufactured by ICI, which comprised a layer of plasterboard and a layer of polyurethane foam bonded to the rear. The strip of Purlboard above the windows extended the full perimeter of the external wall in each flat. This is a picture of the original interior finishes and windows.¹³

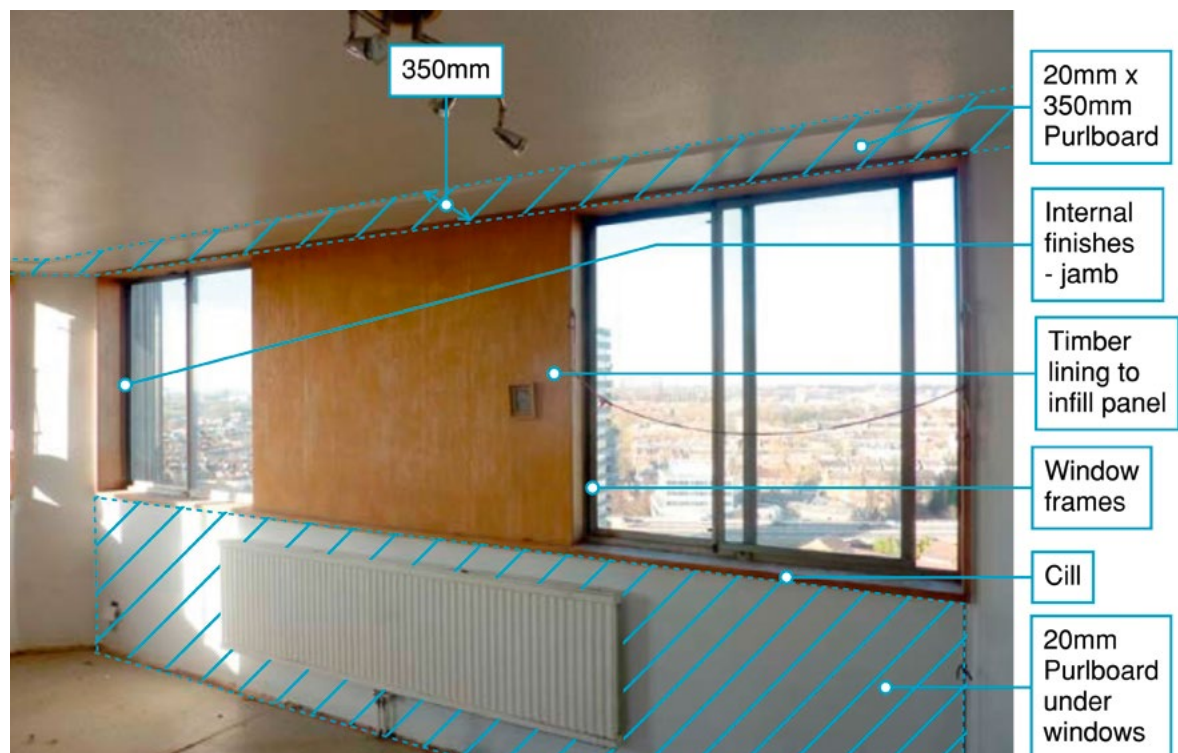


Figure 3.4

- 3.18 Within the central core of the building was a single staircase and two lifts serving each floor of the tower and opening onto a central lobby surrounded by six individual flats. This floor plan shows the layout of the floors between floors 4 and 23, which was uniform throughout those levels.¹⁴

¹² Dr Lane supplemental report at 3.1.18 [BLAS0000003] p. 4.

¹³ Dr Lane supplemental report [BLAS0000008] p. 7 Fig. 8.4.

¹⁴ Dr Lane supplemental report [BLAS0000004] p. 15 Fig. 4.13.

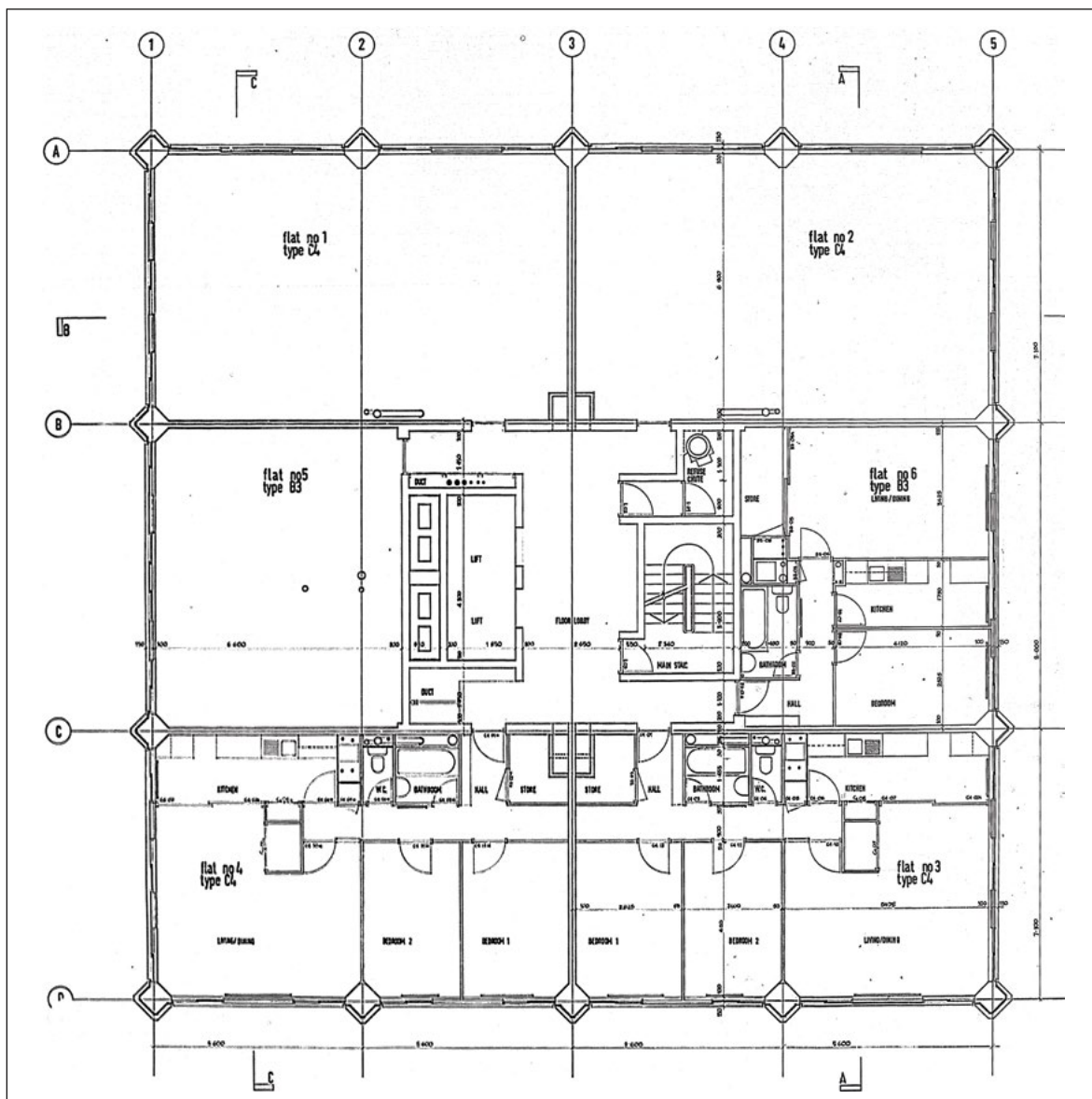


Figure 3.5

- 3.19 The building was provided with a dry rising fire main¹⁵ which could be charged or pressurised with water during firefighting operations. On floors 4 to 23 dry riser outlets were provided in the lobbies on every floor. The common lobbies in the tower were also provided with a smoke control system.

Later modifications

- 3.20 Apart from the refurbishment carried out between 2012 and 2016, a number of major works were carried out on the tower by the TMO that are relevant to the work of the Inquiry.
- 3.21 In 1985 the front doors of the flats were replaced. An application under the Building Regulations for the fitting of new self-closing, fire-resisting flat doors was made in 1985,¹⁶ but no further details are known about that work at this time.

¹⁵ This means that the pipe is not filled with water and is only charged or pressurised with water during firefighting operations. This is in contrast to a “wet” fire main where the pipe is constantly kept pressurised with water: Dr Lane supplemental report at 15.8.8 [BLAS0000015] p. 32.

¹⁶ [RBK00000275].

- 3.22 Between 2005 and 2006 both lifts were refurbished. The work appears to have included the “like for like” replacement of the two lift cars and the renovation of the lift motor room and associated equipment. It was carried out by Apex Lift & Escalator Engineers Ltd; Butler & Young Lift Consultants were the Planning Supervisors.
- 3.23 Between 2011 and 2013 the TMO carried out a programme of replacing the entrance doors to the flats on floors 4 to 23 occupied by RBKC tenants. The purpose of the work was to replace 106 flat entrance doors with fire doors which complied with relevant fire safety standards.¹⁷ The manufacturer of the doors and contractor which carried out the work was Manse Masterdor.
- 3.24 Between 2016 and 2017 a new tenant gas supply was installed to serve the “Flat 2s” in the tower (i.e. the flats in the south-east corner). The work was required because corrosion within one of the existing gas risers had led to a small leak in September 2016. The riser was isolated and a new riser was installed. The new riser enters the building on the south-east side at the basement level and rises vertically through the central staircase between floors 2 and 23. At certain floors it was necessary to install a new lateral gas pipe which passes out through the stair wall, across the lobby and into Flat 2.¹⁸ The boxing-in of this pipework in the lobbies had not been completed at the time of the fire on 14 June 2017. The work to replace this riser was commissioned by Cadent Gas Ltd, the relevant gas transporter. The new riser and laterals were designed and installed by tRiIO, a gas design, engineering and delivery business.

Changes to the surrounding area

- 3.25 One of the most significant changes to the area immediately surrounding Grenfell Tower occurred between 2012 and 2015 when a new Leisure Centre and Academy School were built to the east and north of the tower respectively. This was known as the “Kensington Academy and Leisure Centre Project”. Studio E were the architects for the project; the building contractor was the Leadbitter Group.
- 3.26 To the east of Grenfell Tower there had been a sports centre on the Lancaster Green area. It had been built in the 1970s as a swimming pool and was further developed in the mid-1980s to include a sports hall and squash courts. Between 2012 and 2015 the existing sports centre was demolished and a new leisure centre was built which included two swimming pools and a multi-use sports hall.
- 3.27 In September 2014 the Kensington Aldridge Academy opened to the north of the tower, on Silchester Road. This was part of the “Building Schools for the Future” government investment scheme. The lead sponsor was Aldridge Education; RBKC was a co-sponsor.¹⁹ The Academy has a capacity of over 1,000 students and is recognised as one of the top academies in the UK.²⁰ After the fire at Grenfell Tower, the school had to relocate for the academic year 2017-2018 and was unable to return to its original buildings until September 2018.

¹⁷ Dr Lane supplemental report at 4.6.9-4.6.10 [BLAS0000004] p. 29. The remaining flat entrance doors which were not listed for replacement in 2011 were the doors for Flats 56, 61, 86, 92, 105, 112, 142, 154, 156, 165, 166, 185, 195 and 206. Of these flats, 12 were leasehold flats and two were tenanted flats (Flats 154 and 166).

¹⁸ No laterals were required at floors 7, 15, 18, 19, 20, 22 and 23 and hence those compartment walls were not penetrated by these risers.

¹⁹ Kensington Aldridge Academy is recognised as one of the top academies in the UK. In 2017, Ofsted graded the school not only “outstanding” in all areas but “exceptional” and in 2018 it was awarded TES Secondary School of the Year.

²⁰ In 2017, Ofsted graded the school not only “outstanding” in all areas but “exceptional”.

- 3.28 Due to the presence of the Academy and Leisure Centre and the railway line to the west of the tower, the primary access route to Grenfell Tower for vehicles is Grenfell Road, that being the only route to the tower with unrestricted vehicle access. Although there are secondary access routes for vehicles via Bramley Road and Silchester Road, both of those are through pedestrianised areas, either Station Walk or a paved pedestrian area between the Leisure Centre and the Academy School which contains rising bollards.²¹
- 3.29 This is a plan view of the area after completion of the Kensington Academy and Leisure Centre Project:



Figure 3.6

²¹ Dr Lane supplemental report 17.5.20 [BLAS0000017] p. 50.

Chapter 4

Fire Safety Design and the “Stay Put” Strategy

1 Compartmentation and the “stay put” strategy

- 4.1 High-rise residential buildings pose particular difficulties for effective firefighting because their upper floors are beyond the reach of established means of external rescue and firefighting. In order to ensure the safety of those within the building, therefore, it has been necessary to include features that will enable the occupants to remain safe until a fire has been extinguished or they can be evacuated. For some time it has been the practice to incorporate many different active and passive safety measures into a high-rise building in order to provide layers of protection that reinforce each other and are capable of maintaining a safe route by which the occupants can leave the building. In most cases that will be a protected stairway.
- 4.2 The principle of the design known as “compartmentation” lies at the heart of these safety features. In essence it involves creating within the building a series of self-contained living spaces (usually individual flats) which are separated from all other similar spaces and from the common parts by fire-resisting barriers (walls, floor and ceiling), so that if a fire breaks out within one space it can be contained within that space for long enough to enable the fire and rescue service to extinguish it before it spreads to other parts of the building.
- 4.3 The concept of compartmentation, combined with other supporting fire safety provisions, has given rise to the “stay put” strategy, under which, in the event of a fire elsewhere in the building, the occupants are advised to remain within their own flats unless they are directly affected by fire, heat or smoke. This safety strategy reflects the assumption that where traditional construction methods are used, a fire in such a building will usually be contained within the flat of origin and that it is safer for the occupants of other flats to remain where they are rather than leave the building.
- 4.4 In its original form the design and construction of Grenfell Tower fully reflected these principles, which can be traced back at least as far as the beginning of the construction of high-rise residential buildings in the post-war years. The 1962 British Standard Code of Practice 3, Chapter IV, Precautions Against Fire, Part 1 (precautions in flats and maisonettes over 80 feet), provided that:
- “The assumption should no longer be made that buildings must be evacuated if a fire occurs, and high rise residential buildings should, therefore, be designed so that the occupants of a floor above a dwelling which is on fire may, if they choose, remain safely on their own floor. It may be necessary to evacuate the floor on which the fire occurs, and in some circumstances those floors which are in the immediate vicinity of the fire, but the occupants of these floors should be free to reach safety in any other part of the building via the staircase.”
- 4.5 In 1971, at around the time that Grenfell Tower was being designed, the British Standard Code of Practice CP3, Chapter IV Part 1 Flats and Maisonettes (in blocks over two storeys) stated that:
- “It has become apparent, and generally agreed, that external rescue by the fire service may not always be possible from blocks of flats and maisonettes, even when the dwellings are in reach of escape ladders ... Also, the assumption should no longer be made that entire buildings, or even adjoining dwellings, need to be evacuated if a fire occurs. Owing to the high degree of compartmentation provided in dwellings in modern blocks, the spread of fire and smoke from one

dwelling to another and the need to evacuate the occupants of adjoining dwellings are unusual. The occupants should be safe if they remain where they are. Nevertheless the possibility that individuals may seek to leave the building cannot be overlooked and provision should therefore be made for the occupant of any dwelling to do so by his own unaided efforts, using adequately protected escape routes within the building without outside assistance.”

- 4.6 As Dr Barbara Lane said, this expression of the “stay put” strategy in CP3 1971 was a building safety condition, but it was dependent on the proper installation and operation of active and passive fire protection measures, such as fire-resisting construction around front doors, lobbies and the protected stairway.¹
- 4.7 In order to understand the actions of the LFB on the night of the Grenfell Tower fire, and in particular the decisions and actions of those on the incident ground and in the control room, it is necessary to consider how the “stay put” strategy was reflected in the guidance and policy documents in circulation at the time of the fire.

2 Guidance for building owners

- 4.8 Following the fire at Lakanal House in July 2009, to which I refer in more detail below, the Local Government Association published guidance for building owners entitled Fire Safety in Purpose-Built Blocks of Flats (“the LGA guidance”). It was commissioned by the DCLG and published after wide consultation, including among the DCLG itself and the Chief Fire Officers’ Association. It included the following passage:

“18.2 Compartmentation requires a higher standard of fire resistance than that normally considered necessary simply to protect the escape routes. This is to ensure that a fire should be contained within the flat of fire origin. Accordingly those in flats remote from the fire are safe to stay where they are. Indeed, in the majority of fires in blocks of flats, residents of other flats never need to leave their flats.

18.3 This is the essence of the “stay put” principle. It has underpinned fire safety design standards from even before the 1960s, when national standards were first drafted. It is still the basis on which blocks of flats are designed today. In the majority of existing blocks, it remains entirely valid.”

- 4.9 Compartmentation has thus been an essential feature of the design of high-rise residential buildings for over 50 years and the “stay put” strategy, which is integral to that, has in general proved to be sound (although there have been important exceptions, such as the Lakanal House fire).
- 4.10 Paragraph 19 of the LGA guidance points out that the alternative to a “stay put” strategy is one that involves simultaneous evacuation, which requires a means of alerting residents to the need to leave the building. Purpose-built blocks of flats are not normally provided with general fire detection and alarm systems because experience has shown that most residents do not need to leave their flats when there is a fire elsewhere in the building. Indeed, in some circumstances they might place themselves at greater risk if they were to do so.
- 4.11 Paragraphs 18 and 19 of the LGA guidance suggest that the risk inherent in the absence of a fire-detection and alarm system in high-rise blocks is acceptable because it is very rare for there to be an extensive failure of compartmentation. That view is consistent with the absence from Approved Document B of any suggestion that high-rise residential buildings should be fitted with a means of communicating with all occupants simultaneously in order to facilitate a total evacuation. Indeed, total evacuation of a high-rise residential building is inconsistent with the principle underlying Approved Document B, which is that proper

¹ Dr Lane supplementary report 3.2.15, 3.2.27, 3.2.28 [BLAS0000003].

compliance with the guidance will achieve effective compartmentation and render total evacuation unnecessary. That balance of risk is carefully set out in Part A of the LGA guidance (particularly paragraphs 12 to 14) and is based on historical statistics. It appears to have been endorsed by central and local government and by fire and rescue services.

3 Guidance for fire and rescue services

- 4.12 Guidance for fire and rescue services on fighting fires in high-rise residential buildings was published by the DCLG and the Chief Fire and Rescue Adviser in February 2014 in the form of Generic Risk Assessment 3.2 entitled “Fighting fires in high rise buildings (GRA 3.2)”. For present purposes, it is sufficient to note that it clearly contemplated the possibility that total or partial evacuation of a high-rise building might be necessary if compartmentation failed and required contingency plans to be formulated and training to be provided to enable fire and rescue services to take appropriate action in such an eventuality.

Chapter 5

The Regulatory Context

- 5.1 When Grenfell Tower was built in the early 1970s, London had its own system of building legislation, comprising the London Building Acts 1930-39 and associated by-laws which imposed technical requirements in relation to the performance of roofs, walls and other parts of buildings when exposed to fire.¹ It was not until 1985 that building work in inner London was brought within the scope of the general Building Regulations. Section 34 of the London Building Acts (Amendment) Act 1939 (the 1939 Act) set certain requirements in relation to the means of escape in case of fire and section 20 imposed additional fire safety requirements for tall buildings. Designers of buildings could obtain assistance in discharging the relevant statutory obligations from guidance published by the London County Council and the Greater London Council² and national guidance, in particular from British Standard Code of Practice CP3.³ According to Dr Barbara Lane, certain features of the building suggest that the architect was looking primarily to British Standard Code of Practice CP3 1971 when designing the building. In particular, CP3 1971 permitted the construction of high-rise residential buildings with a single stairway and a cross-ventilated single lobby on each floor. Travel distances up to 15 metres between residential apartments and the entrance to the escape route were permitted. In addition, section 20 of the 1939 Act and the associated Code of Practice required certain provisions to be made in the stairs for firefighting.⁴
- 5.2 By the time the main refurbishment of Grenfell Tower was carried out between 2012 and 2016, the Building Act 1984 (the 1984 Act) and the Building Regulations 2010 made under it governed the construction of such buildings. Pursuant to section 1 of the 1984 Act, the Secretary of State has power to make Building Regulations for a number of broad purposes, including securing the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with them. The Building Regulations 2010 do not contain technical requirements, but set out in Schedule 1 a series of functional requirements which must be achieved, thereby allowing flexibility in the means by which the requirements are satisfied.⁵
- 5.3 Regulation 4(1)(a) of the Building Regulations 2010 requires building work to be carried out so that it complies with the applicable functional requirements in Schedule 1. "Building work" for these purposes includes the material alteration of an existing building, i.e. an alteration that would result in its ceasing to comply with a relevant requirement or becoming more unsatisfactory in relation to a relevant requirement than it was before (regulations 3(1)(a) and (2)).

¹ [CTAR00000001] pp. 8-10 at 2.2-2.18; [BLAS00000003] pp. 8-10; [BLAS00000004] pp. 17-22.

² The key London guidance was contained in (1) the London County Council (LCC) Guide "Means of Escape in case of Fire 1954" (amended in 1967 by the Greater London Council (GLC)), (2) the GLC section 20 "Code of practice for buildings of excess height" (1970).

³ National guidance for fire precautions (and particularly means of escape) was contained in either the 1962 or 1971 versions of a British Standard Code of Practice CP3, Code of basic data for the design of buildings, Chapter IV, Precautions against fire. This national guidance was relevant to the Public Health Act 1961 and the Building Regulations 1965.

⁴ The concrete depth to the stairs suggests e.g. that the higher standard of fire resistance required in the section 20 Code was, in fact, provided. Refer to Dr Lane [BLAS00000004] pp. 20-21 4.2.23-4.2.39, Appendix H [BLAS00000029] for a comparison of the section 20 Code and CP3 1971 requirements and also her oral evidence at Day 79/16/9-19/6.

⁵ Todd [CTAR00000001] pp. 10-12 at 2.19-2.34.

- 5.4 Requirement B3(4) of Schedule 1 is that the building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited. Requirement B3(3) requires measures to be taken, to an appropriate extent where reasonably necessary, to inhibit the spread of fire within the building and to subdivide the building with fire-resisting construction. Requirement B4(1) is that the external walls of the building shall adequately resist the spread of fire over the walls.
- 5.5 Section 6 of the 1984 Act provides for publication by the Secretary of State of documents providing practical guidance with respect to the requirements of the Building Regulations. That practical guidance is contained in a series of Approved Documents issued by the Secretary of State which refer to British Standards and other guidance material. Approved Document B (ADB) provides that practical guidance in relation to fire safety by setting out methods which, if correctly followed, can be expected to result in compliance with the Building Regulations.
- 5.6 The current version of ADB is that published in 2006 as amended in 2007, 2010 and 2013.⁶ A person designing a building is not obliged to follow its recommendations relating to methods of compliance and may choose to adopt other methods or materials provided that the building when completed complies with the functional requirements of the Building Regulations.⁷
- 5.7 Paragraph B3(3) of Schedule 1 to the Building Regulations requires measures to be taken, to an appropriate extent where reasonably necessary to inhibit the spread of fire within the building, to subdivide the building with fire-resisting construction. Such measures are likely to include the provision of fire-resisting partitions and doors. Table B1 of ADB 2010 (the version in force at the time the front doors to the flats in the tower were fitted) sets out the guidance on the standards to be met by fire doors. It recommends that if a door is in a compartment wall which separates a flat from a space in common use, it should have a minimum performance of “FD 30S” when tested in accordance with BS 476-22 (i.e. be capable of resisting fire under test conditions for a minimum of 30 minutes and limit the leakage of smoke to a prescribed extent). Paragraph 2 of Appendix B also recommends that (with certain limited exceptions) all fire doors should be fitted with self-closing devices. Similar provisions were contained in ADB 2013 current at the time of the fire.

⁶ Todd [CTAR00000001] p. 15 at 2.51.

⁷ Todd [CTAR00000001] p. 11 at 2.25.

Chapter 6

The Refurbishment

1 An overview

- 6.1 The most significant development, both in terms of the history of the building and relevance to the fire on 14 June 2017, was the refurbishment carried out between 2012 and 2016 (the main refurbishment). During that period Grenfell Tower underwent substantial change. The work affected both the outside and the inside of the building. Most significantly, it incorporated the over-cladding of every storey of the existing building with a new insulation and rainscreen cladding system.
- 6.2 Planning permission was first sought in 2012 and a lead contractor, Leadbitter Construction Ltd, was appointed. However, after a further procurement process, in June 2014 Rydon Maintenance Limited (Rydon) was eventually appointed the design and build contractor.
- 6.3 The architect for the main refurbishment was Studio E; the Employer's Agent and Quantity Surveyor was Artelia Projects UK Limited (Artelia). The cladding subcontractor to Rydon was Harley Facades Ltd (Harley) (which succeeded Harley Curtain Wall Ltd). Some specialist fire engineering services were provided during the project by Exova Warringtonfire.
- 6.4 The client for the refurbishment works was the TMO. The works were funded by RBKC which released the funds for the project in May 2012. The Department of Building Control at RBKC acted as building control authority, conducting a number of inspection visits between August 2014 and July 2016. The Building Certificate for completion of the works was signed by RBKC on 7 July 2016.
- 6.5 In addition to the over-cladding of the building, there was a full refurbishment internally of the very lowest floors from the ground floor to floor 3 inclusive, including structural works. This included the creation of nine new flats on these lower floors and the relocation and refurbishment of the existing nursery and boxing club. Soft and hard landscaping works were also carried out in the area immediately surrounding the tower.
- 6.6 Building services works were carried out within every floor and within every flat. The mechanical and electrical services (M&E) engineer was Max Fordham (appointed by the TMO); Rydon also engaged JS Wright & Co. Ltd (JS Wright) to carry out detailed designs and installation of the M&E works. These internal building services works included the fitting of a new heating system to all areas, the provision of a new boosted cold water distribution system and the refurbishment and extension of the existing environmental ventilation and smoke control system, together with some alterations to the lifts and dry riser system.

2 The cladding system – design and materials

- 6.7 A central part of the main refurbishment was the addition to the tower of a ventilated rainscreen insulation and cladding system. Effectively a new external wall was created by attaching a number of components to the existing concrete facade. At floors 4 to 23 they comprised insulation materials, new windows, new window infill panels and outer aluminium composite material (ACM) rainscreen panels.

- 6.8 At floors 1 to 3 the outer wall was re-clad with glass-reinforced concrete castings on the columns and other types of rainscreen panels.¹ In this report, and in what appears immediately below, it is appropriate to focus on floors 4 to 23 of the tower, because the lower external walls were not involved in the fire.
- 6.9 This is a close-up picture of the tower at the higher floors after the external cladding works had been completed:²

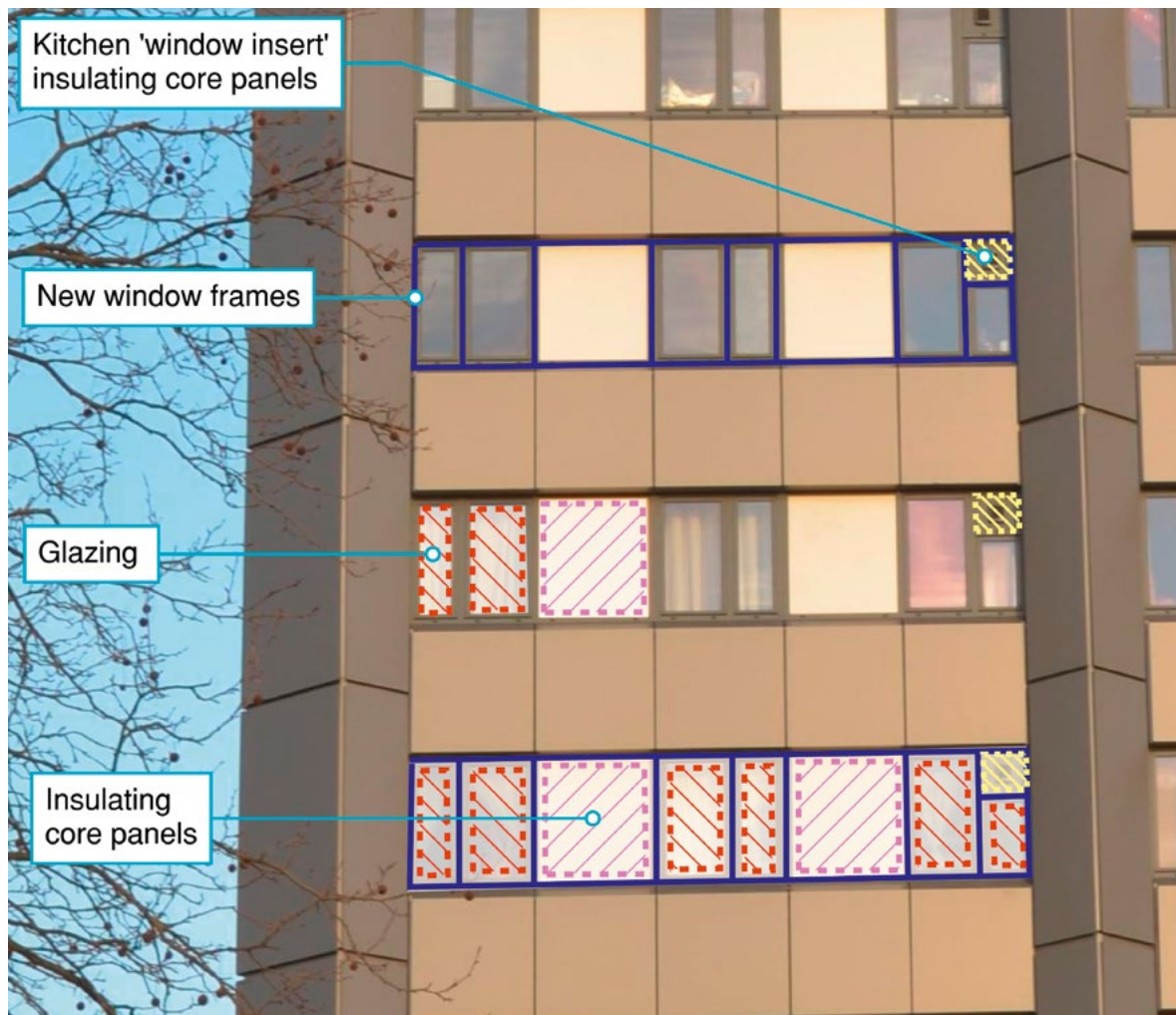


Figure 6.1

- 6.10 It will be necessary to examine in Phase 2 the precise reasons why it was decided to undertake the cladding work; no conclusions can be drawn about that at this stage. What follows below is a description of the cladding system, its design and geometry and the materials used.

The rainscreen ACM panels

- 6.11 The outer layer of the new external facade, which covered the existing concrete spandrel panels and the columns, comprised ventilated rainscreen panels made of aluminium composite material. Before being fitted to the building the panels were fabricated into “cassettes”, i.e. three-dimensional shapes which can be hung on steel or aluminium supports fixed to the

¹ Including Reynobond PE Aluminium Composite Panel RAL9010; refer to Professor Bisby at [LBYS0000001] p. 78 and CGL Wallplank (a type of ventilated rainscreen system): Dr Lane supplemental report [BLAS0000004] p. 33 Fig. 4.21.

² Dr Lane supplemental report [BLAS0000004] p. 35 Fig. 4.22.

concrete structure.³ In general this kind of system is called a “ventilated rainscreen system” because it is designed to shelter the building from the majority of direct rainfall but has gaps which are designed to permit the ventilation of the cavity behind the panels and ensure that water is collected and drained away.⁴

- 6.12 The rainscreen panels were manufactured as plain sheets by Arconic Architectural Products SAS (Arconic) and were fabricated into cassettes for use at Grenfell Tower by CEP Architectural Facades Ltd (CEP). The panels used on the columns and for the spandrels at floors 4 and above were known as “Reynobond 55 PE” Aluminium Composite Panels (ACP) and had an external finish referred to as “Smoke Silver Metallic Duragloss 5000 Satin”. Each panel consisted of a 3mm thick core of polyethylene bonded between two 0.5mm thick sheets of aluminium. To date, two different coloured PE cores have been found in panels fixed to the tower, one black and one translucent. Testing is being undertaken to establish whether there are any significant differences between the properties of these materials in terms of their reaction to fire.⁵ The results of those tests will be examined at Phase 2.
- 6.13 Polyethylene is a combustible synthetic thermoplastic polymer which melts and drips on exposure to heat. It can flow whilst burning and generate burning droplets. It has a high calorific value compared with other common construction materials and will provide a fuel source for a growing and spreading fire.⁶ It melts at 130-135°C and ignites at around 377°C.⁷ On exposure to heat aluminium melts at approximately 660°C.⁸ It has a comparatively high coefficient of thermal expansion, which means that it can be expected to warp and deform under the influence of heat.⁹
- 6.14 In the spandrel locations, the panels were formed with a 30° sloping return to the bottom of the window, and a 90° horizontal return to the top of the window.¹⁰ On all of the cut edges of the panels the polyethylene core was exposed and the polyethylene core was also exposed along the fold lines on the inside of each cassette.¹¹ At the head of the window the design incorporated a 20mm gap between the panel and the window frame.¹² The spandrel panels were hung on vertical cladding rails at approximately 1150mm centres; they were fixed to the building using steel angle pieces (at the window head and sill), brackets and cladding rails on which the panels were hung.¹³ The spandrel panels were of varying sizes depending on their locations. This is a close-up photograph of the panels on the tower:¹⁴

³ This is in contrast to a “riveted” system, where the panels are flat and are cut into pieces and are riveted or screwed onto the building through the face of the panel itself into the supporting bracket rail: Dr Lane oral evidence Day 79/118-12-119/25 and diagram [ARC00000368] p. 3, and Dr Lane supplemental report [BLAS0000008] pp. 52-53 Figs. 8.57-8.58.

⁴ A useful definition of a ventilated rainscreen system and its components appears in the British Standard Code of Practice for the design and installation of natural stone cladding and lining: Rainscreen and stone on metal frame cladding systems, BS 8298-4: 2010. It explains that such systems should include: a) an outer layer (the rainscreen) intended to shelter the building from the majority of direct rainfall, b) a cavity which can include insulation, intended to collect any water which passes through the joints and to permit such water to be collected and drained from the system, and c) a backing wall, intended to provide a barrier to air infiltration and water ingress into the building.

⁵ Professor Bisby supplemental report [LBYS0000001] p. 77.

⁶ Professor Bisby supplemental report [LBYS0000001] p. 178 paragraph 860.

⁷ Professor Bisby supplemental report [LBYS0000001] p. 101 Table 3; Professor Torero supplemental report [JTOS0000001] p. 37 Table 1.

⁸ Professor Bisby supplemental report [LBYS0000001] pp. 104-105 4.12 paragraph 461.

⁹ Professor Bisby supplemental report [LBYS0000001] p. 105 4.12 paragraph 462.

¹⁰ Dr Lane supplemental report [BLAS0000008] p. 49 Fig. 8.53.

¹¹ Professor Bisby supplemental report [LBYS0000001] p. 47 Fig. 20; Dr Lane supplemental report [BLAS0000008] p. 59 Fig. 8.65; Professor Bisby oral evidence Day 78/70-75. As explained by Professor Bisby in oral evidence, the sample ACM cassette which he was provided with had a bevelled edge (i.e. at an angle of approximately 45°), along one of its inner edges (all other edges were cut at 90°), but it was not possible to know if that was the case for other cassettes used in the refurbishment (Day 78/70/12-72/25).

¹² Dr Lane supplemental report 8.10.7 [BLAS0000008] p. 50.

¹³ Dr Lane supplemental report 8.10.9-8.10.10 [BLAS0000008] p. 51.

¹⁴ Dr Lane supplemental report [BLAS0000008] p. 51 Fig. 8.56.

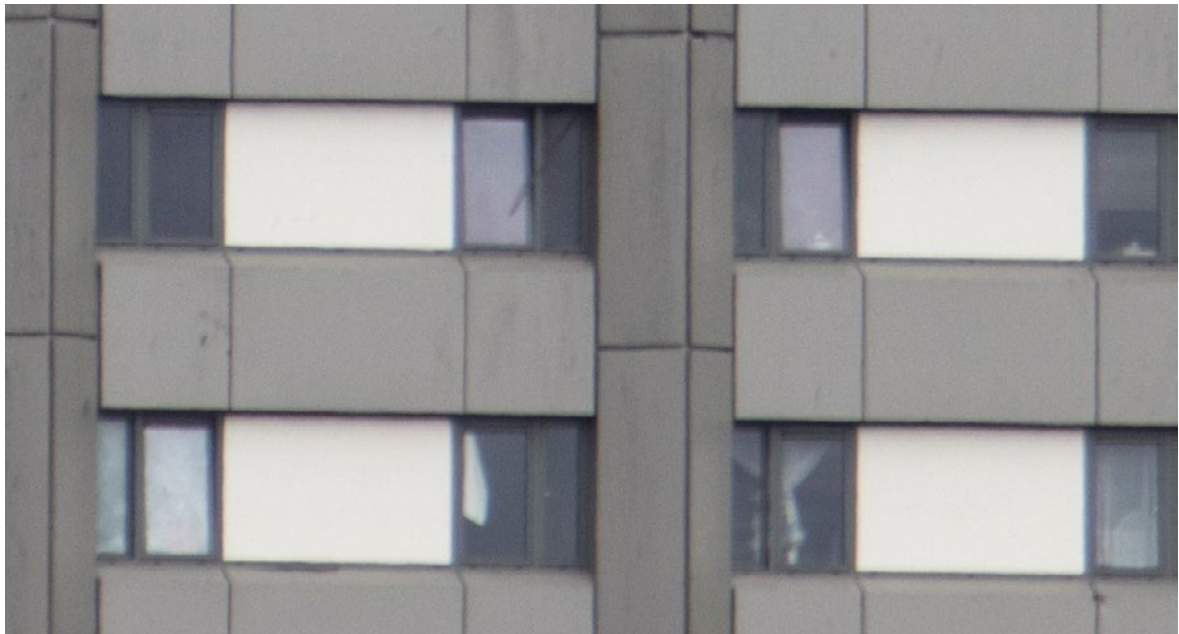


Figure 6.2

- 6.15 On the columns, the cassette panels were longer in shape, each one extending from halfway up the spandrel panel below the window, to halfway up the spandrel panel above the window, as can be seen from the image above. This meant that there was a continuous panel at the junction between the windows and the column.¹⁵ The column panels were also fixed to the face of the concrete columns using steel angle pieces and cladding rails.¹⁶ The columns were clad with one panel per face, i.e. two panels for the internal columns and three panels on the corner columns. There were gaps of between 15mm and 30mm between the panels, both on the spandrels¹⁷ and the columns,¹⁸ some of which can be seen in the image above.¹⁹
- 6.16 Dr Lane has compared the cassette panels installed at Grenfell Tower with Arconic’s standard details for modular cassette panels. There are a number of differences between the Grenfell Tower panels and standard Arconic cassette panels, including the return depth of the panel, which is significantly greater on the cassettes used on Grenfell Tower.²⁰ It appears that both the shape of the cassettes and the method of fixing were designed specifically for the refurbishment project.

Spandrel and column insulation

- 6.17 Behind both the spandrel and the column ACM panels was a layer of insulation fixed directly to the building. On the spandrels this consisted of two 80mm layers of insulation board, either Celotex RS5000 polyisocyanurate (PIR) polymer foam or (in very limited quantities) Kingspan K15 phenolic polymer foam, depending on the particular location. On the columns, the insulation consisted of one 100mm layer of Celotex RS5000 PIR. A small number of Kingspan K15 insulation boards have also been found on the columns.²¹ In some instances an additional

¹⁵ Professor Bisby [LBYS0000001] p. 55 Fig. 27.

¹⁶ Dr Lane supplemental report at 8.10.10 [BLAS0000008] p. 51 and the section view at [BLAS0000008] p. 49 Fig. 8.54.

¹⁷ Dr Lane supplemental report [BLAS0000008] pp. 58-59 Figs. 8.66 and 8.10.30.

¹⁸ Dr Lane supplemental report [BLAS0000008] p. 59 Fig. 8.65.

¹⁹ During her site investigations Dr Lane noted that the gaps between the panels ranged from 15mm to 30mm.

²⁰ 117mm on the spandrel panels compared to 50mm in the standard details: Dr Lane supplemental report at 8.10.16-8.10.27 [BLAS0000008] pp. 52-58.

²¹ Dr Lane supplemental report [BLAS0000008] 8.9.18 p. 34; Professor Bisby supplemental report [LBYS0000001] p. 84 paragraph 344; BRE Global Client Report dated 20 February 2019 [MET00039807] p. 46 paragraph 66.

piece of insulation board was located adjacent to the windows, alongside the columns,²² but that varied across the building.²³ The insulation was fixed to both the spandrels and the columns by means of 180mm stakes screwed into the face of the existing concrete.²⁴

- 6.18 Between the inside face of the rainscreen panel and the outer face of the insulation there was a space or cavity, the width of which varied from 139mm on the columns to 156mm on the spandrels. These cavities were an integral part of the design, their purpose being to allow ventilation and the drainage of any water that penetrated the gaps between the rainscreen panels. Smaller cavities, which had no design function, were also created between the flat surfaces of the insulation boards and the ridged pre-cast biscuit facing of the columns.²⁵ This is a horizontal section detail taken from Professor Bisby's report, which shows the refurbished system at the junction between the concrete spandrel beam and the concrete column:²⁶

²² Professor Bisby supplemental report [LBYS0000001] p. 44 Fig. 17.

²³ Professor Bisby oral evidence at Day 78/82/16-83/14.

²⁴ Dr Lane supplemental report [BLAS0000008] p. 28, 8.9.4.

²⁵ Dr Lane supplemental report [BLAS0000008] pp. 32-33 Figs 8.35, 8.36 and 8.9.13.

²⁶ Professor Bisby supplemental report [LBYS0000001] p. 43 Fig. 16.

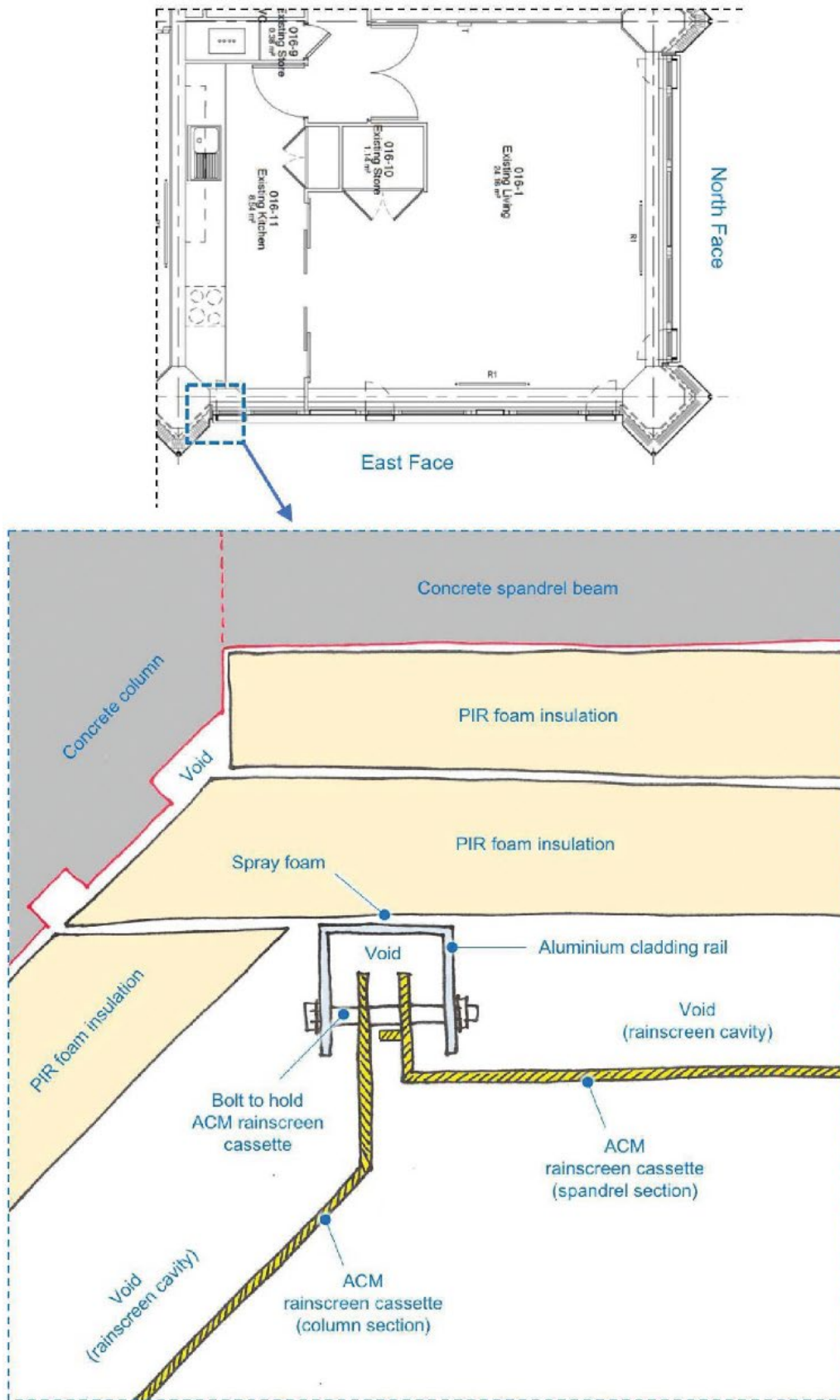


Figure 6.3

- 6.19 The front and rear faces of the insulation boards on both the spandrels and the columns were covered by aluminium foil with a thickness of less than 0.1mm.²⁷ However, the edges of the insulation boards were exposed to the atmosphere.²⁸ Although there is some evidence that foil tape was used to cover the joints between insulation boards, as shown in the photograph below,²⁹ there is currently no evidence that foil tape was used to protect the edges.



Figure 6.4

- 6.20 PIR and phenolic foam are both synthetic thermosetting polymers, which have surface temperatures at ignition in the range of 306-377°C and 429°C respectively.³⁰ Both have a low thermal inertia. (The surface temperature of a material with low thermal inertia increases rapidly when heated.) As a result, they have a comparatively low time to ignition and can support rapid flame spread. They can also accelerate the spread of flame on adjacent materials by insulating the cavity and preventing energy from being lost from the system.³¹

²⁷ Professor Bisby supplemental report [LBYS0000001] p. 80 paragraph 325.

²⁸ Dr Lane supplemental report [BLAS0000008] 8.9.24 p. 34; Professor Bisby supplemental report [LBYS0000001] p. 147 paragraph 708 and p. 179 paragraph 871 and also Figs. 21, 25 and 84.

²⁹ Dr Lane supplemental report [BLAS0000008] p. 35 Fig 8.37.

³⁰ Professor Bisby supplemental report [LBYS0000001] p. 101 table 5 and p. 102 table 6.

³¹ Professor Bisby supplemental report [LBYS0000001] p. 101 paragraph 438.

- 6.21 An expanding polymeric spray foam was used to fill some of the gaps created at joints between insulation boards and more widely throughout the cladding system.³²

Cavity barriers

- 6.22 Siderise RH “Open State” Horizontal Cavity Barriers were installed in the facade system in both the horizontal and vertical positions.³³ These cavity barriers incorporate an intumescent strip which is designed to expand in the event of a fire and seal the gap between the barrier and the rear of the cladding.³⁴ In the horizontal position they were installed approximately 700mm below the level of the windowsills and extended over the columns at that level.³⁵ On both the columns and the spandrels they were mechanically fixed using metal support brackets which pierced the full depth of the barrier at 400mm centres.³⁶ Cavity barriers were not provided for all the columns, however,³⁷ and no cavity barriers were present at the nose of the columns,³⁸ or at the head of the rainscreen cladding (i.e. the top of the building).³⁹
- 6.23 Inspections of the cavity barriers have shown that:
- they were not continuous, because the cladding rails supporting the ACM panels broke through them at least every 1100mm;⁴⁰ and
 - in many cases they were poorly fitted, with gaps between them instead of being tightly abutted.⁴¹

3 Windows – design and materials

- 6.24 The main refurbishment also brought about significant changes to the windows of Grenfell Tower. New windows were installed on every floor. During the refurbishment the windows were moved outwards so that they no longer sat flush with the concrete but flush with the new cladding system.⁴² They were also smaller in size than the original windows. Repositioning the windows outside the line of the concrete structure without providing a non-combustible barrier between the interior of the building and the cavity within the cladding system undermined the effective compartmentation of the building.
- 6.25 These changes to the size and placing of the windows created gaps in what had as a result become part of the internal walls, as follows:

³² Dr Lane supplemental report [BLAS0000008] 8.9.6 p. 28; Professor Bisby supplemental report [LBYS0000001] pp. 89-90 paragraphs 370-372.

³³ No cavity barriers designed to be used vertically were identified on site: Dr Lane supplemental report [BLAS0000008] 8.9.53 pp. 46-47.

³⁴ Dr Lane supplemental report [BLAS0000008] 8.9.37 pp. 41-42 and Fig. 8.45; Dr Lane Day 79/143/3-15.

³⁵ Dr Lane supplemental report [BLAS0000008] p. 12 Fig. 8.8 and [BLAS0000008] pp. 38-39 Fig 8.41 and paragraph 8.9.29; Professor Bisby [LBYS0000001] p. 57 Fig. 29.

³⁶ Dr Lane supplemental report [BLAS0000008] 8.9.29 pp. 38 and 40 and Fig. 8.43.

³⁷ Dr Lane supplemental report [BLAS0000008] 8.9.54-8.9.56 p. 47 and also [BLAS0000011] 11.20.83-11.20.87 p. 83 and p. 86 Fig. 11.31.

³⁸ Dr Lane [BLAS0000010] 10.3.40 p. 21.

³⁹ Dr Lane supplemental report [BLAS0000011] pp. 87-88 Figs. 11.32 and 11.33.

⁴⁰ Dr Lane [BLAS0000008] 8.9.48 pp. 41-44 and Figs. 8.44, 8.47 and 8.48; Professor Bisby [LBYS0000001] p. 52 paragraph 243 and Figs. 25 and 29.

⁴¹ Dr Lane supplemental report [BLAS0000008] 8.9.49-8.9.51 p. 45 and Figs. 8.49 and 8.50, and also Lane Day 79/149-150. Dr Lane has also identified that horizontal cavity barriers were installed with the green manufacturer’s tape on the bottom (although this does not appear inconsistent with the manufacturer’s instructions) and she has indicated that she wishes to consider this further at Phase 2 [BLAS0000008] pp. 42-43.

⁴² Dr Lane supplemental report [BLAS0000008] p. 9 Fig. 8.6 for section views of the original and refurbished windows.

- a. Vertical gaps had previously existed between the outer corner of the concrete spandrels and the edges of the columns where the two abutted, but before the refurbishment they had formed part of the exterior wall. One result of repositioning the windows was to incorporate those gaps into the interior behind the new window frames.⁴³ In some places the gaps were filled with an expanding polyurethane foam; in others they remained open.⁴⁴
- b. Before the refurbishment there had been a sloping lip on the outside of the building beneath the windows. Another result of repositioning the windows beyond the outside line of that lip was to create a horizontal gap below the windows.⁴⁵

Spaces between windows and columns – EPDM membrane

- 6.26 The reduction in the size of the windows created a gap of between 30mm and 120mm between the sides of the windows and the adjacent columns.⁴⁶ (The variation in the size of the gap was due to the fact that the columns were not all precisely aligned vertically.⁴⁷) The gap was covered with a black EPDM (Ethylene Propylene Diene Monomer) synthetic rubber weatherproofing membrane of 1mm thickness.⁴⁸ EPDM is combustible and is thermally thin, which means it will burn quite rapidly.⁴⁹ (The best indication available at present is that it has an ignition temperature of between 180°C and 378°C, but the precise figure does not matter for present purposes.⁵⁰) The EPDM was bonded to the window frame and the face of the concrete column,⁵¹ but in some places it was bonded between the two layers of spandrel insulation.⁵² Around the columns the EPDM membrane covered the cavity between the insulation and the rainscreen panels without any additional protection.⁵³

uPVC window surrounds

- 6.27 New uPVC (unplasticised polyvinyl chloride) window sills, jambs and heads were installed around each of the windows on top of the existing timber window surrounds, which were left in place.⁵⁴ They had a uniform thickness of 9.5mm and a smooth white finish. No specific manufacturer has yet been identified. uPVC is a solid combustible polymer which begins to lose its stiffness at around 60°C and loses it entirely at about 90°C.⁵⁵ It has an ignition temperature of between 318°C and 374°C.⁵⁶ It chars when exposed to heat and generally displays limited surface spread of flame due to its high chlorine content.⁵⁷ The uPVC window surrounds were glued partly to the pre-existing timber window sills, window heads and window jambs, and

⁴³ Dr Lane supplemental report [BLAS0000009] pp. 12-13 and Figs. 9.8-9.10.

⁴⁴ Dr Lane supplemental report [BLAS0000009] pp. 12-13 and Figs. 9.8-9.10.

⁴⁵ Dr Lane supplemental report [BLAS0000009] p. 9 Fig. 9.6.

⁴⁶ Dr Lane supplemental report [BLAS0000008] p. 10 Fig. 8.7 and p. 17 Fig. 8.15.

⁴⁷ Dr Lane oral evidence Day 79/30/23-79/32/6.

⁴⁸ Dr Lane supplemental report [BLAS0000009] pp. 20-25; Professor Bisby supplemental report [LBYS0000001] p. 90 paragraphs 373-376.

⁴⁹ Professor Bisby oral evidence Day 78/133/10-13; Professor Torero oral evidence Day 77/137/3-11.

⁵⁰ Dr Lane supplemental report [BLAS0000008] 8.8.2 p. 21; Professor Bisby oral evidence Day 78/64/1-22.

⁵¹ Dr Lane supplemental report [BLAS0000008] 8.8.5 p. 22.

⁵² Dr Lane supplemental report [BLAS0000008] 8.9.7 pp. 28-29 and Fig. 8.31.

⁵³ Dr Lane supplemental report [BLAS0000008] pp. 22-23 Figs. 8.22 and 8.23.

⁵⁴ Dr Lane supplemental report [BLAS0000008] 8.7.1-8.7.11 pp. 14-16.

⁵⁵ Professor Torero [JTOS0000001] p. 36 lines 1104-1105 and p. 37 Table 1 and Professor Torero Day 77/54. Refer also to Professor Bisby's presentation on 20 June 2018 where he stated that typical day-to-day upper service temperature limits for uPVC are in the range of about 50°C and its melting temperature is between 75-105°C. Refer also to Professor Bisby oral evidence Day 78/59/6-60/19.

⁵⁶ Professor Torero [JTOS0000001] p. 37 Table 1.

⁵⁷ Professor Bisby supplemental report [LBYS0000001] p. 91 paragraph 379.

partly to 25mm insulation boards which were used to close off the opening into the cavity in the cladding caused by the repositioning of the windows. No mechanical fixings appear to have been used.⁵⁸ The new window arrangement is illustrated in the following photographs:⁵⁹

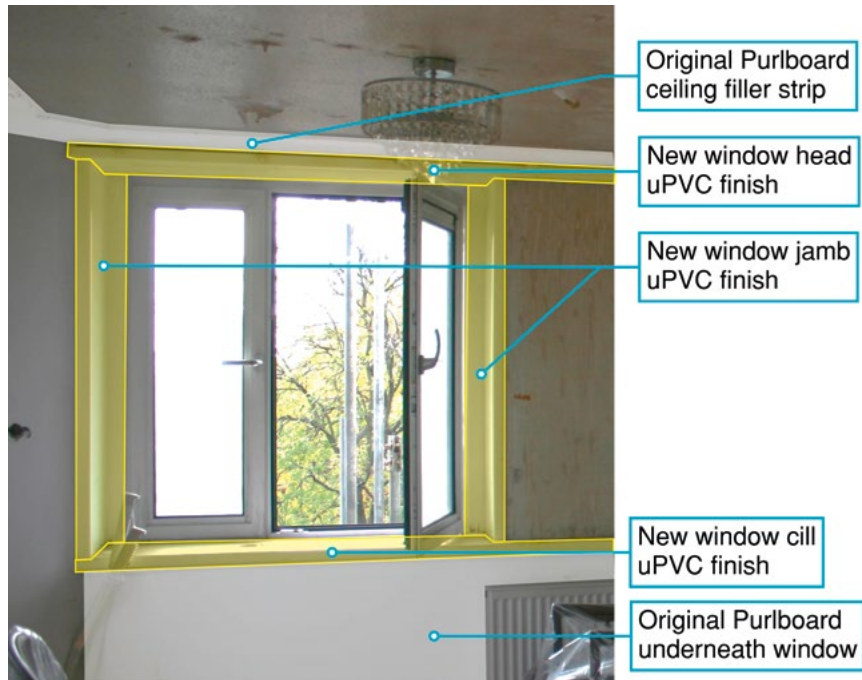


Figure 6.5

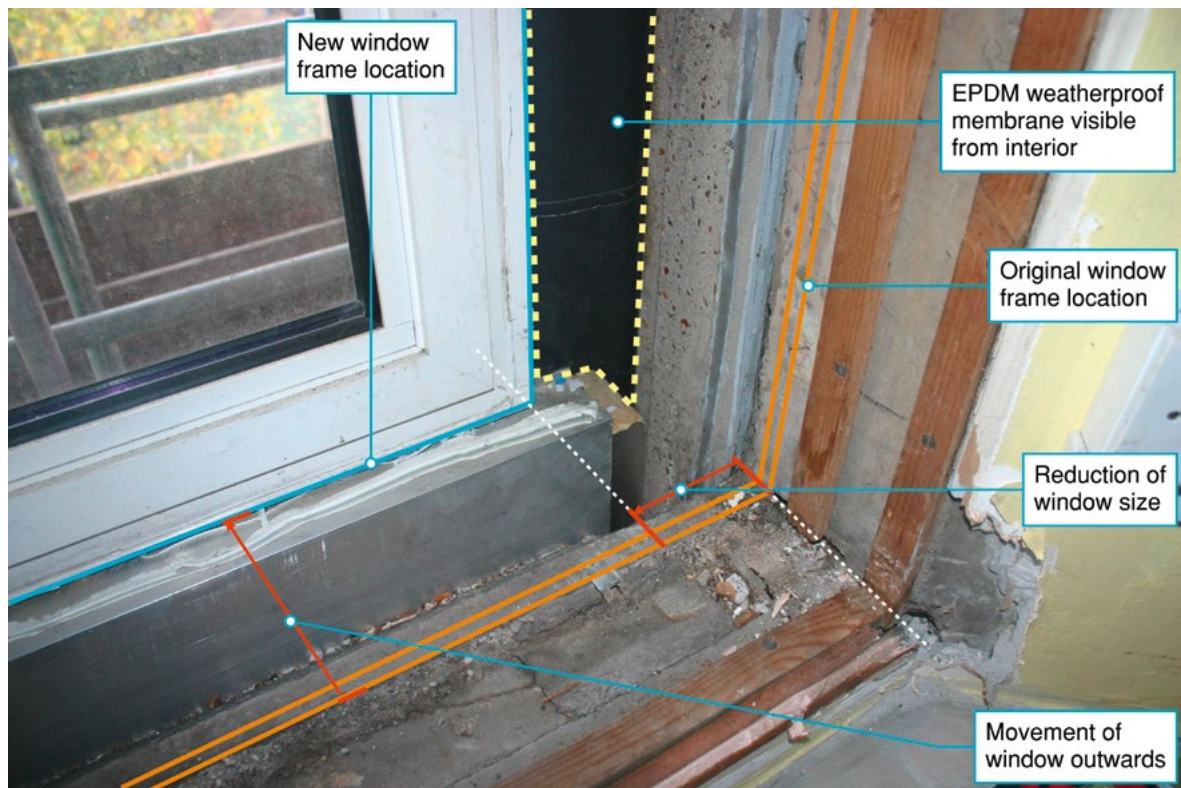


Figure 6.6

⁵⁸ Professor Torero supplemental report [JTOS0000001] p. 42 Fig. 55; Professor Bisby's supplemental report [LBYS0000001] p. 93 paragraph 384; Dr Lane Day 79/47/1; Professor Bisby Day 78/61/17-62/19.

⁵⁹ Dr Lane supplemental report [BLAS0000008] p. 16 Fig. 8.14 and p. 24 Fig. 8.25.

Window insulation

- 6.28 On both jambs and also at the head and sill of the windows, beneath the uPVC, was a 25mm layer of PIR insulation,⁶⁰ either Celotex TB4000 or Kingspan Thermapitch TP. These are both types of PIR insulation, but were much thinner products than those used on the spandrels and the columns. The position of the insulation boards around the windows can be seen from these two photographs:⁶¹

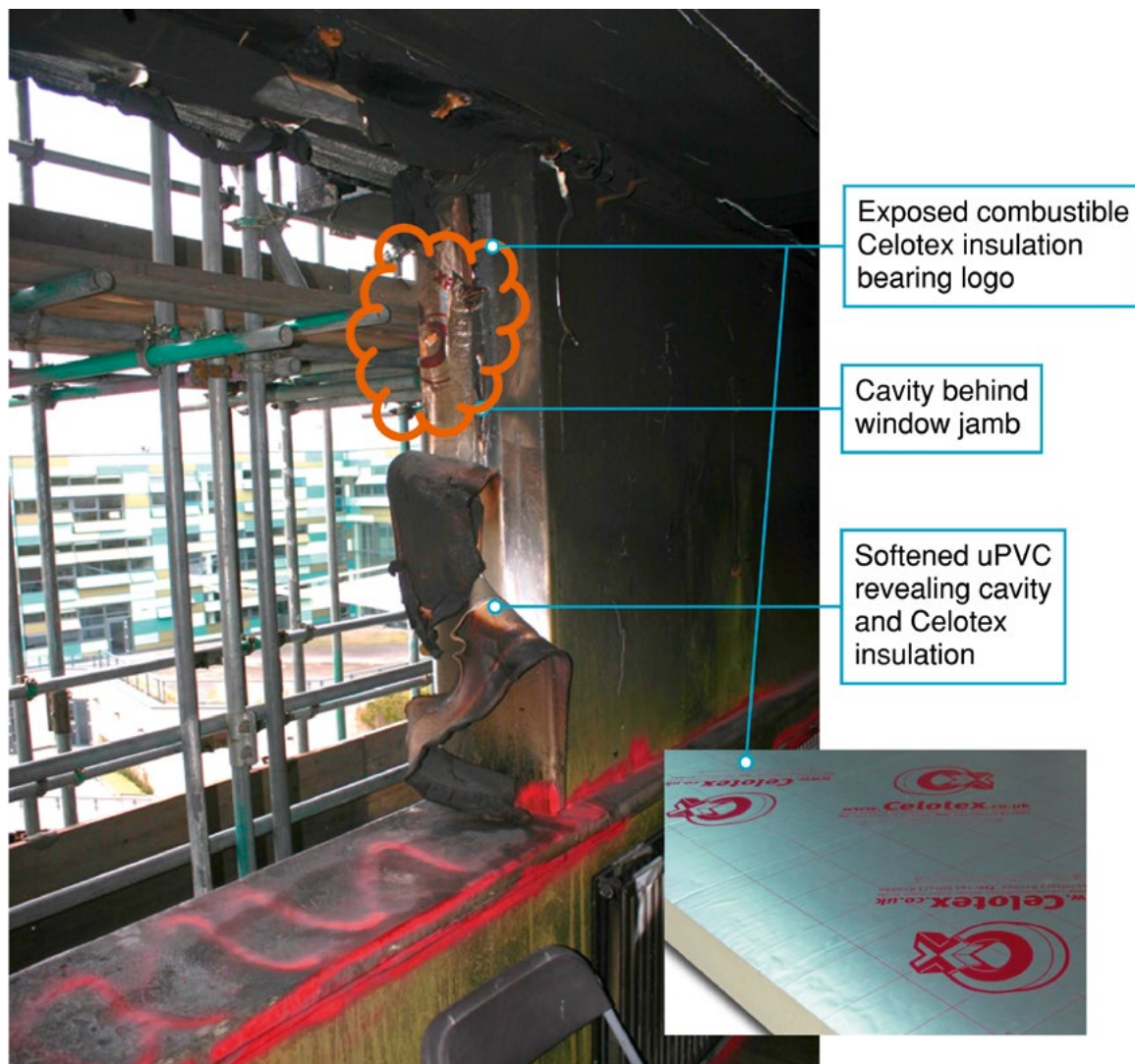


Figure 6.7

⁶⁰ Dr Lane supplemental report [BLAS0000008] p. 19 Fig. 8.18 and [BLAS0000009] p. 20 Fig. 9.13.

⁶¹ Dr Lane supplemental report [BLAS0000008] p. 19 Fig. 8.18 and [BLAS0000009] p. 6 Fig. 9.3.

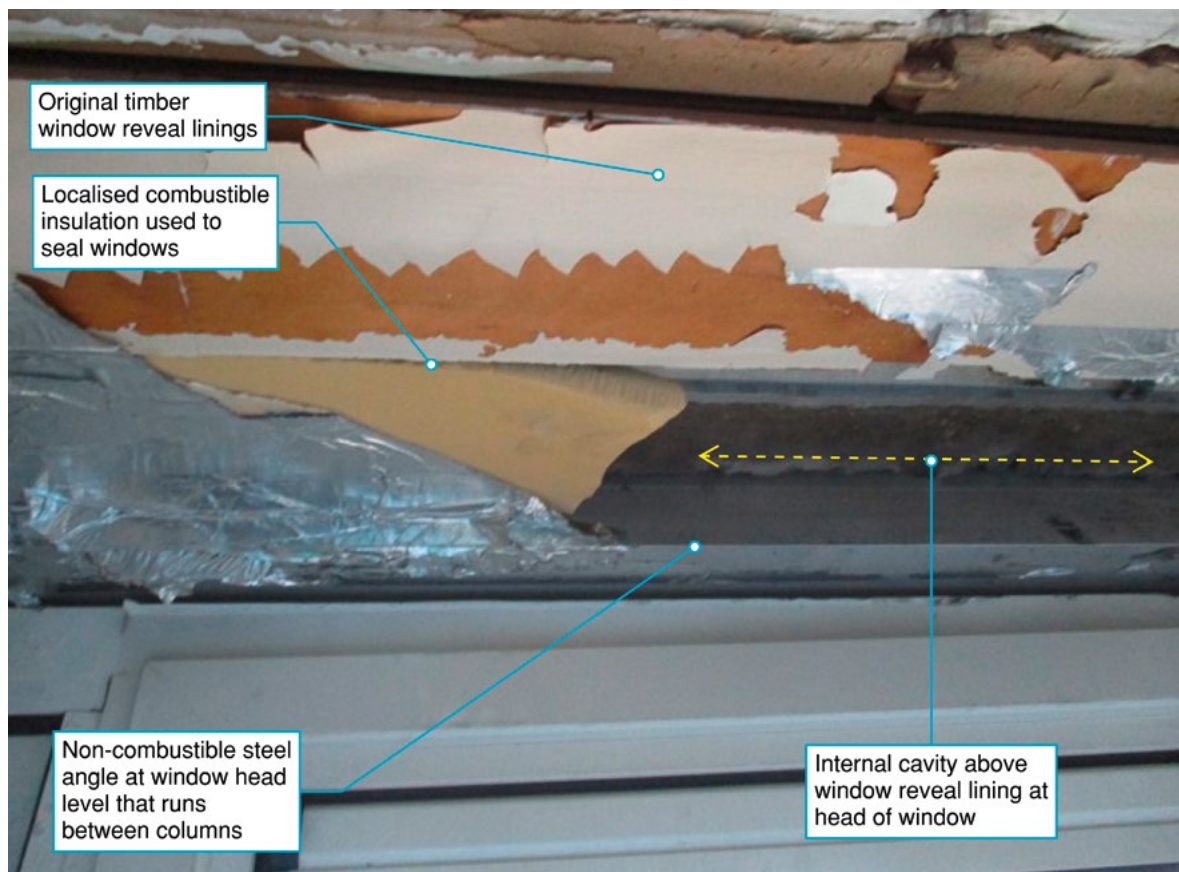


Figure 6.8

Window infill panels

- 6.29 New white “window infill panels” were installed to close the spaces between the windows. These were approximately 1318mm in height and varied in width between 820mm and 1375mm.⁶² They were also installed flush with the outer face of the new cladding system. The original window infill panels were left in place, creating a cavity between the old and the new panels.⁶³ These new panels were manufactured by Panel Systems Limited under the product name “Aluglaze”. They consisted of an insulating core of 25mm (blue) Styrofoam (extruded polystyrene, often referred to as “XPS”) between two sheets of 1.5mm thick aluminium finished with polyester powdered coating on both surfaces.⁶⁴ Such panels are sometimes referred to as “sandwich panels” or “insulation core panels”.⁶⁵ Extruded polystyrene is a closed cell rigid foam. It is a low thermal inertia thermoplastic polymer and therefore it rapidly melts at its surface when exposed to fire. When heated it is likely to form burning droplets or burn as a liquid pool.⁶⁶ It has an ignition temperature of 356°C.⁶⁷

⁶² Dr Lane supplemental report [BLAS0000008] p. 61 8.10.33.

⁶³ Dr Lane supplemental report [BLAS0000008] p. 20 Fig. 8.19.

⁶⁴ Dr Lane supplemental report [BLAS0000008] p. 61 8.10.32-8.10.36; Professor Bisby supplemental report [LBYS0000001] pp. 389-402 paragraphs 95-97.

⁶⁵ Dr Lane oral evidence Day 79/137/7-10.

⁶⁶ Professor Bisby supplemental report [LBYS0000001] p. 101 paragraph 436.

⁶⁷ Professor Bisby supplemental report [LBYS0000001] p. 101 Table 4.

Aluminium windows

- 6.30 The windows themselves were manufactured by Metal Technology Limited and sold under the name “5-20 Hi+ Tilt and Turn Polyester Powder Coating Aluminium Thermally Broken Windows”. They are made mainly of extruded aluminium. The aluminium alloys used in the production of these windows have a melting temperature of around 660°C and will not directly contribute to fire development.⁶⁸

Extractor fan and infill panel

- 6.31 Extractor fans set in an insulating core panel were incorporated into the new kitchen windows. The insulation material was again extruded polystyrene.⁶⁹ The extractor fans themselves were manufactured by Nuair as part of its CYFAN product range.⁷⁰ The body and main structural components of these fans appear to be made primarily from polycarbonate-acrylonitrile butadiene styrene (PC-ABS) plastic, which is a blended, combustible, thermoplastic polymer. The properties of that material are still being investigated.⁷¹

Method of fitting windows

- 6.32 Parts of the original window detailing were left in place, despite the installation of new windows as part of the refurbishment. In particular, the original wooden sills and wood joinery were retained beneath the new uPVC heads, sills and jambs and existing Purlboard panels above and below the windows were left untouched.⁷² The original white window infill panels were retained behind the new infill panels.
- 6.33 The following figures show the position of the original window frames together with other features of the new window arrangement, including the windows themselves, the EPDM membrane and the gaps created by the reconfiguration of the windows.⁷³

⁶⁸ Professor Bisby supplemental report [LBYS0000001] pp. 94-95 paragraph 387.

⁶⁹ Dr Lane supplemental report [BLAS0000008] pp. 62-63 8.10.39-8.10.42 and Figs. 8.72-8.73.

⁷⁰ Professor Bisby supplemental report [LBYS0000001] p. 98 paragraph 415.

⁷¹ Professor Bisby supplemental report [LBYS0000001] p. 98 paragraph 417.

⁷² Dr Lane supplemental report [BLAS0000008] p. 16 Fig. 8.14.

⁷³ Dr Lane supplemental report [BLAS0000008] p. 24 Figs. 8.24 and 8.25.



Figure 6.9

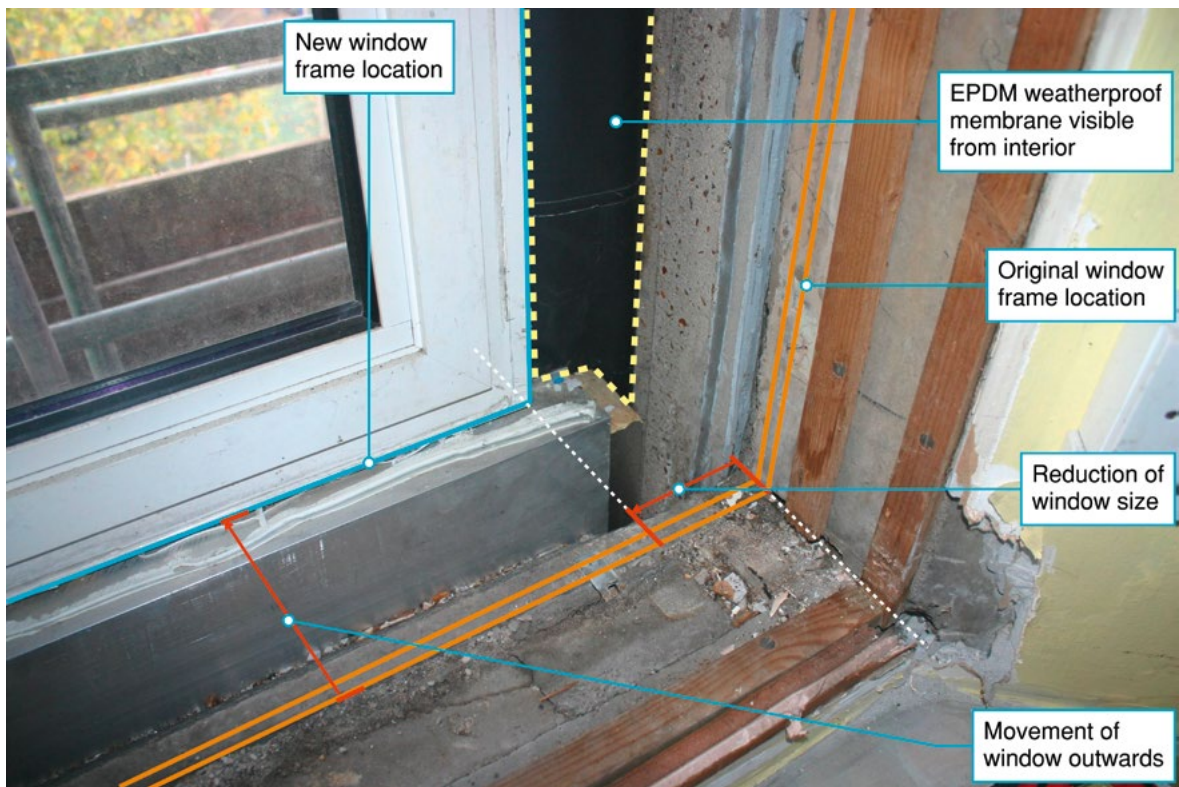


Figure 6.10

6.34 No cavity barriers were installed around the windows.⁷⁴

⁷⁴ Dr Lane supplemental report [BLAS0000011] p. 74 11.20.22-23.

4 The architectural crown

- 6.35 The refurbishment of the building also involved changes to the pre-cast concrete architectural “crown” described earlier in this report. The concrete columns and beams at the top of the tower were wrapped in a band of tall, narrow Reynobond 55 PE ACM cassettes or “fins” which extended around the perimeter of the building above level 23. The “C”-shaped fins were fixed into reverse oriented “C”-shaped aluminium channels. In addition, the tops of the columns were provided with tapered detailing using the same material. The fins and the associated structure at the crown had no functional purpose and were purely aesthetic.⁷⁵
- 6.36 Below is a design drawing of the architectural crown at roof level and showing the new “C”-shaped ACM fins and the new detailing at the top of the columns.⁷⁶

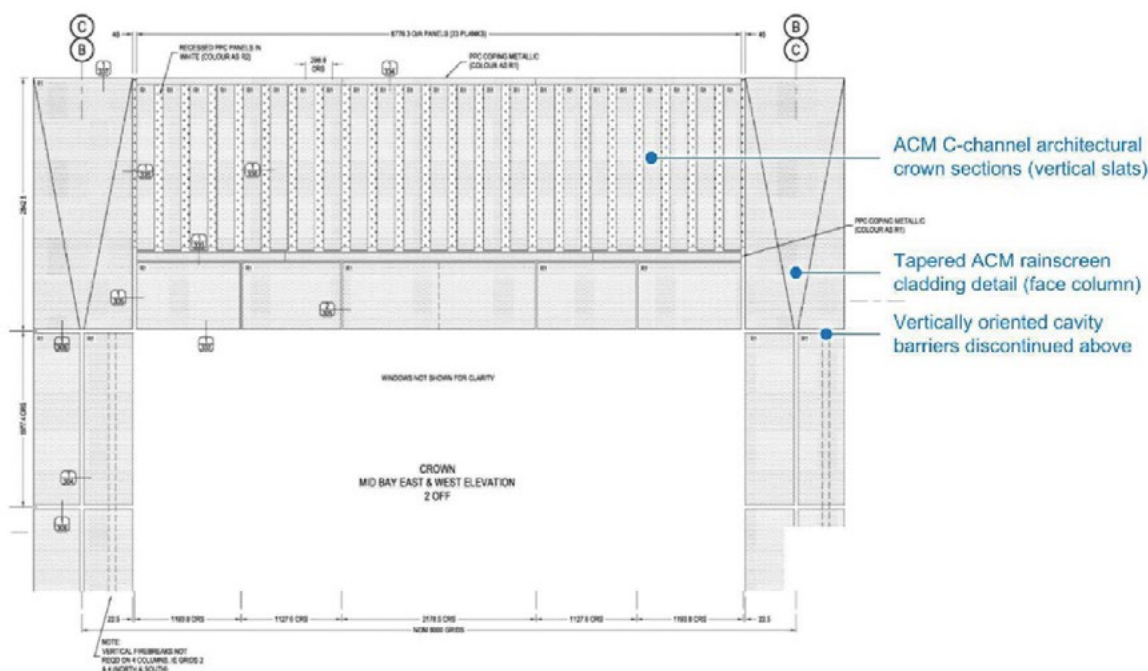


Figure 6.11

⁷⁵ Dr Lane oral evidence Day 79/87/14-23.

⁷⁶ Professor Bisby supplemental report [LBYS0000001] p. 61 Fig. 32.

- 6.37 In the following picture of the crown taken after the fire it is possible to see the remains of the ACM fins and aluminium rails, together with the original concrete behind.⁷⁷

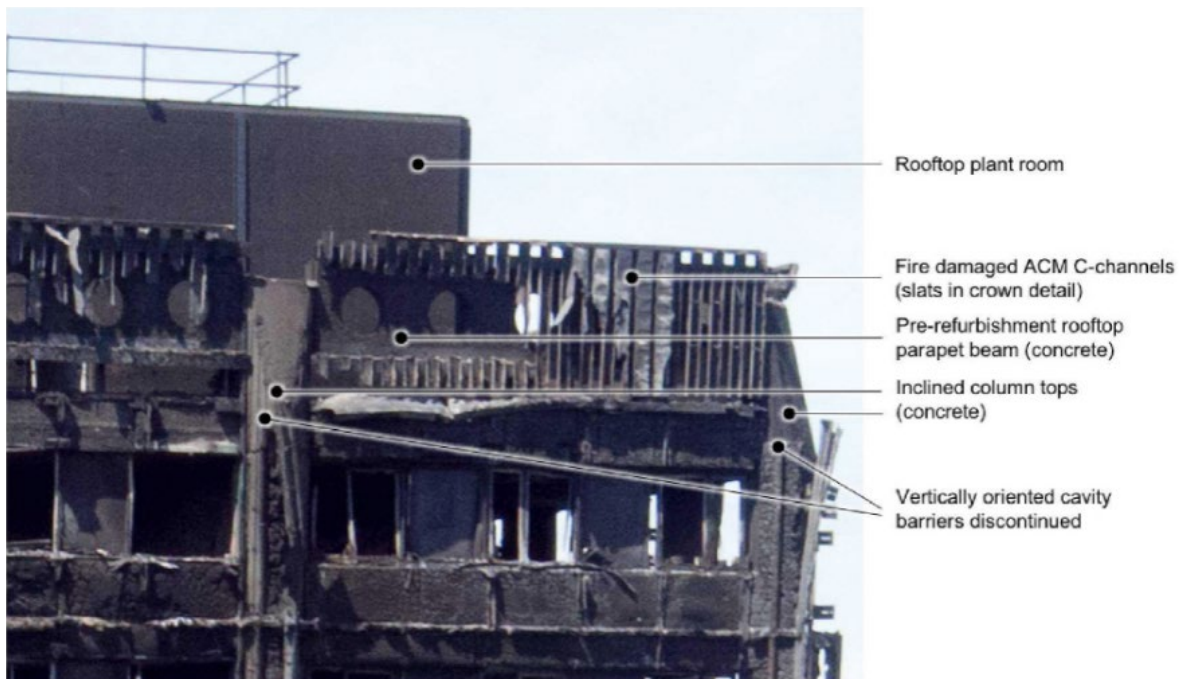


Figure 6.12

5 Other modifications

Floors 1-3: stairs and new flats

- 6.38 The main refurbishment involved significant works at the lower floors of the tower. On the ground floor an original access stair was demolished and the nursery was relocated and refurbished. A new entrance lobby was created. At floor 1 a bridge connection was made to serve that floor and at floor 2 a new access route was created to the stairs in the core of the building. At floor 2 the boxing club was reduced and refurbished and an additional flat was inserted into the south-west corner of the building. At floor 3 the stairs that originally served the floor from the ground floor were removed and new residential flats were constructed. In total nine new residential flats were created in these levels.

Lifts

- 6.39 In order to accommodate the new flats, the hydraulic lift that had served the non-residential lower floors of the building was removed and new door openings into the two lift shafts serving the main building were created at floors 1 and 3. As at the date of the fire in June 2014, there were two fire control switches; one on the ground floor between the lifts and one on the second floor.

Heating and hot and cold water systems

- 6.40 A new heating system was created for the whole of the tower as part of the main refurbishment. The existing boilers were retained to continue serving the walkways and a new central gas-fired boiler to serve the tower was installed in the basement. Six new risers were put in to

⁷⁷ Professor Bisby supplemental report [LBYS0000001] p. 63 Fig. 35.

carry hot water to all floors and a new service cupboard was created in the lobbies on every level from level 4 upwards to accommodate the risers and return piping.⁷⁸ In each lobby the pipes left the service cupboard and were concealed above a new plasterboard ceiling. They entered the individual flats through holes drilled through the concrete walls above the front door. Each existing residential flat was served by an individual heat interface unit (HIU), which was electrically operated and enabled the residents to control their heating and hot water. New pipework and radiators were installed in each flat.⁷⁹ A new boosted cold water system was also installed which distributed cold water from a plant room at roof level. This also involved installing additional pipework in each of the lift lobbies which entered flats through holes drilled through the concrete walls.⁸⁰

Environmental and smoke ventilation system

- 6.41 The environmental and smoke ventilation system was overhauled and modified as part of the main refurbishment. The original smoke control system had been designed as a “corridor smoke dispersal system” and was intended to serve one floor at a time. It was a natural ventilation system with fans providing smoke extraction in the event of a fire. There were a pair of smoke extraction shafts on the north side of the building and a pair of fresh air inlet shafts on the south side of the building. In each lift lobby there were two pairs of Automatically Opening Vents (AOVs) serving these shafts which were designed to open automatically when smoke was detected by sensors in a lobby. This allowed the extraction fans to pull smoke up the shafts on the north side of the building to the outside at roof level and fresh air to enter through the south shafts. There was also an override switch to enable firefighters to operate the system on the fire floor manually. This is a basic diagram of the original smoke control system:⁸¹

Operation of original smoke control system

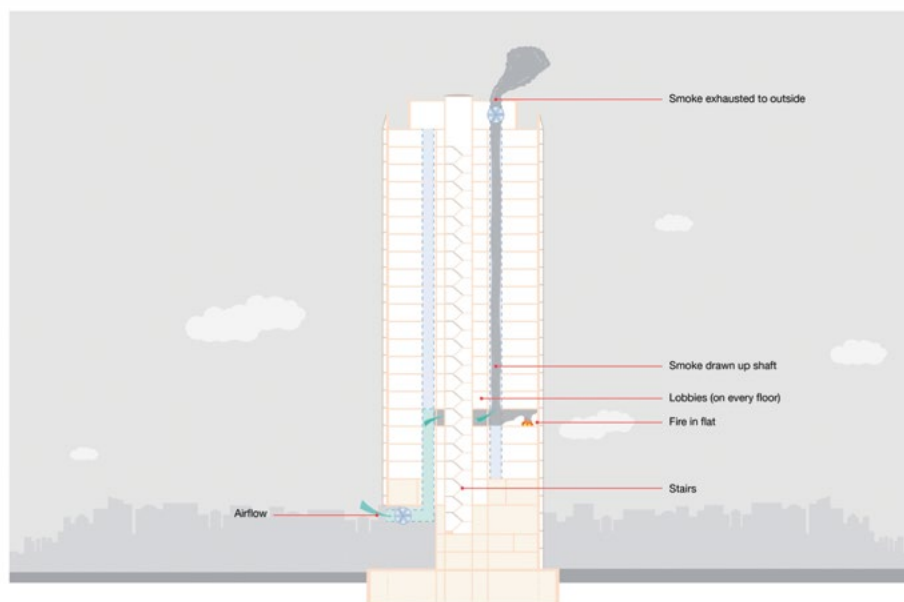


Figure 6.13

⁷⁸ Dr Lane supplemental report [BLAS0000004] pp. 42-49.

⁷⁹ Dr Lane supplemental report [BLAS0000004] pp. 47-48 4.7.60-4.7.63.

⁸⁰ For a full description of these works refer to Dr Lane supplemental report [BLAS0000004] pp. 49-53 4.7.64-4.7.73.

⁸¹ Dr Lane presentation 18 June 2018 slide 173.

6.42 During the refurbishment it became apparent that it would be necessary to provide environmental air control in the common parts of the tower because the new services installed in the lobbies could cause them to become uncomfortably warm under normal conditions. As a result, the existing smoke control system was modified to become a combined environmental and smoke control system. It was designed and commissioned by PSB UK Ltd. Under normal circumstances the new system was designed to provide ventilation to the lift lobbies by drawing fresh air up the south shafts and expelling warm air up the north shafts, but, in the event of smoke being detected in a lift lobby, it was designed to act as a means of smoke control only by drawing smoke both up the north shafts and down the south shafts with replacement air being drawn from the stairs.⁸² As in the case of the original system, it was designed to operate on only one floor at a time. In order to clear smoke, the AOVs on the floor affected would all open and those on all other floors would all close. Fans at roof and second floor level would then draw smoke out of the lobby both through the north shafts to the top of the building and through the south shafts to louvres sited above the entrance at level 2. Below is a basic diagram of the new system.⁸³

Operation of the combined lobby environmental and smoke control system

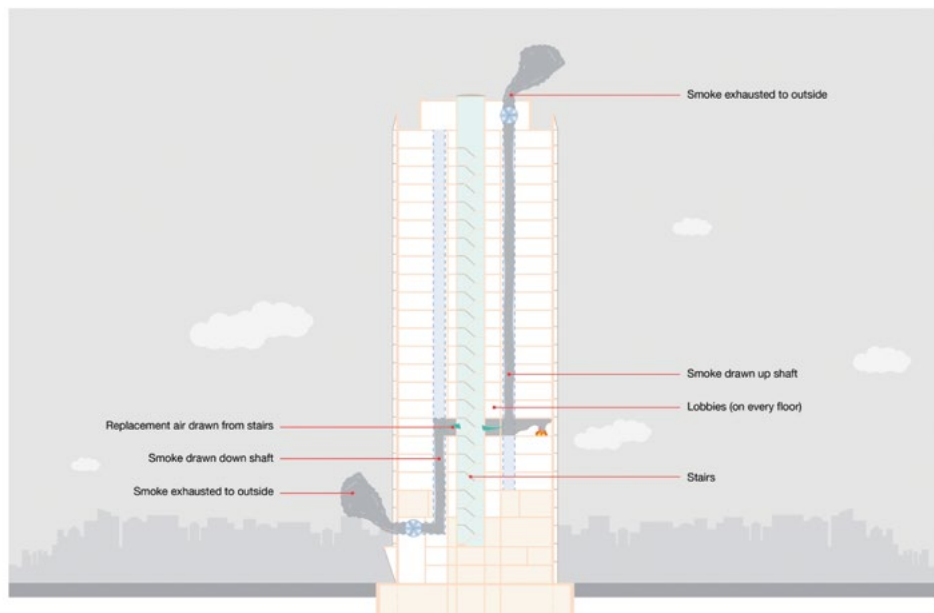


Figure 6.14

6.43 In order to provide for this new combined environmental and smoke control system, new features were introduced into the existing system including: new AOVs at floors 4 to 23, new exhaust fans and outlet on the roof, new exhaust fans at level 2, new ductwork at level 2 (connecting the south smoke shafts to louvres outside the building via smoke extraction fans), new builders' work shafts (linking the bottom of the existing smoke shafts to each of the lift lobbies), a new environmental fan on floor 2, new fan shut-off dampers, a permanently open vent head at the head of the stairs and on the ground floor, and new control panels and detectors.⁸⁴ These new control panels and detectors included a human machine interface panel ("HMI panel") located in the ground floor lobby, smoke detectors in the lobbies and

⁸² Dr Lane Day 81/129/13-22.

⁸³ Dr Lane presentation 18 June 2018 slide 179.

⁸⁴ Dr Lane supplemental report J6.5.2 [BLAS0000031] pp. 52-53.

yellow smoke vent key panels in each lobby. The latter were provided in order to enable firefighters to override the system if they wanted it to operate on a floor other than that which had been automatically selected.

- 6.44 It will be necessary to return to the design and operation of the smoke control system later in this report.

Dry rising main

- 6.45 At ground floor level the main refurbishment included provision of a new dry riser inlet to serve the existing dry rising main in the core of the building. This required new pipework on the lower floors of the tower in order to connect with the existing pipework at floors 4 and above. The original inlet valve at ground level had been located opposite the entrance, inside the building. It had served floors 4 to 23, but not floors 1 to 3. During the main refurbishment, that inlet valve was relocated to the outside of the tower to the left of the entrance on the south side. New landing valves were created at floors 1 to 3 and new branches were installed at floors 1 and 2. A new drain for the system was also created at basement level.

Landscaping

- 6.46 As part of the main refurbishment, soft and hard landscaping works were carried out around the immediate perimeter of the tower, including new areas of hardstanding and soft landscaping. To the east of the tower there was an area of hardstanding immediately adjacent to the building, with trees, grass and soft landscaping beyond. To the north was another area of hardstanding and a grassy slope which was steep enough to impede vehicle access. To the west was a children's playground and to the south was the main entrance. An extended area of hardstanding was created to the south of the building linking up with the top of Grenfell Road.

Chapter 7

The London Fire Brigade

7.1 In Part II of this report I set out in narrative form my conclusions about the origin of the fire, its development, the attempts made by the LFB to extinguish it and rescue those who were trapped in the building, and the steps taken by those in the control room to handle emergency calls relating to the incident. In order to provide the context for those Parts it is necessary to describe the organisation and structure of the LFB, the principles which govern its operations and the equipment at its disposal.

1 Statutory responsibilities

7.2 Since 1 April 2017 the London Fire Commissioner (the Commissioner) has been the fire and rescue authority for Greater London. Part 2 of the Fire and Rescue Services Act 2004 (the 2004 Act) imposes certain obligations on the Commissioner as Greater London's fire and rescue authority. They include the promotion of fire safety (section 6(1)) and making provision for extinguishing fires and the protection of life and property in the event of fires within Greater London (section 7(1)). In order to fulfil her obligations under section 7(1), section 7(2) requires the Commissioner (among other matters) to secure the provision of the personnel, services and equipment necessary efficiently to meet all normal requirements, to secure the provision of training for personnel, to make arrangements for dealing with calls for help and for summoning personnel, and to make arrangements for obtaining information needed for extinguishing fires and protecting life and property. This last obligation, imposed under section 7(2)(d), is of particular importance in relation to preparations for fighting fires in high-rise buildings.

7.3 The Commissioner is appointed by,¹ and accountable to, the Mayor of London (the Mayor).² The Mayor may also give guidance and directions (both general and specific) in relation to the manner in which the Commissioner's functions and duties are to be performed.³ Under the Greater London Authority Act 1999 (the 1999 Act) the Mayor must approve the final text of the London Safety Plan.⁴

7.4 The LFB is the fire and rescue service for Greater London. For the purposes of the 1999 Act, it comprises the personnel, services and equipment secured by the Commissioner for the purposes of carrying out her obligations, including those under sections 6 and 7 of the 2004 Act. The Commissioner is also responsible under section 327D(5) of the 1999 Act for ensuring that the LFB is "efficient and effective".

2 Structure and organisation

7.5 The LFB has some 5,500 employees, of whom 4,600 are full-time operational firefighters and officers. For organisational purposes it divides Greater London into four geographical areas, North East, North West, South East and South West. Each area comprises a number of London Boroughs.

¹ Subsection 327A(3) of the 1999 Act.

² Subsection 327A(7) of the 1999 Act.

³ Subsections 327D(1) and (3) of the 1999 Act.

⁴ Subsections 327G(2) and (3)(b) of the 1999 Act; and also the Mayor's Direction of 21 March 2017.

- 7.6 The Commissioner is the highest-ranking officer and is ultimately responsible for the running of the LFB. Immediately below the Commissioner are the following supporting ranks:⁵
- a. eight Assistant Commissioners (AC), who are responsible for managing a range of departments and services within the LFB;
 - b. 12 Deputy Assistant Commissioners (DAC), four of whom are responsible for the day-to-day management of the four geographical areas and eight of whom are responsible for operations or policy matters; and
 - c. a number of Group Managers (GM), who, if they are Borough Commanders, manage groups of fire stations or, if they are not Borough Commanders, carry out day-to-day work in specific policy areas.
- 7.7 The LFB’s operations involve two principal spheres of activity: the control room and the incident ground. In the control room the LFB takes emergency calls from the public, despatches fire appliances to incidents and maintains communications with the incident ground. At the incident ground firefighters acting under the direction of the incident commander and other officers take steps to extinguish the fire and, if necessary, carry out rescue operations.
- 7.8 Ultimate responsibility for the control room and its operations lies with the DAC for Operations; reporting to them is the Principal Operations Manager (POM). The POM is responsible for “ensuring that Brigade Control,⁶ emergency calls and the mobilising of resources are managed efficiently and effectively”.⁷ Supporting the POM are two Senior Operations Managers (SOMs) and supporting them, in descending order of seniority, are the Operations Managers (OM), the Assistant Operations Managers (AOMs) and the Control Room Officers (CROs). The SOMs have overall responsibility for the management of the control room, its staff, policies, training and procedures.⁸
- 7.9 Firefighting operations are organised around fire stations located in the various London boroughs, each under the direction of a Group Manager. At the time of the fire at Grenfell Tower there were 103 operational fire stations in London. Every fire station is on duty every day of the year. North Kensington is the nearest fire station to Grenfell Tower; the next nearest is Kensington.
- 7.10 Individual fire stations are staffed by the following personnel:
- a. a Station Manager (SM), who is responsible for the overall management of the station;
 - b. Watch Managers (WM), who are in charge of individual “watches”;
 - c. Crew Managers (CM), who are in charge of the crews of fire appliances; and
 - d. Firefighters (FF), who carry out firefighting and fire safety work.
- 7.11 Some fire stations are equipped with two appliances and some with only one. Fire stations with two fire appliances have nine firefighters on each watch and those with one fire appliance have five firefighters on each watch. Each watch is under the direction of a Watch Manager. Watch Managers are divided into two categories, “A” and “B” (the latter being the more senior). A Watch Manager B is in charge of each watch at fire stations with two fire appliances

⁵ LFB’s Glossary of Terms (Sept 2017) [LFB00000008] p. 9.

⁶ I.e. the control room.

⁷ Control Report p. 177.

⁸ Smith Day 21/3/19-25-4/1-6.

(such as North Kensington);⁹ a Watch Manager A is in charge of each watch at fire stations with one fire appliance (for example, Kensington).¹⁰ Watch Managers carry out day-to-day firefighting and fire safety work as well as junior work in policy areas.

- 7.12 Each appliance has a crew of three or four firefighters under the direction of a Crew Manager (or Watch Manager A in the case of stations with only one appliance). Crew Managers carry out routine firefighting and fire safety work. At fire stations with two fire appliances, each watch has two Crew Managers; at fire stations with one fire appliance, each watch has one. Each fire station operates a two-shift, four-watch system. The watches are denoted Red, Blue, Green and White. Each watch works a two-day shift followed by two night shifts. Each series of shifts is followed by four days off. The change between the day and night shifts occurs at 09.30 and 20.00 each day.

3 The control room

Staffing, layout and equipment

- 7.13 OMs, AOMs and CROs constitute the day-to-day staff in the control room. They are divided into watches. The Deputy Commissioner, POM and SOMs work ordinary office hours.¹¹ They are not a part of a watch and are not routinely required to work from the control room.
- 7.14 The OM and AOMs (who are also referred to as supervisors or “Officer of the Watch” (OOW) when on duty) manage the control room. The OM has overall responsibility for the watch on duty and he or she is required to manage all the control room functions and staff.¹² The OM is also responsible for the assessment of control room performance against agreed service levels and quality standards.¹³ The AOMs support the OM by overseeing the emergency call-handling and incident management activities of the CROs. They provide guidance to the CROs to ensure that service level standards are achieved at all times.¹⁴ They are also required to maintain the reliability and readiness of relevant control and operations equipment and to work closely with the supervisory structure to ensure effective co-ordination of activities.¹⁵ An AOM can perform the role of an OM in times of sickness or annual leave and can also take calls in the role of a CRO during busy times.¹⁶
- 7.15 The CROs are the frontline control room staff. In any shift they can be assigned to one or two of the three core roles of call-taker, paging operator and radio operator. All CROs are trained to perform all these roles.
- 7.16 The control room, known colloquially within the LFB as “Brigade Control”, is usually located at the London Operations Centre in Merton, South West London. It is a large, modern purpose-built facility completed in 2012 which superseded the old Docklands-based control room. It also hosts the LFB’s Resource Management facility and the London Resilience Group, a London-wide organisation independent of the LFB.¹⁷ On the night of the Grenfell Tower fire, the control room was operating from its fallback facility in Stratford, East London because routine maintenance was taking place at Merton. The control room at Stratford is set up in

⁹ LFB organogram [LFB00000017].

¹⁰ LFB organogram [LFB00000016].

¹¹ Control Report p. 176.

¹² Control Report p. 176 and Norman witness statement [MET000080589] p. 2.

¹³ Control Report p. 177.

¹⁴ Control Report pp. 177-178.

¹⁵ Control Report p. 178.

¹⁶ Real witness statement [MET000080589] p. 2.

¹⁷ Control Report p. 174.

the Stratford Fire Station. It is not permanently staffed and is only used occasionally when planned maintenance is being carried out at Merton.¹⁸ It can also be brought into operation for a spontaneous or unplanned event that significantly affects the operation of the main facility.¹⁹ The photographs on the following pages show the two control rooms.²⁰

7.17 The facilities at the two sites are intended to replicate each other,²¹ so that the staff can carry out their roles in the same way wherever they are located. In most respects the facilities at the two sites are the same. CROs sit at banks of desks with three computer screens each and a headset. The layout enables at least two CROs to sit near to each other on each bank of desks.

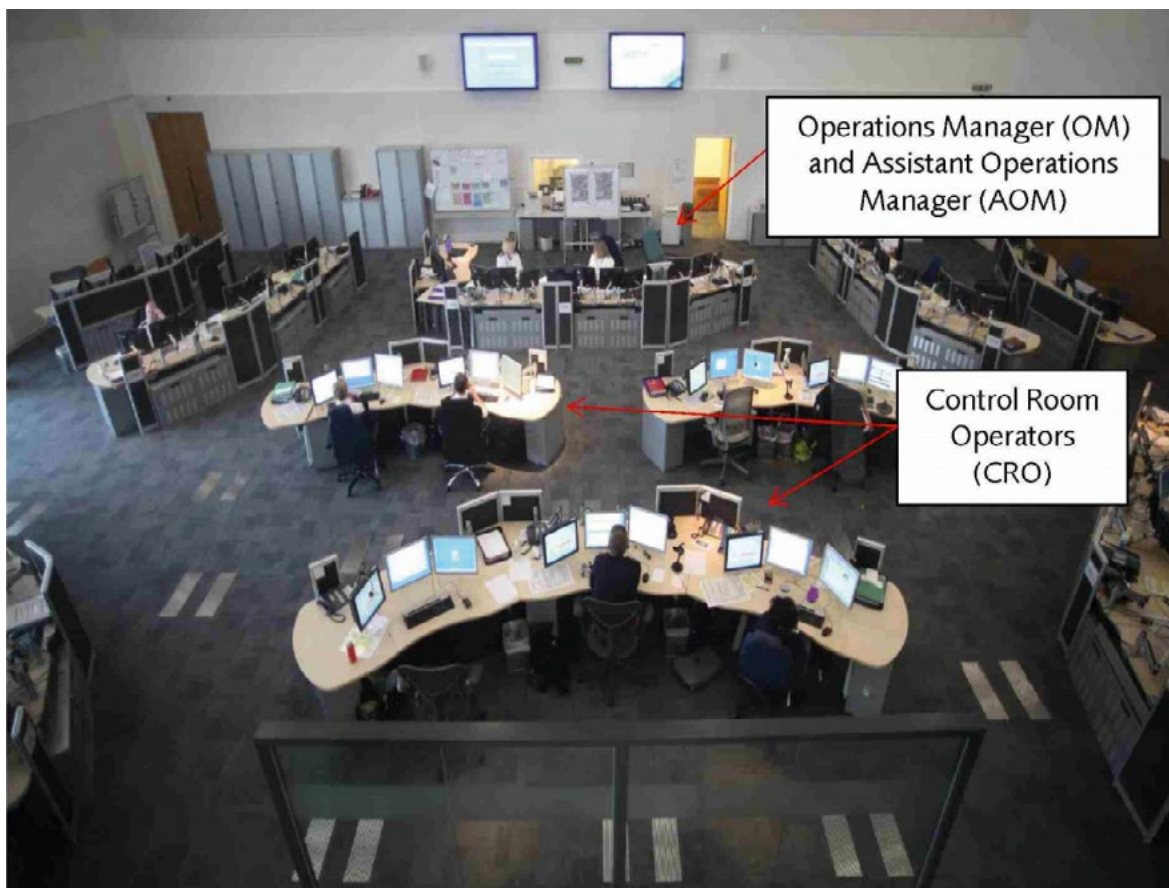


Figure 7.1 The Merton Control Room

¹⁸ LFB Organisational Overview Report [LFB00001905] paragraph 7.3. To CRO Heidi Fox's knowledge, it was used twice in 2017 by the time she made her statement on 5 October 2017 [MET00007764] p. 4.

¹⁹ LFB Organisational Overview Report [LFB00001905] paragraph 7.3.

²⁰ Control Report pp. 173-174.

²¹ LFB IMP Incident Report [LFB00003114] p. 1.



Figure 7.2 The Stratford Control Room

- 7.18 The senior control room staff, namely the OM and AOMs, sit at their own bank of desks (known colloquially as “the head table”)²² from which they can see the whole of the room. They also have three computer screens and a headset each and are able to listen in to calls taken by the CROs. A “red phone” is located on their desk. That is the critical information line that is usually connected to the command units at the incident ground to allow communication of “risk critical” or “life risk critical” information by a direct line.²³ It is also the line by which other control rooms can contact the LFB control room when they are assisting the LFB with calls and by which BT can also contact the control room. SM Jason Oliff explained that on the supervisors’ desk there is also a dedicated direct link to the National Police Air Service (NPAS) helicopter via an intercom radio system which has a tannoy-like microphone and speaker.²⁴
- 7.19 At each terminal a member of staff has access to the following computer and communications systems:
- a. On the first computer screen is the Integrated Control and Communications System (ICCS), which is the means by which members of staff, predominantly the CROs, access telephone and radio communications comprising incoming telephone calls, such as 999 calls and radio messages transmitted from an incident. It works by way of a touchscreen.²⁵
 - b. The second computer screen is the VISION terminal. This is the LFB’s mobilising system and is the means by which CROs record calls coming in and mobilise the LFB’s appliances.²⁶

²² Oliff Day 23/28/7-19.

²³ Oliff Day 23/61.

²⁴ Oliff Day 23/61, 64, 65.

²⁵ Control Report p. 174.

²⁶ Control Report p. 174.

The VISION system also contains a dynamic incident log of all the actions entered on the system associated with one event. Everyone in the control room is able to access the log of an incident, if they wish to do so.²⁷ I was provided with copies of two documents based on this log which describe in different degrees of detail the events of the Grenfell Tower fire, the short incident log²⁸ and the End of Incident Report.²⁹

- c. A third computer screen gives the CRO access to a standard desktop computer, which is connected to the LFB's intranet.³⁰

7.20 It is evident from the photographs above (and was confirmed by a number of witnesses) that the two control rooms differ in size. Stratford is not only physically much smaller than Merton, but has only 16 mobilising positions as opposed to Merton's 29 positions (22 positions in the main control room and seven in the training suite).³¹ OM Alexandra Norman described the Stratford control room as "a third of the size" of the Merton control room.³² Some of the CROs who gave evidence said that they felt that the smaller room enabled them to hear more easily what was going on around them and communicate better with colleagues.³³ OM Norman said that the smaller size of the Stratford control room "helps to get a general overview of what is happening during a shift" and she believed that on the night it helped her to hear the conversations going on around her and to understand the nature of the calls.³⁴

7.21 Although much of the equipment in the two control rooms is the same, on the night of the fire the Stratford control room lacked certain key facilities. In Merton, as can be seen from the photograph, the control room staff would usually have access to two 70-inch television screens, one showing a 24-hour news channel, which is normally switched on, and one which can show the NPAS downlink when it is in use at an incident.³⁵ The NPAS downlink transmits images from the NPAS helicopters. This is sometimes known as the "heli-tele".³⁶ SM Oliff said that the purpose of these screens is for the staff in the control room to have a "physical picture of the actual incident that's being dealt with" and to give the senior control room officers an overview of the development of the incident.³⁷

7.22 The Stratford control room has a single television screen, which can be seen in the top right-hand corner of the photograph above, but it is smaller. The Stratford control room does not have access to the NPAS downlink, and so staff working there could not view images from a police helicopter if they were available.³⁸ Nor does it have access to the Dynamic Cover Tool (DCT), a computer program providing interactive maps designed to assist CROs in moving appliances between locations during large incidents or at periods of peak demand.³⁹

²⁷ Norman Day 42/45/-46/1-11.

²⁸ [MET00013830].

²⁹ [LFB00004496].

³⁰ Control Report p. 175.

³¹ Smith Day 21/40/15-21.

³² Norman witness statement [MET000080589] p. 2.

³³ For example, Duddy witness statement [MET00007787] p. 5 and Norman witness statement [MET000080589] p. 2.

³⁴ Norman witness statement [MET000080589] p. 2 and Norman Day 42/56/13-17.

³⁵ Smith Day 21/94/8-19.

³⁶ IMP Incident Report p. 2.

³⁷ Oliff Day 23/35/1-25/35.

³⁸ IMP Incident Report p. 2.

³⁹ Control Report p. 175; Norman witness statement [MET000080589] p. 2 and Day 42/58-59.

Duties and rostering

- 7.23 As call-takers, CROs answer emergency (999) calls and other operationally urgent calls from other parts of the LFB and partner agencies, such as the MPS, the LAS or other control rooms outside London.⁴⁰ They advise callers and mobilise resources appropriate to the type of incident. They respond to and process requests for resources and information coming from the incident ground. They are also responsible for updating the VISION mobilising system, which includes amending the system to show when officers and appliances are available, assigned to an incident, en route to an incident and in attendance at an incident.⁴¹
- 7.24 One CRO on each shift is assigned as paging operator responsible for notifying LFB officers and staff about an incident using a paging system. The paging operator should follow Policy No. 412 (Mobilising Policy),⁴² which sets out when appliances, officers, equipment and external agencies are to be notified of an incident and of a need to attend. Most officers and staff who have been paged are required to acknowledge the alert by calling the paging operator. At that point the paging operator provides further details about the incident and updates the VISION mobilising system as appropriate, for example, to show that the officer is on their way to the incident.⁴³ A CRO assigned as paging operator can also take calls.
- 7.25 Two CROs are assigned as radio operators on each shift. A radio operator receives and transmits messages on the LFB's "main-scheme" radio. One radio operator handles the radio communications for North London (on channel 4, also known as "RT4"); the other handles communications for South London (on channel 2, also known as "RT2"). A third CRO provides cover for the radio operators when they take a break, although they will perform other roles as well.⁴⁴ In periods of high demand it is possible for one radio operator to operate both channels, thereby allowing the other radio operator to take calls.⁴⁵ A radio operator can also update the status and availability of appliances and senior officers on VISION.⁴⁶
- 7.26 Each 24-hour period is divided into four shifts. There are six teams, known as "watches"; each watch works on a six-day shift rota.⁴⁷ The shift pattern is set out below:⁴⁸

| Shift name | Start time | Finish time |
|-------------|------------|-------------|
| Days | 08:00 hrs | 20:00 hrs |
| Early short | 08:00 hrs | 16:00 hrs |
| Late short | 14:00 hrs | 22:00 hrs |
| Nights | 20:00 hrs | 08:00 hrs |

- 7.27 In any 24-hour period, three watches are rostered to work. One watch takes the day shift, one watch takes the "short" shifts by splitting the team into two so that a team member will either work on the early shift or the late shift, and one watch takes the night shift.⁴⁹ The day shift and the night shift are the core shifts; staff on the shorter shifts usually undertake administrative work or relieve those on the core shift throughout the day when they take a break.⁵⁰

⁴⁰ Control Report p. 178.

⁴¹ Control Report p. 178.

⁴² Ref. Issue date: 26 October 2005. Reviewed as current 15 July 2016.

⁴³ Control Report p. 178.

⁴⁴ Darby witness statement [MET00013961] p. 2.

⁴⁵ Control Report p. 178.

⁴⁶ Control Report p. 178.

⁴⁷ Norman witness statement [MET000080589] p. 2 and Smith witness statement [MET00007766] p. 2.

⁴⁸ Control Report p. 176.

⁴⁹ Control Report p. 176.

⁵⁰ Darby witness statement [MET00013961] p. 2.

- 7.28 Each watch is composed of 16 members, but the minimum number required to be on duty in any shift is 11⁵¹ (two supervisors and nine CROs).⁵² However, it is usual to have three supervisors and eight CROs present.⁵³ OM Norman explained that if there were a fourth supervisor present, they would act as a CRO, but it would not be normal for a supervisor to act in that capacity in any other situation.⁵⁴ She explained that, provided a minimum of 11 staff members were present, there was some flexibility in relation to the ranks involved.⁵⁵
- 7.29 When the watch is split across the short shifts, and the minimum number of staff are on duty, six will be allocated to the early short shift and five to the late short shift.⁵⁶ Using the minimum number of staff required in accordance with the LFB's Control Report, one can deduce that the following number of staff required to be on duty during each period is as follows:
- a. from 08:00 to 14:00: 3 supervisors and 14 CROs;
 - b. from 14:00 to 16:00: 4 supervisors and 18 CROs;
 - c. from 16:00 to 20:00: 3 supervisors and 13 CROs;
 - d. from 20:00 to 22:00: 3 supervisors and 13 CROs;
 - e. from 22:00 to 08:00: 2 supervisors and nine CROs.
- 7.30 During a 24-hour period, either the POM or one of the SOMs will provide cover to the control room on a rotational basis as the Brigade Control Senior Manager.⁵⁷ In this role the Brigade Control Senior Manager has oversight of operations, providing a monitoring and supporting role to the OM on duty and undertaking the liaison role between the control room and the LFB's principal management team.⁵⁸ The POM or SOM is not required to be present in the control room outside normal working hours, but they must respond to pager communications and call the control room to assess the situation and decide whether it is necessary to attend.⁵⁹
- 7.31 The POM or SOM will automatically be mobilised to attend the control room in various circumstances, including:⁶⁰
- a. when an incident occurs requiring between 9 and 12 appliances ("pumps");
 - b. when a Major Incident is declared by the LFB;
 - c. when there is a major loss or degradation of the control room's communications or computer systems or the primary control centre has to be evacuated to the fallback site; or
 - d. when several lengthy fire survival guidance (FSG) calls are in progress.

⁵¹ Smith witness statement [MET00007766] p. 2 and Control Report p. 176.

⁵² Control Report p. 176.

⁵³ Smith Day 21/7/4-8; Norman Day 42/66/17-20.

⁵⁴ Norman Day 42/62/1-42/66/17.

⁵⁵ Norman Day 42/67/2-4.

⁵⁶ Control Report p. 176.

⁵⁷ Control Report p. 176.

⁵⁸ Control Report p. 177 and Smith Day 21/34/20-25-21/36/8.

⁵⁹ Smith witness statement [MET00007766] p. 1.

⁶⁰ Control Report p. 177.

- 7.32 During a large operational or multi-agency incident, the LFB will set up a Brigade Coordination Centre.⁶¹ The purpose of the centre is to provide support to, and implement the decisions of, the duty AC.⁶² It also ensures that the LFB continues to provide the usual service and response across the whole of London.⁶³ The centre will usually be located at one of the LFB's facilities, either Merton or its headquarters at Union Street,⁶⁴ but on 14 June 2017 it was set up in the same building as the Stratford control room. It is set up and managed by a duty DAC as Brigade Co-ordinating Manager.⁶⁵
- 7.33 When an incident requires eight or more pumps (fire appliances), a Station Manager⁶⁶ is mobilised to the control room to act as duty Officer of the Day (OOD).⁶⁷ The role of the OOD is to provide additional oversight and support to the Operations Manager in the control room and the duty Brigade Co-ordinating Manager in the Brigade Coordination Centre.⁶⁸ The OOD will also resolve resourcing problems, carry out resource planning and provide a link between operational staff at fire stations and senior duty officers on call.⁶⁹ The OOD does not advise control room staff about the advice they should give callers.⁷⁰

VISION and other control room systems

- 7.34 The VISION terminal is the LFB's mobilising system. For each incident, a log is created on VISION which is updated as the incident progresses.⁷¹ The information included is varied and includes items such as the resources and officers requested and deployed, any messages received from the incident ground, such as increasing the number of pumps (e.g. make pumps 10), or informative messages describing the progress of an incident for the benefit of the control room and those monitoring it.⁷² The incident log can also include details of whether other agencies have been informed.⁷³ It will also contain an action plan for the incident, if one exists.⁷⁴ There is a live feed from the VISION system to an electronic viewing platform called BOSS.⁷⁵ Senior officers and fire stations are able to access BOSS remotely in order to find out what is happening at an incident.⁷⁶
- 7.35 The ICCS is the means by which CROs access telephony and radio communications. It works by way of a touchscreen. VISION and ICCS are integrated. The two systems enable the CROs to manage emergency calls and to mobilise the LFB's operational resources and officers.

Handling emergency calls

- 7.36 The LFB issues policy documents containing instructions about the way in which its personnel are expected to carry out their various duties. In June 2017, the two principal policies governing the handling of emergency calls by the control room were Policy No. 539 (Emergency Call Management) (PN539) and Policy No. 790 (Fire Survival Guidance Calls) (PN790). In addition,

⁶¹ Fenton witness statement [MET000080569] p. 3.

⁶² ORR v 0.7 p. 490.

⁶³ Fenton witness statement [MET000080569] p. 3.

⁶⁴ Fenton witness statement [MET000080569] p. 2.

⁶⁵ ORR v 0.7 p. 490.

⁶⁶ ORR v 0.7 pp. 34, 505.

⁶⁷ Control Report p. 177.

⁶⁸ Control Report p. 177 and Oliff Day 23/17/16-24.

⁶⁹ Control Report p. 177 and Oliff Day 23/17/16-18/24.

⁷⁰ Oliff Day 23/19/1-4.

⁷¹ Smith Day 21/46-47.

⁷² Smith Day 21/46/4-19, 21/74/1-16.

⁷³ Smith Day 21/46/4-19, 21/74/1-16.

⁷⁴ Smith Day 21/46/4-19.

⁷⁵ Smith Day 21/46/21-25-21/47/1-17.

⁷⁶ Smith Day 21/46/21-25-21/47/1-17.

two Reference Information Files (RIFs) were available to the control room to assist call-handling, the RIF for Operators and the RIF for Supervisors. Taken together, the policies and RIFs described in some detail how the LFB expected CROs and senior officers in the control room to conduct operations. PN790 had both been drafted in the light of national guidance on fire safety contained in *Generic Risk Assessment 3.2* (GRA 3.2) published by the Department for Communities and Local Government in February 2014 with a view to helping fire and rescue services identify the significant hazards and risks likely to be encountered when fighting fires in high-rise buildings. PN539 had been updated in the light of that guidance. Neither policy is concerned solely with incidents in high-rise buildings.

- 7.37 The policies to which I have referred are generally implemented in the following way. When a 999 call comes into the control room, a flashing red box appears on all the ICCS screens.⁷⁷ The first available CRO responds by touching an icon on the screen, which opens a new entry on the call collection form (CCF) and enables details of the call to be entered on the system.⁷⁸ As the ICCS and the VISION system are integrated, some details, such as the caller's telephone number, are automatically entered on the CCF.⁷⁹ The CRO then starts to gather information from the caller.
- 7.38 Usually, a CRO first asks for the postcode or a road name to establish the location and obtain the relevant address.⁸⁰ If the person is living in a flat, the usual practice is to ask how many floors the building has so that the CRO can determine if the building is a high-rise block.⁸¹ The CRO then obtains information from the caller in order to determine the type of incident that is taking place (e.g. a fire or a person trapped in a lift) in order to mobilise the appropriate appliances and officers and give the caller any necessary advice.⁸²
- 7.39 Once the CRO has determined what type of incident is taking place, they enter the "Incident Type Code" on the VISION system (e.g. A1 is for fire, A1HR is for a high-rise fire) which generates a pre-determined attendance (PDA).⁸³ The PDA is the minimum level of response that the LFB is required to mobilise to a particular kind of incident.⁸⁴ At the time of the Grenfell fire, a general fire had a PDA of three fire appliances; a high-rise fire had a PDA of four appliances, comprising three pumps and a pump ladder, under the direction of a Watch Manager.⁸⁵ (The distinction between a pump and a pump ladder is explained below.) On the VISION screen the CRO can see which fire stations are nearest to the incident and, while speaking to the caller, can mobilise the nearest (in this case North Kensington).⁸⁶ A live display shows the appliances mobilising. Once the CRO has mobilised the required appliances and officers, it is the responsibility of the incident commander to determine whether any additional resources are required. The incident commander requests whatever resources he or she considers necessary by radio message to the control room, which then sets about mobilising them.⁸⁷

⁷⁷ Duddy witness statement [MET00007787] p. 1.

⁷⁸ Smith Day 21/42/20-25-21/43/1-5.

⁷⁹ PN539 paragraph 4.4 [LFB00000737] p. 4; Smith Day 21/43/9-15.

⁸⁰ Duddy witness statement [MET00007787] p. 1.

⁸¹ A building of more than five floors is classified as high-rise: Smith Day 21/44/12-25.

⁸² Duddy witness statement [MET00007787] p. 1.

⁸³ Duddy witness statement [MET00007787] p. 1 and section 7 and Appendix 1 of PN412 [LFB00001531].

⁸⁴ Duddy witness statement [MET00007787] p. 1 and section 7 and Appendix 1 of PN412 [LFB00001531].

⁸⁵ The management of the LFB's operational response to incidents is set out in PN412 (Mobilising Policy), and particularly Appendix 1 of PN412 (issue date 26 October 2015, reviewed as current 15 July 2016) [LFB00001531].

⁸⁶ PN412 paragraph 2.9 [LFB00001531] and Smith Day 21/45/9-20.

⁸⁷ PN412 paragraph 2.10.

- 7.40 During a call, a CRO provides advice to a caller depending on the situation in which they find themselves. CROs can obtain assistance from the RIFs available on their computer terminals; they can also seek help from a supervisor.⁸⁸ Supervisors can monitor calls through the ICCS system or can speak directly to CROs at their desks.⁸⁹
- 7.41 In the course of speaking to a caller a CRO may find that they need to communicate with the radio operator in order to send a message to the incident ground. The CRO sends the message to the radio operator by creating a “service request” on VISION.⁹⁰ That is done by opening a service request box on the VISION terminal and entering the details.⁹¹ The CRO directs the message to the attention of the appropriate radio operator by adding a reference to the channel by which it is to be sent. Thus, a message will carry the prefix “RT4” if it is to be sent by the North London radio operator.⁹² The message will be displayed on VISION with the label “Service Request Created”. Once the message has been saved, it is added to a list of service requests which everyone in the control room with access to the VISION system can see. The radio operator responsible for the relevant channel is expected to pick up the message and transmit it.⁹³ If a message has priority, such as an FSG message, the CRO may call out to the radio operator to alert them to it, saying something like “Message on 4”.⁹⁴ The message can be amended by the CRO, in which case the system will show “Service Request Updated”. The status of the message can also be changed on VISION by a CRO or a supervisor to show that it is “In Progress”, meaning that the radio operator has picked it up and is dealing with it.⁹⁵
- 7.42 When the radio operator has completed the request, they tick a box on the screen, thereby generating the message “Service Request Completed”, which is recorded on VISION.⁹⁶ It is important to note that the radio operator does not change the details of the original service request and only ticks a box to indicate that it has been completed.⁹⁷ The terms of the original service request become, in effect, a label by which to identify any subsequent actions taken in response to it. An example of how a service request message appears on VISION is shown below.⁹⁸

⁸⁸ Norman witness statement [MET000080589] p.1, Reference Information File (RIF) Fire Survival Guidance (Supervisor) [LFB00003541]; Reference Information File (RIF) Fire Survival Guidance (Operator) [LFB00003542].

⁸⁹ Norman Day 42/43/23-42/44/3; Smith Day 21/36/12-19.

⁹⁰ Darby Day 33/145/1-16.

⁹¹ Darby Day 33/145/1-16.

⁹² Darby Day 33/145/1-16.

⁹³ Darby Day 33/145/1-16.

⁹⁴ Darby Day 33/152/1-13.

⁹⁵ For example, SIL p. 20, 01:53:52; Duddy Day 42/194/11-15; Smith Day 21/83/15-22.

⁹⁶ For example, SIL p. 20.

⁹⁷ Darby Day 33/159/2-7.

⁹⁸ SIL p. 20.

| | | | |
|----------|-----|------|--|
| 01:51:13 | HJF | | Service Request Service Request Created: RT4 TO G271 INFO REC FROM SRY POLICE CALLER IN FLAT 111 ON THE 14TH FLOOR IS IN THE BATHROOM AREA WITH SMOKE ENTERING ROOM HE IS HAVING DIFFICULTIES IN BREATHING |
| 01:51:18 | AG | | Service Request Service Request Created: TO CH4 G271 PEOPLE ON 10 TH FLOOR ARE ASKING TO TO LEAVE FLATS - CAN YOU CHECK THEM |
| 01:52:59 | PM | BC04 | User Comment Acknowledged receipt of incident 076029-14062017 |
| 01:53:52 | SAD | | Service Request Service Request InProgress: RT4 TO G271 INFO REC FROM SRY POLICE CALLER IN FLAT 111 ON THE 14TH FLOOR IS IN THE BATHROOM AREA WITH SMOKE ENTERING ROOM HE IS HAVING DIFFICULTIES IN BREATHING |
| 01:53:57 | DR | BC02 | User Comment Acknowledged receipt of incident 076029-14062017 |
| 01:53:59 | SAD | | Service Request Service Request Completed: TO CH4 G271 PEOPLE ON 10 TH FLOOR ARE ASKING TO TO LEAVE FLATS - CAN YOU CHECK THEM |
| 01:54:03 | DR | PR6 | User Comment Acknowledged receipt of incident 076029-14062017 |
| 01:54:04 | AN | | Agency F4 NOW EN ROUTE TO BRIGADE CONTROL AS DUTY DAC |
| 01:54:05 | SAD | | Service Request Service Request Completed: RT4 TO G271 INFO REC FROM SRY POLICE CALLER IN FLAT 111 ON THE 14TH FLOOR IS IN THE BATHROOM AREA WITH SMOKE ENTERING ROOM HE IS HAVING DIFFICULTIES IN BREATHING |

Figure 7.3

- 7.43 The radio operator is primarily responsible for transmitting messages to and from the incident ground; they are the essential link between the two.⁹⁹ Once a firefighting crew has been assigned to an incident, there should be a constant flow of information passing between them.¹⁰⁰ The radio operator transmits messages passed to them by the CROs or the supervisor¹⁰¹ and the crews transmit messages from the incident commander to the control room. That may be a request for additional resources or what is known as an “Informative Message”, which is intended to provide the control room and officers not in attendance at the incident with an accurate description of the incident and the progress being made.¹⁰² All radio messages received from the incident ground are logged through VISION by the radio operator.¹⁰³ They are then picked up by another CRO who takes the necessary action, e.g. by mobilising the required resources. The paging operator alerts senior officers to ensure their attendance, if necessary.¹⁰⁴
- 7.44 The radio used by the radio operator is the main-scheme radio. The main-scheme radio uses the Airwave Network, a commercial radio network, and is usually referred to simply as Airwave. The channels used by the LFB are designated Fire London Operations (FLONOPS) with code names for individual channels available. “M2FN” is the code name for the channel

⁹⁹ Darby witness statement [MET00013961] p. 2.

¹⁰⁰ Darby witness statement [MET00013961] p. 2.

¹⁰¹ Darby witness statement [MET00013961] p. 2.

¹⁰² ORR v 0.7 p. 503. SOM Smith provided a definition of “informative message” at Day 21/29/12-13.

¹⁰³ Darby witness statement [MET00013961] p. 4. Time marks on the SIL may appear later in time than the action to which they refer, given that the radio operator updates the incident log only once the action has been taken or, for example a message has been received.

¹⁰⁴ Darby witness statement [MET00013961] p. 4.

that covers North London.¹⁰⁵ The channels are also known as “RT4” etc., shorthand for “radio transmission, channel 4”.¹⁰⁶ These names are used interchangeably.¹⁰⁷ Channel 1 is a spare channel, which can be used to transmit a large number of FSG calls or for communications relating to a single incident, if staffing numbers allow.¹⁰⁸ Anyone who possesses a portable handheld Airwave radio can listen to the communications on any of these channels. Senior LFB officers of Station Manager rank and above are issued with Airwave radios and one is fitted in every appliance.¹⁰⁹ The control room can therefore transmit messages to appliances by Airwave radio and senior officers can listen in, which may be necessary if they have been notified of the incident and need to monitor its progress in order to decide whether they need to attend. Senior officers can communicate with each other over the Airwave radio but these communications are not recorded.¹¹⁰

4 The incident ground

The incident commander: role and responsibilities

7.45 At every incident it is necessary for an officer to assume the role of incident commander and direct operations on the ground. Policy No. 431 (Incident Commander) describes the role and responsibilities of the incident commander, who is the person responsible for discharging fire service functions at the incident.¹¹¹ The general rule is that the commander of the first fire appliance to attend an incident undertakes the role of incident commander unless and until relieved by a more senior officer.¹¹²

7.46 The responsibilities of the incident commander are described in paragraph 6 and Appendix 2 of PN431. For present purposes it is sufficient to say that they include:

- a. assessing the incident and deciding upon an operational plan;
- b. making dynamic risk assessments, which involve striking a balance between ensuring firefighters’ safety and discharging the responsibility of the fire and rescue service to extinguish fire and to save life and property;
- c. assessing the need for additional resources; and
- d. establishing an effective incident command structure and communications network.

However, PN342 recognises that the incident commander may need to adapt or move away from operational policy if it is justifiable in terms of risk and benefit, but advises that any such move should be kept to the minimum necessary to achieve the desired objective in order to minimise exposure to the increased levels of risk.¹¹³

¹⁰⁵ Darby witness statement [MET00013961] p. 2 and Day 33/134/20-23.

¹⁰⁶ Darby Day 33/157/10-13.

¹⁰⁷ Darby Day 33/135/4-6.

¹⁰⁸ PN790 paragraph 5.13; Darby Day 33/134/14-23, 33/135/7-15.

¹⁰⁹ Smith Day 21/65/24-25-21/66/1-8, 21/68/17-22.

¹¹⁰ Smith Day 21/136/4-8.

¹¹¹ PN431 paragraph 5.1 [LFB00000174].

¹¹² PN431 paragraph 3.1 [LFB00000174].

¹¹³ PN342 [LFB00000236] p. 3.

- 7.47 Communications on the incident ground and between the incident ground and the control room are of the utmost importance. Paragraph 7 of PN431 requires the incident commander to establish and maintain clear lines of communication throughout the incident, to ensure that communications are maintained between the incident ground and the control room, and to establish and maintain effective lines of communication with other services and agencies.¹¹⁴
- 7.48 In many cases the initial incident commander is likely to be a Watch Manager, but if the incident increases in scale or seriousness, a more senior officer is required to attend to ensure that the incident commander holds a rank appropriate to the gravity of the incident. If the number of appliances required to attend is increased, the seniority of the incident commander increases. As one would expect, the outgoing incident commander is expected to give their successor a full description of the operational situation when handing over command.¹¹⁵

The monitoring officer: role and responsibilities

- 7.49 When the number of pumps required at an incident reaches 15, the LFB's practice is to appoint a monitoring officer, whose role and functions are described in Policy No. 424 (Monitoring Officer). The monitoring officer's primary function is to measure the efficiency, effectiveness and, where possible, the economic performance of individuals and the organisation as a whole at an incident¹¹⁶ by applying the decision-making model and comparing their own conclusions with those of the incident commander.¹¹⁷ The monitoring officer and the incident commander are expected to discuss any differences between their assessments and decide what action is required to ensure safe systems of work. The monitoring officer is also expected to tour the incident ground, evaluate the operational plan and report back to the incident commander,¹¹⁸ and, if the incident escalates or its management is beyond the experience or ability of the incident commander, to assume command immediately.¹¹⁹

Sectors

- 7.50 At larger or more complex incidents the incident commander may divide the incident ground into sectors, each under the command of a sector commander, to enable a practicable span of control to be maintained. There are two types of sector: an operational sector, which is defined by reference to a physical area of the incident ground, and a functional sector, which is defined by reference to a support role and the resources it commands. The incident commander may also appoint one or more operations commanders to take responsibility for a number of sectors on the incident ground, thereby maintaining an effective span of control and providing a greater level of command.

Incident command support

- 7.51 The LFB provides a variety of command support arrangements based on the size and nature of the incident. At smaller incidents, command support is provided by the Initial Command Pump (ICP),¹²⁰ which provides the communications link between the control room and the incident ground. The ICP's means of communication with the control room is the main-scheme radio, with its transmitter and receiver fixed in the front cab at head height where the

¹¹⁴ Paragraphs 7.1-7.3 respectively [LFB00000236] p. 10.

¹¹⁵ PN431 Appendix 1 [LFB00012840] p. 6.

¹¹⁶ PN424 paragraph 4.1 [LFB00004944].

¹¹⁷ PN424 paragraph 4.5 [LFB00004944].

¹¹⁸ PN424 paragraph 4.6 [LFB00004944].

¹¹⁹ PN424 paragraph 4.7 [LFB00004944].

¹²⁰ PN238 (incident command procedures) paragraph 7 [LFB00013472] p. 5.

driver and officer in charge sit.¹²¹ The ICP continues to perform its communications role until the incident is concluded or it is relieved by a command unit¹²² (a mobile control room), if the incident requires one. On arrival at the incident ground commanders of appliances and senior officers alike report to the ICP or the command unit, hand in their nominal roll boards and are given information about the incident. The nominal roll board is a physical plate carried on all LFB vehicles that provides details about the type of appliance, its call-sign and the names and rank of its crew. Senior officers also carry a nominal roll board which, in their case, records the officer's name, call-sign, vehicle registration number and any specialist qualifications.

- 7.52 A command unit is mobilised to provide a dedicated and enhanced level of command support at larger incidents (typically those involving four or more appliances). It is staffed by at least two Watch Managers who provide command support for the incident commander. The command unit carries the Command Support System (CSS), together with other systems which are designed to provide the incident commander with access to the ORD, the primary purpose of which is to record significant hazards and risks, as well as what the LFB calls "less obvious hazards and any unique control measures in place",¹²³ and any particular tactical plans or command and control procedures that may be required. The CSS also carries other relevant information, such as data on water supplies and maps.
- 7.53 The officers on the command unit perform a number of important functions. These include recording preliminary details of the incident on the CSS, transmitting messages to and from the control room and maintaining the plan of the incident, including a record of the duties and location of senior officers and operational crews committed at the incident. The command units also play an important role in ensuring that the incident commander can communicate with the various parts of the incident ground. They should maintain radio contact with the incident commander if they leave the command unit; they also co-ordinate and maintain radio contact with the operations and sector commanders. Command units can also be used for logistical functions, such as marshalling and hosting tactical co-ordination group meetings.
- 7.54 At larger incidents additional command units will automatically be mobilised but they can, if necessary, be requested by the incident commander. When the control room is receiving FSG calls, an additional command unit will automatically be mobilised, together with a senior officer, to collate and manage FSG information. Each command unit is equipped with a Casualty Information Sheet, a laminated template which enables information to be recorded in respect of up to seven FSG calls.¹²⁴

Provision of basic information to fire crews

- 7.55 The primary purpose of the Operational Risk Database (ORD) is to alert crews to risks and hazards at a particular building additional to those that are normally encountered, together with any less obvious hazards and unique control measures that may be in place. The ORD also contains any particular plans or command and control procedures required.¹²⁵
- 7.56 The "tip sheet"¹²⁶ is a document which is printed off in the watch room and gives the mobilised crews basic information regarding the incident, including the address, classification of the incident and the number of appliances attending, as well as the information about the relevant building recorded in the ORD.

¹²¹ Dowden Day 10/38/21-39/7.

¹²² PN238 paragraph 7.4 [LFB00013472] p. 5.

¹²³ LFB Organisational Overview [LFB00001900] p. 20.

¹²⁴ PN820 Appendix 1 (Forward Information Board) [LFB00000188] pp. 8-9.

¹²⁵ Policy No. 800 (Information gathering/contingency plans) (dated 16 July 2012) [LFB00000705] pp. 7-8.

¹²⁶ Dowden Day 9/147-148/11.

- 7.57 Once mobile and on their way to the incident, the initial incident commander (as well as other attending crews) have access to the Mobile Data Terminal (MDT). This is a vehicle-mounted fixed tablet computer which has a 12-inch touch screen. It is fitted to most operational vehicles.¹²⁷ The MDT sits in the front of an appliance, between the driver and the officer commanding the crew. It provides the crew with access to the information recorded on the ORD in relation to the relevant building, including the tactical and any operational contingency plans.¹²⁸

5 Equipment

- 7.58 When describing the response of the LFB to the fire at Grenfell Tower it is necessary to refer to some of the equipment in use, including, for example, the means of providing basic information about the relevant building, fire appliances and breathing apparatus. It may be useful at this stage, therefore, to provide a brief description of the more important pieces of equipment available to the LFB.

Fire appliances

- 7.59 There are two basic types of basic fire appliance: a pump appliance (known simply as a “pump”) and a pump ladder. A pump carries a crew of up to six firefighters. It is equipped with an internal pump designed to supply water for firefighting operations and a 9-metre ladder. The pump carries several lengths of hose, nozzles (known as “branches”) for controlling the water, and other equipment, including breathing apparatus. A pump ladder is very similar. It can carry the same number of firefighters and similar equipment, but has a 13.5-metre ladder.
- 7.60 In addition to pumps and pump ladders some fire stations are equipped with Fire and Rescue Units (FRUs), which carry specialist rescue equipment for use at complex incidents.¹²⁹
- 7.61 The LFB has 11 aerial appliances of which two types are relevant: turntable ladders (TLs) and aerial ladder platforms (ALPs). A turntable ladder is a vehicle equipped with a ladder that can reach 32 metres in height, i.e. to about the tenth floor of a modern high-rise building. An aerial ladder platform can reach the same height, but the ladder has a cage at its head, which can hold up to four people. The ladder may be operated from ground level or from the cage.

Breathing apparatus

- 7.62 Given the nature of their work, firefighters need to use a variety of protective equipment, including breathing apparatus (BA). BA allows firefighters to breathe whilst working in an oxygen-deficient atmosphere (such as smoke) and is standard equipment when fighting fires or attending incidents involving an acute respiratory hazard. BA consists of a full-face mask, a cylinder containing compressed air with associated air tubes and a pressure gauge, body harness straps, a hand lamp and radio communications. BA sets also have a “bodyguard” distress signal unit which monitors the breathing rate of the wearer and the time the set was first activated.
- 7.63 The LFB uses two types of BA set: Standard Duration Breathing Apparatus (SDBA) and Extended Duration Breathing Apparatus (EDBA). SDBA is carried on all frontline appliances. It is a single-cylinder system, weighing approximately 15 kilograms, which provides a working

¹²⁷ Refer to the definition in the LFB’s ORR v 0.7 p. 504.

¹²⁸ Dowden Day 9/157/2-159/5.

¹²⁹ Dowden Day 11/41.

time of 31 minutes, assuming a consumption rate of 50 litres per minute. The actual working time available, however, depends upon a range of factors, including the wearer's workload and the physical and environmental conditions (for example, the extent of smoke-logging and the temperature that firefighters are experiencing) as well as the wearer's own physical fitness. The safety margin is 12 minutes. An alarm sounds when the pressure in the cylinder falls to 84 bar. When using BA, a firefighter is sometimes said to be operating "under air".

- 7.64 EDBA is carried only on FRUs and is intended to give an enhanced capability at incidents involving long distances or conditions which make SDBA less effective. Specialist training is required to wear EDBA and is typically provided only to FRU crews. EDBA is a double-cylinder system, which weighs about 23 kilograms and provides a working time of 47 minutes, assuming a consumption rate of 56 litres per minute. As with SDBA, the actual duration of the set is determined in part by the circumstances confronting the firefighter. The safety margin is 18 minutes and, as with SDBA, an alarm will sound when the pressure in the cylinders falls to 84 bar.

Ground monitor

- 7.65 In the following section of the report there are references to a piece of equipment called a "ground monitor", a piece of equipment which allows a jet of water to be directed against a building without the need for constant attendance by firefighters. It consists of a nozzle fed by a hose and supported by a metal frame anchored to the ground. Once set up, it can be left unattended to maintain a constant stream of water.

Radio equipment

- 7.66 The LFB uses two principal types of communications equipment. One is the digital Airwave radio system described earlier, which is generally used for communications between the control room and fire appliances and between senior officers; the other is an ultra-high frequency analogue radio system for use on the incident ground. Senior officers can communicate with each other over the Airwave radio, but they do not use them on the incident ground and any communications between them using that method are not recorded.¹³⁰
- 7.67 All operational firefighters, including senior officers, have their own handheld analogue UHF radios (sometimes known as "fireground radios"), which have eight channels:
- Channels 1 and 2 are dedicated to incident command. Channel 1 is the default channel for all initial incident command communications and remains the primary command channel until circumstances, or the incident commander, require additional radio capacity. If additional capacity is required, channel 2 is used.
 - Channels 5 and 6 are used by breathing apparatus crews.
 - Channel 3 is for firefighter crew communications.

The main drawback of the fireground radios is that on any given channel they can transmit or receive only one voice transmission at a time.

- 7.68 The LFB's fleet of command units also carries portable UHF radio repeaters and what is known as "leaky feeder" equipment. A leaky feeder is a coaxial cable, 175 metres long, which is normally connected to a radio repeater and extended as required. The radio repeater technology can be deployed to supplement or enhance communications.

¹³⁰ Smith Day 21/136/4-8.

- 7.69 Some BA sets are fitted with a dedicated UHF Breathing Apparatus Radio Interface Equipment analogue radio known as a “BARIE set”. As breathing apparatus crews can be asked to operate in potentially explosive atmospheres, all BARIE sets must be intrinsically safe. In order to meet that requirement, they are limited to a power output of 1 watt per channel, which can affect their operational range.

BA entry control equipment

- 7.70 When BA is in use, an entry control officer is appointed to manage the deployment of firefighters entering the relevant area under air by means of an entry control board (ECB). An ECB is an electronic telemetry board which displays real time information in relation to each BA wearer whose set has been logged on to it.
- 7.71 The ECB is a rechargeable, battery-powered unit incorporating a digital radio transmitter and receiver with integral antennae. Each ECB has 12 BA tally channel slots, each able to accept the encoded tally of one BA set. The data transmission link between the ECB and each BA set is activated by the insertion of the tally, which has a built-in encoded transponder, into one of the available sockets on the ECB. The ECB identifies the associated BA set and the individual BA wearer’s telemetry signal radio icon illuminates (green) continuously, confirming that a successful telemetry signal is established between the ECB and the BA set. The entry control officer is then able to monitor air consumption rates for each BA wearer and, therefore, the remaining time available to them. The individual BA tally channel LED display shows the end of the working duration of the cylinder used by that wearer. The ECB stores data that can be downloaded after an incident.¹³¹

6 Firefighting

- 7.72 The Narrative refers to various technical terms and certain equipment which was used by the LFB to support firefighting and search and rescue deployments on the night. It may assist if two of those terms and equipment are explained here.

The bridgehead

- 7.73 The bridgehead is the forward command post, from which firefighters are committed to fight the fire and where the ECB is maintained. It must be established in safe air. When fighting a fire in a high-rise building, it is standard operating procedure to establish the bridgehead two floors below the fire floor, unless it is possible for safe air to be reliably maintained at a position closer to the fire.¹³² Crucially, when positioning the bridgehead, consideration should be given to the spread of smoke through doors that will be opened to enable hoses to be put in to the riser and which will have to remain open for firefighting purposes.¹³³

Forward Information Board

- 7.74 Forward Information Boards (FIBs) are used by those in command of the bridgehead to record important information. An FIB consists of a Perspex back board and two double-sided laminated sheets, printed with four templates and is designed for gathering and recording

¹³¹ As it was for the Grenfell Tower incident. The data are contained in the evidence of AC Andrew Bell (Day 9/114/5-125/3 and [LFB00003588]) and Malcolm Stanton ([LFB00003587 and LFB00023330] and summarised in the LFB telemetry schedule [LFB00023326]).

¹³² PN633 paragraph 7.19 [LFB00000178] p. 11.

¹³³ PN633 paragraph 7.20 [LFB00000178] p. 11.

information. The use of FIBs is covered by Policy No. 820 (Forward Information Board),¹³⁴ Appendix 1, figure 3 of which is a casualty information template with space for up to seven people. A record of people rescued and areas searched or partly searched should be made to share information generally, to assist with prioritising further rescues and to avoid repeated searches being made of the same areas.

¹³⁴ Introduced in 2013 as part of the LFB's response to the Lakanal House fire.

Chapter 8

Before Grenfell: the Lakanal House Fire

1 The Lakanal House fire and the ensuing inquests

- 8.1 Lakanal House, Havil Street, Camberwell, London SE5 is a high-rise residential block containing 98 flats and maisonettes spread over 14 floors. On 3 July 2009 a fire broke out in a maisonette on floor 9 and despite the prompt attendance of firefighters, spread rapidly beyond the compartment of origin upwards to floors 10, 11 and 12 and downwards to floors 5 and 7. Within 30 minutes smoke had spread to involve floors 6 to 12 and smoke-logging affected large parts of the building, including the communal staircase, corridors and many of the flats. Six people died in the fire, three of whom were children. Fifteen people were taken to hospital suffering from the effects of smoke inhalation and one firefighter was admitted for treatment for heat exhaustion. A total of 38 people were assisted out of the building or were rescued by the LFB. At its height, more than 100 firefighters were in attendance at the scene, with 18 pumps, nine FRUs and other specialist appliances and officers.
- 8.2 Following an investigation by the MPS and the Health and Safety Executive (with the involvement of the LFB), the Crown Prosecution Service decided in May 2012 that no prosecutions should follow. Thereafter dates were set for the inquests, which were heard by Assistant Deputy Coroner, Her Honour Frances Kirkham CBE, between 14 January and 28 March 2013. A full transcript of the coroner's summing up to the jury of 20 and 21 March 2013 can be found at <https://www.lambeth.gov.uk/elections-and-council/lakanal-house-coroner-inquest>.
- 8.3 On 28 March 2013, at the end of the hearings, the coroner made a number of recommendations under rule 43 of the then current Coroners' Rules, some of which were directed at the LFB. So far as concerned the LFB control room, the coroner said that, in the light of the "extensive work [already] undertaken to learn from the experience with the fire at Lakanal House", the introduction of new policies and the review of existing policies, she would make no recommendations in relation to communications between the control room and the incident ground, guidance on the handling of FSG calls or training for officers dealing with such calls.
- 8.4 The Lakanal House fire was an important event in the history of the LFB's response to firefighting in a high-rise residential block and to emergency call handling. It is no exaggeration to say that the Lakanal House fire is etched into the consciousness of the LFB as an institution and into the memories of those officers who attended it. Of the CROs on duty in the control room on the night of the Grenfell Tower fire, four (CROs Debbie Real, Heidi Fox, Angie Gotts and Peter May) had been on duty during the Lakanal House fire and had handled calls from people inside the building.

2 The LFB's response to the Lakanal House fire

- 8.5 As a result of the Lakanal House fire, the LFB undertook a detailed internal review of its practices and policies relating to call management in general and FSG calls in particular. In November 2012 it produced a detailed report entitled "Fire at Lakanal, Havil Street, SE5 on 3 July 2009 – Role and Actions of the LFB Control"¹ (the LFB Lakanal Report).¹

¹ [HOM00001124].

- 8.6 The LFB Lakanal Report examined the historic frequency of FSG calls received by the control room, the training and experience of the CROs in providing fire survival guidance and the nature of the essential advice to be given to callers. The statistics for the five years to 2009 revealed that the number of emergency calls in response to which fire survival guidance had been given was very small compared with the overall number received by the control room.² In the five years to 2009 there were 77 FSG calls out of a total of 728,770 calls received, or 0.0101%, and a yearly average of 15.4 FSG calls out of 145,754 calls received (0.0105%). Of these, there was only one call where any fatalities (in that case two) had been recorded.³
- 8.7 There is no evidence to suggest that the picture changed materially in the years between the Lakanal House fire (2009) and the Grenfell Tower fire (2017). It is also important to observe that, of the total of 60 emergency calls handled by the control room during the Lakanal House fire, only four were FSG calls.⁴ Even that number of FSG calls from a single incident and the pressure they created were described by one officer who assisted the LFB's Lakanal House investigation as "unique".⁵
- 8.8 The other important aspect of the LFB Lakanal Report for present purposes was the examination of how the control room handled FSG calls during that fire. The report arrived at its conclusions at section F6. Paragraphs 290 and 293 to 296⁶ are worth setting out in full here:

"290. **Information gathering:** The quality of the information gathered by [CROs] during the incident varied dependent on the type and length of call. Some calls only required the confirmation of the address to confirm it was a 'duplicate' to the Lakanal fire, whereas the FSG calls involved detailed information gathering. [CROs] often found out about the caller's flat number, which floor they were located on, if they were on their own and their specific location in the flat. However, in the various source documents (e.g. MobIS report, FI report, recordings) there is reference to floor numbers being gathered from callers but these were not always passed to the incident ground in every instance.

...

293. **Expectations that callers would be rescued and 'stay put' advice:** [CROs] had a clear expectation that fire crews would reach the callers quickly. Their experience was that fire appliances arrive quickly and that people are rescued by the Brigade. This is borne out by the fact that only rarely, where FSG is given, do people die in fires (see section E3). As rescues by crews were not immediate there is a question whether the [CRO] and/or callers, could have assessed the risk of attempting to escape from the flat and whether the risk of moving closer to the fire (but escaping) was less than staying put and awaiting rescue. [CROs] relied on advising callers to 'stay put' expecting that this would keep callers safe from the fire.

294. **Escape/alternative escape routes:** Many callers mentioned that there was smoke outside their flat or that there was smoke in the corridor preventing escape. This may have caused [CROs] to move straight into the 'protect' phase of FSG and not explore alternative escape routes with the callers. There is a real risk in attempting a self-evacuation from a building on fire that the occupant will move themselves into a position of greater harm rather than waiting in a safe location for rescue.

295. **Assessment/re-assessment of the call/caller:** Some [CROs] did repeat questions to find out what was happening at different stages of the call, including trying to find rooms with less smoke. National guidance (FSC 54/2004) suggests a model which has review of assessment/initial decisions built into it [sic], although this was not included in LFB training materials. Moving to protect advice with the intent of keeping the caller safe may not always be the

² Table 1 and paragraphs 149-152 [HOM00001124] p. 28.

³ LFB Lakanal Report paragraph 168 [HOM00001124] p. 31.

⁴ LFB Lakanal Report paragraphs 182, 185 and Chart 2 [HOM00001124] p. 37.

⁵ LFB Lakanal Report paragraph 287 [HOM00001124] p. 49.

⁶ Repeated at paragraphs 313 and 316-319 [HOM00001124] p. 54.

best solution and the call should be continually re-assessed. There may be a tendency to limit re-assessment due to the protect ethos, although there is evidence that some proactive call handling techniques did take place.

296. **Effective communication between Control and incident command:** There is evidence of information passing from Control to the incident ground and only one occasion when the details of a flat with people trapped were not passed in a timely way. Control supervisors regularly tried to obtain information about the progress with the incident particularly in relation to callers being given FSG. In line with practice at the time, there was much less information being passed from the incident ground to Control about the progress of firefighting and rescue efforts. It is not clear that if [CROs] had been given information about progress that it would have influenced the advice given to callers.”

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