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

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

Phase 1 Report – Appendix L

Lift installations – fire safety requirements and provisions

REPORT OF

Dr Barbara Lane FREng FRSE CEng

Fire Safety Engineering

24th October 2018

Specialist Field	:	Fire Safety Engineering
Assisted by	:	Dr Susan Deeny, Dr Peter Woodburn, Dr Graeme Flint, Mr Tom Parker, Mrs Danielle Antonellis, Mr Alfie Chapman
On behalf of	:	Grenfell Tower Inquiry
On instructions of	:	Cathy Kennedy, Solicitor, Grenfell Tower Inquiry
Subject Matter		To examine the circumstances surrounding the fire at Grenfell Tower on 14th June 2017
Inspection Date(s)	:	6th October, 1st November, 7-9th November 2017

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Appendix L – Lift installations – fire safety requirements and provisions

CONTENTS

L1 Purpose of this Appendix

L1.1.1 In this Appendix L, I set out the required hardware and protection for firefighting lift installations for buildings such as Grenfell Tower both at the time of construction, and under current standards. That analysis has allowed me to conclude that the lifts, replaced in 2005 and most recently modified during the primary refurbishment 2012-2016, did not meet the requirements for a 'firefighting lift'.

L1.1.2 The lifts did undergo a substantial refurbishment in 2005, but appear to have been refurbished to the standards required for a 'fire lifts' in accordance with CP3 1971, and not to the fire fighting lift standard required in 2005.

L1.1.3 The Inquiry has also asked me to examine the control function of the lifts in Grenfell Tower during the fire, based on witness evidence, and compare this to the expected function of such lifts as set out in the design guidance. I have made my comparison based on both the original 'fire lift' functionality and refurbishment-era 'firefighting lift' functionality.

L1.1.4 The behaviour of the lift observed during the fire on the 14th June 2017 is documented in firefighter witness statements, transcripts of fire fighter oral evidence and CCTV evidence.

L1.1.5 In Table L.5 I present my comparison of the expected behaviour (as outlined in the relevant design guidance) of a lift under firefighter control, with selected evidence from firefighters, corroborated by the CCTV images presented in Section L5.

L1.1.6 From this I conclude that at specific (and at different) times during the fire, each lift failed.

L1.1.7 I have also been provided with a report by WSP prepared for the MPS (MET00019973) which provides the preliminary findings of their site investigations of the lift cars, lift controllers and fire control switches.

L1.1.8 WSP make the following observations for the switches:

"As the fireman's switch on the 2nd floor (walkway) was not connected to the controllers we can only assume that it was never tested at regular intervals ....

As the mechanism on the fireman's switch on the ground floor was defective then we can assume this had not been examined by the lift service company at regular intervals"

L1.1.9 They also conclude that:

L1.1.10 *"We can safely assume that the lift controllers did not receive any signal for a recall to the designated landing (Log 68) and that the lifts were not switched to fireman's Service (Log 70)"*

L1.1.11 The compliance of testing and maintenance of the fire safety systems in Grenfell Tower by the responsible persons with the Regulatory Reform (Fire Safety) Order 2005 will form part of the Phase 2 investigations.

L1.1.12 I recommend that the Public Inquiry appoint a lift expert to carry out a detailed investigation into the design, construction, maintenance, and operations of the lifts. All these issues can then be further examined by the lift expert, including the issues I have raised to date.

L2 Firefighting lift features in design guidance

L2.1 Relevant design guidance

L2.1.1 As I have explained in Section 4 the relevant years for the main lift installations (called HO90 and HO91) at Grenfell Tower are:

- 1974: Time of construction and installation of original lifts.
- 2005: Replacement of lift installation.
- 2015: Addition of 4 new landing openings on two floors (levels 1 & 3).

L2.1.2 In Section 4 of my report I explain those works

L2.1.3 Further information regarding the status of the design guidance in those time frames, can be found in Appendix D of my report.

L2.2 Firefighting lift provisions in ADB 2013

L2.2.1 The guidance at the time of the most recent 2012-2016 refurbishment, Section 17.2 of ADB 2013, requires a firefighting lift to be installed in tall residential buildings.

L2.2.2 As seen in Diagram 52 of ADB 2013, ADB 2013 states that the fire-fighting lift landing doors should be at least FD60 fire doors.

L2.2.3 ADB 2013 section 17.13 then refers to Section 7 & 8 of BS5588-5:2004, which requires a firefighting lift to have the following features:

a) Primary and secondary electrical supplies with automatic changeover in the event of primary supply failure. The cabling for each of the supplies should take separate paths to the machine room – to provide robustness to the function of the lift throughout firefighting operations;

b) Water ingress protection to the installation and shaft – to prevent the ongoing use of the lift for firefighting operations to be affected by firefighting water;

c) Provision of an escape hatch – to facilitate the rescue of trapped firefighters in the lift car;

d) BS EN 81-72 compliant firefighting communication system between the lift car, machine room and lobby at access level;

e) Other lifts in the same well as a fire-fighting lift should not introduce significant additional fire risks: Goods lifts and service lifts should not be located within fire-fighting shafts. Passenger lifts should not be located within a fire-fighting shaft unless the lift cars are constructed in accordance with BS EN 81-72.

f) Firefighting controls at Ground Level – so firefighters are able to assume control of the lift car without interference once arriving at the building;

g) Compliance generally with BS EN 81-72 which sets out further guidance on the above as well as the following further provisions:

i. A capacity of 630kg;

ii. A minimum size of 1100mm x 1400mm; and

iii. The lift should reach the furthest floor from fire service access level within 60s.

L2.2.4 These requirements are summarised in Figure L.1:

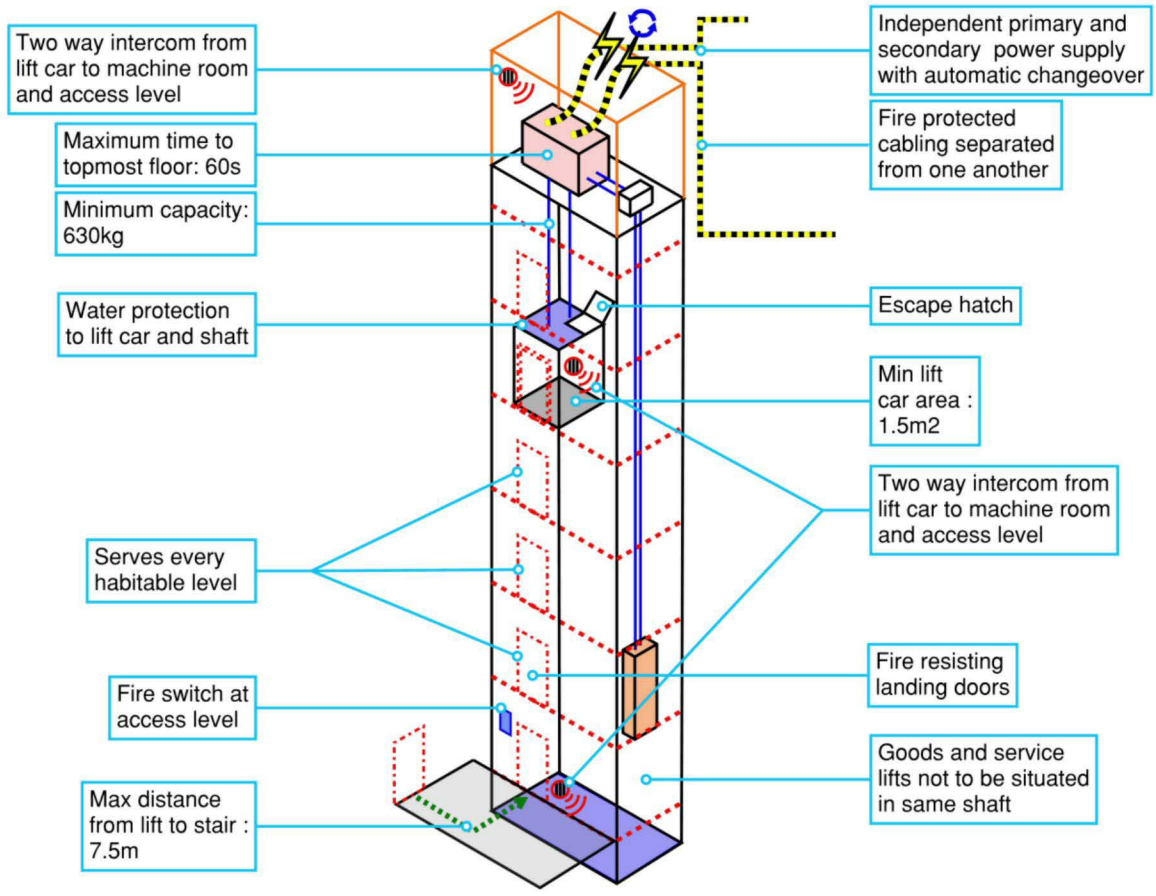

Figure L.1: 'Firefighting lift' requirements as per ADB 2013

L2.2.5 The foreword of BS 5588-5:2004 states:

"This new edition represents a retitling and full revision of the standard, and introduces the following principal changes:

...

b) removal of all recommendations relating to fire-fighting lifts that are now covered in BS EN 81-72;"

L2.2.6 Hence, it is intended to be read in conjunction with BS EN 81-72. However, BS EN 81-72:2003 states in Section 1: *Scope*:

"1.2 This standard is not applicable to:

- *lifts installed in existing buildings;*
- *important modification to existing lifts installed before the publication of this standard;"*

L2.3 Firefighting lifts provisions in CP3 1971 and Section 20 Code of Practice 1970

L2.3.1 Neither CP3 1971 or Section 20 Code of Practice 1970 include a description of 'firefighting lifts', and instead state make provision for 'fire lifts' in a building.

L2.3.2 CP3 1971 states:

a) Where passenger lifts are installed in a building, one or more should be provided with a fire switch whereby firemen obtain the use of a lift without interference; and

b) In blocks of flats, fire lifts should serve every residential floor; and

c) A fire lift should have a platform area of not less than $1.5m^2$ / "*approximately 15 ft*^{2}" a capacity of 550kg / "*approximately 1200lb*" and reach the top floor from Ground Level within one minute; and

d) The electric supply to any fire lift should be provided by a sub-main circuit exclusive to the lift; and

e) The cabling of the power supply should avoid high fire risk areas; and

f) The maximum distance from the stair door to the lift is 10 metres.

L2.3.3 These requirements of a CP3 1971 '*fire lift*' are summarised in Figure L.2:

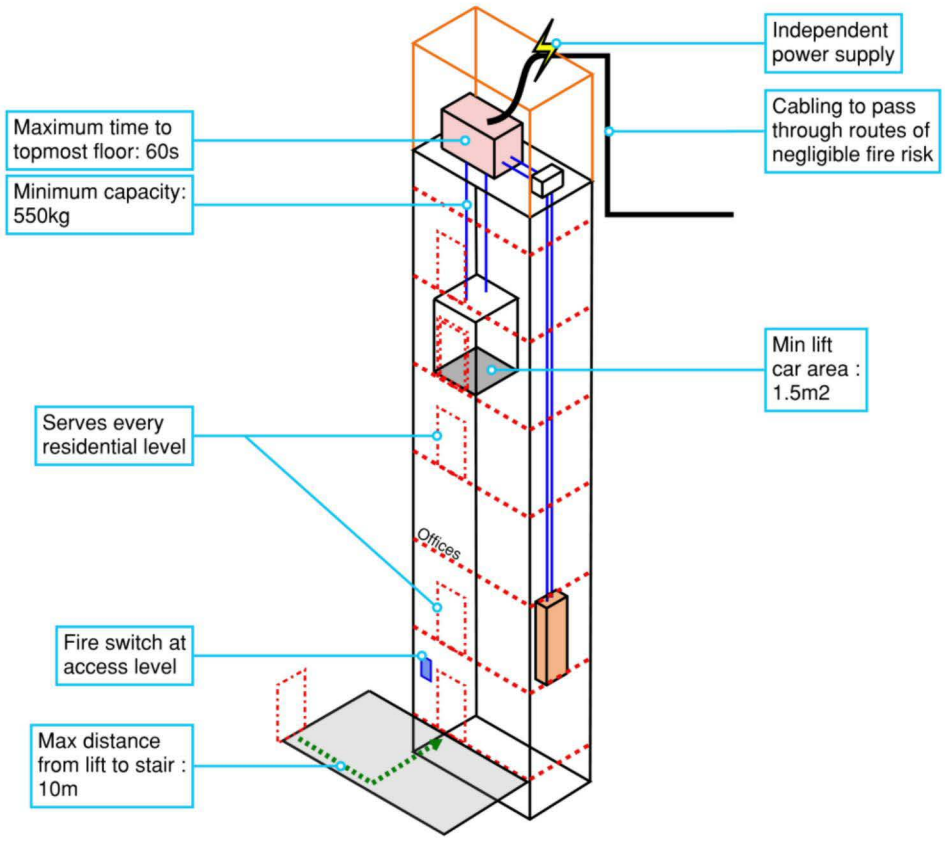

Figure L.2: 'Fire lift' requirements as per CP3 1971

L2.3.4 Section 20 A3.01 *"Enclosures to fire lift and switch control"* states:

"A fire lift should be enclosed with walls in conformity with A Part 1 item A1.03 of this Appendix and be arranged so as to be available for the exclusive use of firemen in an emergency.

A switch-operated control in a glass-fronted box, clearly marked 'FIRE SWITCH'. should be provided at ground level or other level to be decided by the Chief Officer of the London Fire Brigade, adjacent to the lift opening. whereby firemen can obtain immediate control of the lift without interference by the ordinary call points."

Service lifts should not be adapted for use as fire lifts without the prior approval of the Council."

L3 Operation of a firefighting lift under firefighter control

L3.1.1 Fire lifts and fire fighting lifts should be programmed such that the operation of a fire control switch can initiate the functions described in the following design guidance.

L3.1.2 I have presented this 'firefighter functionality' as it was described in the available design guidance during the construction of Grenfell Tower, at the time of the lift replacement in 2005, and in 2015 during the refurbishment works.

L3.2 Design guidance during original installation: 1972 - 74

L3.2.1 CP3 1971 & GLC Section 20 Code of Practice 1970

L3.2.2 Clause 6.5 of British standard code of practice CP3 Chapter IV: Precautions against fire Part 1: Flats and maisonettes (in blocks over two storeys) 1971 requires that lift enclosures and machine rooms conform to BS 2655 and CP 407.101:

6.5 LIFT ENCLOSURES AND MACHINE ROOMS

Lift enclosures and machine rooms should conform with BS 2655 and CP 407.101 (see also **7.6**).

Lift machine rooms should preferably be sited at the top of the lift shaft and should always be so sited if the lifts open out of a common approach route or stairway that provides the only means of escape from a dwelling.

Figure L.3: Clause 6.5 CP3 1971

L3.2.3 Furthermore, clause 7.6 of CP 3 1971 includes requirements for fire lifts, including provision of a "Fire Switch":

7.6 FIRE LIFTS

7.6.1 Where passenger lifts are installed in a building, one or more should be arranged so as to be available for the exclusive use of firemen in an emergency by providing at entrance level a switch in a glass-fronted box marked ' FIRE SWITCH ' which operates a control whereby firemen can obtain the use of a lift without interference from the landing call points. Alternatively, the fire switch may be in a box protected by a metal cover and which can be unlocked by a key which would pass the dry riser box and any other locks which would require to be opened by the fire brigade. The design and type of switch for use with fire lifts should conform to the requirements of the local Fire Authority.

Figure L.4: Clause 7.6 CP3 1971

L3.2.4 The requirements of the GLC Section 20 Code of Practice 1970 are identical, with one exception. CP3 1971 permits a fire control switch to be in a *"glass fronted box marked 'FIRE SWITCH'"* or "*in a box protected by a metal cover and which can be unlocked by a key which would pass the dry riser box"* GLC Section 20 Code of Practice 1970 permits only a glass fronted box.

L3.2.5 BS 2655-1: 1971

L3.2.6 *BS 2655-1:1971 Specification for lifts escalators, passenger conveyors and paternosters. General requirements for electric, hydraulic and hand-powered lifts* provides further relevant guidance for lift installations. It states in section 4.5 *Fire switch*:

*"**4.5.3 Operation.** The operation of the fire switch shall be such that all safety devices remain operative, including maintenance switches. Arrangements shall be made for the operation of the fire switch to bring the firemen's lift*

car to the fire control level without delay and with doors parked open. A service switch, as defined in Part 9, shall not override the fire control switch.
Whilst under 'fire control' all landing call-points and control switches shall be rendered inoperative and sole control vested in the car control station, ensuring that any collective control becomes inoperative."

L3.2.7 Therefore, at the time of construction of Grenfell Tower, a switch was required "*which operates a control whereby firemen can obtain the use of a lift without interference from the landing control points*".

L3.2.8 The purpose of the switch described in CP3 1971 is to bring the lift under sole control of the fire service for their use.

L3.3 Design guidance at time of lift replacement – 2005

L3.3.1 ADB 2000

L3.3.2 The statutory guidance at the time of the lift replacement in 2005 was Approved Document B, 2000 edition. ADB 2000 section 18.11 states that firefighting lift installations should be constructed and installed in accordance with the recommendations of Section 3 of BS 5588-5:1991.

L3.3.3 BS5588-5: 1991

L3.3.4 BS 5588-5:1991 *Fire precautions in the design construction and use of buildings. Code of practice for fire-fighting stairs and lifts* provides design guidance in section 3 for firefighting lifts. Furthermore, as stated in BS5588-5: 1991 (replicated below), the control system requirements within this standard replace the 'fireman's switch control' requirements in BS 2655:

"1 Scope

This code of practice provides guidance for designers in providing firefighting stairs and lifts to assist the fire service in firefighting operations. Some recommendations are also made with respect to passenger, goods and service lifts adjacent to a firefighting lift where they affect the use and safety of the firefighting lift.

NOTE 1 The control system described in clause 14 is also suitable for evacuation lifts described in BS5588-8 and should replace the fireman's switch control described in BS2655 wherever possible."

L3.3.5 The control system requirements from Clause 14 of BS5588-5:1991, relevant to a firefighting lift switch, are included below. This standard also includes a requirement for a fire-fighting lift switch and provides a more detailed description of the exact operation required from the lift, after operation of the fire-fighting lift switch.

L3.3.6 BS 5588-5:1991 provides a set of direct recommendations of the firefighting switch operation in section 14.2 (g) and (h):

"***14.2 Recommendations***

…

g) Operation of the firefighting lift switch should automatically ensure the following.

1) Landing call buttons and car control stations within the firefighting shaft, with the exception of the car door controls, should be rendered inoperative.

2) Safety devices for all lift landing doors and all lift car doors in the firefighting shaft that may be affected by smoke or heat, so as to prevent door closure, should be rendered inoperative.

…

3) All lifts within the firefighting shaft should return as soon as practicable to the fire service access level with a "Lift under fire service control" sign illuminated within each lift car. The "Lift under fire service control" sign should remain illuminated until the firefighting lift switch is returned to the "off" position.

NOTE 3 It is important that any lift travelling away from the fire service access level be able to stop and reverse without the car doors opening.

NOTE 4 The firefighting lift (and any other lifts within the firefighting shaft) may be returned to fire service access level at any time by switching the firefighting lift switch from "on" to "off" (for a minimum of 5s) and back to "on".

4) On arriving at the fire service access level, all lifts within the firefighting shaft other than the firefighting lift should be retained there with the lobby and car doors kept in the closed position (after opening for the discharge of passengers).

…

5) The fire service communications system (see clause15) should be operative.

…

7) Warnings that the switch has been operated that are both audible and visible at all points within the lift well, motor room and any other area entered for maintenance purposes should be provided.

NOTE 8 The audible and visible alarm signal need to be provided in case a maintenance engineer is working on the firefighting lift installation. They also need to be operated by the fire alarm system.

…

h) After the firefighting lift has parked, with doors open, in response to operation of the firefighting lift switch, sole control should then be vested in the firefighting lift car control station, and the following should be ensured.

1) It should not be possible to register a call to a landing other than landing by sustained pressure on a lift car call control until the car doors have closed fully. If the car call control is released before the doors have fully closed, they should re-open immediately.

2) Registration of a call should cause the lift car to travel to, and stop with the doors remaining closed, at the selected landing.

3) If the car is in motion, it should be possible to register further calls from within the car. The car should stop at the nearest landing in its current direction of travel for which a call is registered. When the car stops, all calls should be automatically cancelled and the car should not depart until a fresh call is registered.

4) If the car is stationary at a landing, it should be possible to control the opening of the doors only by the application of continuous pressure on the "door open" car control. If the control is released before the doors are fully open, the doors should automatically re-close. Once fully open, the doors should remain open until a new call is registered on the car control station."

L3.3.7 BS5588-5: 2004

L3.3.8 BS5588-5: 1991 was superseded by BS5588-5:2004 *Fire precautions in the design construction and use of buildings. Access and facilities for fire-fighting.* This code was published during the design of the replacement lifts in Grenfell Tower in 2005 and therefore could have been used to provide guidance to the design, even though it was not explicitly referenced in ADB at that time.

L3.3.9 In Section 8 of the 2004 edition of the code, the fire-fighting lift control systems are described (replicated below) and they include a fire-fighting lift switch:

8 Fire-fighting lift control systems

8.1 General

Fire-fighting lift control systems should conform to BS EN 81-72. A fire-fighting lift switch should be provided to enable the fire service to obtain immediate control of the fire-fighting lift(s) in a fire-fighting shaft. Provision should be made to control access to the fire-fighting switch. If there are two or more lifts installed together, there should be clear indication as to which lift is the fire-fighting lift.

NOTE prEN 81-71[1)] gives requirements for lifts that are located in areas subject to vandalism.

Figure L.5: Section 8.1 of BS5588-5:2004

L3.3.10 The requirements for the operation of the lift under fire fighter control did not change in this new standard, as explained in Section 8.2 *Operation of the fire-fighting lift control system:*

The car controls of the fire-fighting lift should become active only after it has arrived at the fire service access level and the fire-fighting lift switch has been operated. Once the fire-fighting lift has arrived at the fire service access level, its doors should open and it should then operate as follows.

a) Fire personnel entering the lift car should be able to register a call to any selected landing in the building by sustained pressure on a car control until the car doors have fully closed.

b) If a car control is released before the doors have fully closed, the doors should immediately reopen and the call should be cancelled.

c) Once the lift is moving, it should be possible to register additional calls on the car controls. The lift should travel in the direction of the first call registered, and should stop at the first floor encountered for which a call is registered.

d) The doors should remain closed unless they are operated by continuous pressure on the "door open" control. It should not be possible to open the doors without sustained pressure on the control.

e) Release of the "door open" control before the doors are fully open should cause the doors to automatically re-close.

NOTE 5 This allows fire service personnel to observe the situation immediately outside the lift landing doors in the fire-fighting lobby.

f) Once the doors are fully open they should remain open until a new call is registered at the car control station.

Figure L.6: Excerpt of section 8.2 of BS 5588-5:2004

L3.3.11 This same operation is described in more detail in BS EN 81-72:2003 *Safety rules for the construction and installation of lifts — Particular applications for passenger and goods passenger lifts — Part 72: Firefighters lifts* (referred to by Clause 8.1 of BS 5588:2004).

L3.4 Design guidance at time of refurbishment – 2012-2016

L3.4.1 ADB 2013 still refers to BS 5588-5: 2004 and also BS EN 81-72:2003.

L3.4.2 BS EN 81-72:2003 has since been superseded by BS EN 81-72: 2015. However, the function of a fire-fighting lift switch to bring the lift under sole operation of the fire service remains unchanged, as I have explained above.

L3.5 Lift Recall function

L3.5.1 Separate to the guidance for firefighting lifts specifically is the guidance for the programming of a normal passenger lift, in the event of fire. I have investigated the relevant standards for the design of passenger lifts for recalling the lift under fire.

L3.5.2 The standards applicable to passenger lifts generally provide requirements for their action in the event of fire. The relevant standard during the 2005-2006 lift installation was BS 5655-1: 1986 and BS EN 81-1: 1998 for the passenger lifts.

L3.5.3 In BS 5655-1: 1986 *Safety rules for the construction and installation of electric lifts* I have found no recommendation for a manual switch to isolate the lifts in the event of a fire. On the contrary, this standard recommends continued function of the lift with measures to prevent it from serving the fire affected floor.

L3.5.4 Section G.2 *General* (recommendations) describes the principle of continued lift function in the event of a fire:

*"**G.2.3** … It seems useful to consider:*
a) that it may not be desirable to interrupt the activities of a whole "tower" because of a localized fire;"

L3.5.5 Section G.3.5 provides specific recommendations for operation depending on the structural arrangement considered:

*"**G.3.5.2.1** On detection of a fire in a compartment other than that formed by the wells and their landings:*

a) the "fire-resisting" doors of the corresponding storeys will close automatically if they are not normally in the closed position;

b) any despatch signals to send the lifts to these storeys will be cancelled and the corresponding buttons in the car made inoperative;

c) the occupants of the threatened storeys shall use the emergency staircases. The corresponding landing call buttons will be made inoperative."

L3.5.6 Section G.2.2 states that smoke detectors shall not be used to initiate this operation:

"Smoke detectors shall, because of their sensitivity, never be associated with the operation of lifts

L3.5.7 Therefore, an alternative means of detection would be required to initiate this function. I did not observe any type of detection other than smoke detectors within the lobbies or find evidence in the 2005 scope of works for installing any other form of detection in the lobbies. Therefore, it does not appear at this time that the functions described in this standard for passenger lifts in the event of fire were installed in Grenfell Tower. However, I may need to revise my analysis should further evidence regarding lift controllers become available.

L3.5.8 BS EN 81-1:1998 *Safety rules for the construction and installation of lifts – Part 1: Electric lifts* does not give any specific guidance on actions of passenger lifts in the event of fire.

L3.5.9 However, I have found specific recommendations in BS EN 81-73: 2005 *Safety rules for the construction and installation of lifts —Particular applications for passenger and goods passenger lifts — Part 73: Behaviour of lifts in the event of fire* which was published during the installation of the new lifts in June 2005 (Table L.1).

L3.5.10 In summary, it states:

a) Lifts shall be taken out of normal service in the event of fire:

i. All landing and car controls shall be rendered inoperative;

ii. All existing registered calls shall be cancelled;

iii. Lift shall return to designated floor and park with doors open.

b) This shall be effected by either automatic fire detection and alarm or a manual recall device.

Table L.1: Relevant guidance from BS EN 81-73:2005 on the actions of passenger lifts in the event of fire

Section	Recommendation
5.1 General	*"Lifts shall be taken out of normal service in the event of fire"*
5.1.1 Input signals	*"The lift shall operate in accordance with 5.3 on receipt of an electrical signal(s). The electrical signal(s) shall be provided either by an automatic fire detection and alarm system or* ***manual recall device****."*
5.1.1 NOTE	*"The decision as to whether an automatic fire detection system or manual recall device is selected is the subject of negotiation at the design/planning stage of the building."*
5.3 5.3.1	*"The principle of the reaction of the lift in the event of fire is to return the car to a designated landing and allow any passengers to exit.* *When a signal indicating a fire is received from the automatic fire detection and alarm system (see 3.6.1) or from the manual recall device (see 3.11) the lift shall react as follows:* *a) all landing controls and car controls including the "door re-open button" shall be rendered inoperative and* *b) all existing registered calls shall be cancelled;"*
5.3.5	*"On arriving at the designated landing lifts with power operated doors shall park there with the car and landing doors open and removed from service."*
5.3.7	*"The lift will automatically be reset to normal operation by:* *...* *b) the reset of the manual recall device designed in such a way that this reset can be done only by authorised persons."*

L3.5.11 Therefore, a recall switch would provide a different function to a fire control switch, because it completely isolates the lift from use for everyone (building occupants and fire fighters).

L4 Assessment of the firefighting lift features

L4.1 Original lifts

L4.1.1 Drawings from the Health and Safety file for the 2005 replacement of the lifts show the existing lifts at the time were sized and rated for weight in accordance with the guidance in CP3 1971 (1200lbs and 15 ft^2) (CST00000384).

L4.2 Replacement in 2005

L4.2.1 The lifts were entirely replaced in 2005 i.e. all associated equipment and machinery was replaced and the lift cars were enlarged from their original size. The Butler and Young specification documentation and health and safety

file (CST00000384) associated with the 2005 replacement includes design drawings dated 04/07/03.

L4.2.2 I have received design and construction documents disclosed by Apex Lifts. As per Section 4.5 of my Phase 1 report, Apex Lift & Escalator Engineers Ltd were appointed as main contractors for the lift replacement works in 2005. These documents have been reviewed for further evidence regarding the design, construction and commissioning of the lifts.

L4.2.3 The letter entitled 'Re: Grenfell Tower, Lancaster West Estate W11 - HO90 and HO91 (APX00000055), dated 27th October 2004, provides evidence that KCTMO instructed Apex to proceed with works on lifts HO90 and HO91. This letter does not mention the hydraulic lift. However, as the hydraulic lift was demolished in the 2012-2016 refurbishment works, it has not been investigated further.

L4.2.4 This design work was carried out prior to the introduction of BS5588-5:2004 (published in November 2004), which states that lift installations should conform to BS EN 81-72:2003.

L4.2.5 The relevant design standard for firefighting lifts at the time of the 2005 replacement, as cited in ADB 2000, was BS 5588-5:1991. This standard was republished in 2004.

L4.2.6 The Butler & Young specification for the replacement lifts installed in 2005 does not provide for full firefighting lifts (L2.2), nor does it specify compliance with the relevant standard at the time i.e. BS 5588-5:1991.

L4.2.7 The only codes listed in the specification document (CST00000384) are outlined in the table below:

Table L.2: Referenced standards in 2005 lift specification document

Standard	Title
BS 5655	Lifts and service lifts (multiple parts)
BS 7255	Code of practice for safe working on lifts
EN 81-1	Safety rules for the construction and installation of lifts — Part 1: Electric lifts

L4.2.8 The Butler & Young specification document for both electric lifts HO90 and HO91 (CST00000384) includes entries for the following BS5588-5 fire fighting fire lift features only:

a. *Section 2A.14 Controller: Duplex Lift Control Logic:* Fireman's Control is required on each lift.

b. *Section 2A.55 Car Intercom and CCTV Equipment:* Refers to an existing car intercom in the lift car to be retained and reinstated in the replacement

lift cars. It is not clear that this is a firefighter intercom as outlined in BS EN 81-72 or provided for other reasons.

c. *2A.70 Firemans Control*: Specifies fireman's control switches, their operation and operation of the lift under their control. No design standard or code of practice is specified.

L4.2.9 An extract of this specification which was included in the Apex Health and Safety file and [CST00000384] is reproduced below.

2A.70 Firemans Control

Each firemans control switch shall have a bevel edge escutcheon for operation of the drop release key.
The faceplate shall be engraved with the words "ON" and "OFF" in characters 10 mm high and engraved arrows indicating direction of operation of the switch. The faceplate shall also be engraved with the words "FIREMANS CONTROL" in characters 15 mm high and all engraving shall be 3 mm deep and filled flush with red epoxy resin.

Activation of the switch shall change the control of the lift to firemans control. The landing indicators shall identify the lift mode by scrolling the message 'LIFT ON FIREMANS CONTROL'. Under firemans control, the lift shall:

1. FIREMANS CONTROL SWITCH - ON

The lift shall remain in service at any position in the lift shaft upon operation of the switch but car and landing calls shall be cancelled and rendered inoperative immediately.

...

On reaching the Ground floor, both the car and landing doors shall open and remain open. The car pushes shall assume control, of the firemans lift only but all landing pushes shall remain inoperative whilst the lift is on Firemans Control.

...

Registration of a car call and closure of the doors shall only be by sustained pressure on a lift car push, after which the lift shall commence travelling to the registered floor. Should a further call be lodged below the first call once the lift is in motion but within stopping distance, the lift shall answer the lowest call and, upon arrival, shall cancel the other call(s).

The lift doors shall only be opened at floor level by sustained pressure on the 'door open' push and if released before the doors fully open, the doors shall close.

L4.2.10 I have considered the following three key sources of information, (from different stages of the project), based on the documents provided by Apex:

a. **Scope of works documents** – planning documents that originally set out the materials, work and components needed to comply with the specification. This comprised of four separate documents:

   i. General requirements (APX00000037)

   ii. Landing fixtures and finishes (APX00000038)

   iii. Lift car fixtures and finishes (APX00000039)

   iv. Outline (APX00000081)

b. **Order progress sheets** – tracker documents found within the disclosed *"project file"* for Grenfell Tower that were used during the project timeline to organise equipment orders. These are split into two copies that are hand completed:

   i. Customer: 'kensington and chelsea' (sic) (APX00000094)
   Fields for order number, date order received, or job number not completed.

   ii. Customer: 'butler and young' (sic) (APX00000094)
   Job number: C5471
   Fields for order number, date order received not completed.

c. **Commissioning certificates** (Table L.3) – certificates outlining a series of tests undertaken when the lifts were put into service to ensure they were operating as intended.

L4.2.11 No method statements were received accompanying the commissioning certificates and therefore I do not know whether all commissioning checks required by the relevant standards were contemplated or undertaken.

Table L.3 Commissioning certificates provided by Apex Lifts Ltd

Type	Test date	Document date	Signed by	Document references	Guidance document
Lift C5471					
Permanent record	None stated	02/02/2006	T.M. Pamment	APX00000095 p15-42	EN 81-1 EN 81-2: 1998
Lift HO90					
Site record	03/02/2006	None stated	T.I. Cook	APX00000096 p3-21	BS 5655-1 (i.e. BS EN 81-1)
Permanent record	03/02/2006	14/02/2006	T. Cook	APX00000095 p43-59 APX00000096 p1-2	
Lift HO91					
Site record	09/08/2005	None	Roger Anthony	APX00000094 p19-40 APX00000095 p1-14	BS 5655-1 (i.e. BS EN 81-1)
Permanent record	09/08/2005	19/08/2005	Roger Anthony	APX00000096 p22-40	

L4.2.12 The '*Scope of works - general requirements'* (Figure L.7) is a one-page document containing the following table only.

SCOPE OF WORKS – GENERAL REQUIREMENTS
GRENFELL TOWER

Details	**Lift No**
Type of Lift	Passenger
Carrying Capacity	12 Person 900Kgs
Operating Speed	2.0 m/s
Roping Arrangement	1:1
Motor Drive System	ACVVVF
Control System	Duplex Collective
Floors Served	22
Floor Designation	S, W, 1 - 20
Machine Room Location	Above
Car Entrance Type	Power Operated
Landing Entrance Type	Side Opening
Dimensions (approx only) Lift Shaft	Width Existing Depth
Lift Car	Width 1400mm Depth 1400mm Height 2250mm
Entrance	Width 900mm Height 2000mm
Machine Room	Width 4303mm Depth 5040mm
Total Travel	63209mm
Pit Depth	1390mm
Headroom	3930mm
SPECIAL REQUIREMENTS	
Fire Fighting Lift to BS5588	
Fire Fighting Control Only	
Standby Generator Interface	
BMS Interface	
Fire Recall	✓

Figure L.7: Excerpt of Scope of Works for 2005 lift replacement (APX00000037)

L4.2.13 Whilst the specific lift reference is not included (i.e. it is not clear if this refers to one specific lift or both), the carrying capacity, speed and dimensions match that listed in the specification document for the two main electric lifts.

L4.2.14 The floor designations (W=walkway, 1-20 floors of residential accommodation), floors served (22) and total travel (circa 63 metres), match the characteristics of the main lifts of Grenfell Tower – see Figure L.7.

L4.2.15 This scope of works also includes a '*special requirements'* section that lists '*BS5588 compliance'*, '*firefighting control'*, '*standby generator interface'* and '*fire recall'*. Based on the completed form, it appears that this section is intended to be read as a selection of options which can be ticked. This Apex scope of works provides further evidence that the lifts installed during the 2005 lift replacement works were not fire fighting lifts as required by the statutory guidance. Specifically:

L4.2.16 **First**, under the section dealing with special requirements *'Fire Fighting Lift to BS5588'*, this is not ticked. The BS 5588 series is titled "*Fire precautions in the design, construction and use of buildings"*. The relevant part of this

series for a fire fighting lift is BS 5588: Part 5: 2004 *Fire precautions in the design, construction and use of buildings, Code of Practice for fire fighting stairs and lifts*, which was the required standard for compliance with Approved Document Part B 2000, the relevant statutory guidance at the time of the works. I can find no evidence in the scope of works specifying BS5588: Part 5, therefore it appears that provision of a fire fighting lift was not included in the Apex scope of works.

L4.2.17 **Secondly**, I have found only three items listed which are consistent with a 'firefighting lift' as per BS 5588-5:2004, namely the carrying capacity, operating speed and lift car dimensions.

L4.2.18 **Thirdly**, due to the following features being omitted from the scope of works documents, the 2005 lift replacement did not provide firefighting lifts in Grenfell Tower:

a) No secondary power supply is included in the scope of works. In the 'Scope of works - general requirements' (APX00000037) the option for provision of a *'standby generator interface'* is not ticked. A standby generator is one method of providing a secondary power supply to a firefighting in accordance with BS 5588-5:2004

b) I have found no evidence that fire resisting landing doors were specified as per ADB Diagram 52 in the *"Scope of works – landing fixtures and finishes"*. This one-page document (APX00000038) lists details of the landing fixtures and finishes, and largely shows that all finishes are to be stainless steel.

c) I have found no evidence of an escape hatch, as required by BS5588-5 in the *"Scope of works – lift car fixtures and finishes"*. This one-page document (APX00000039) lists only details of the lift car fixtures and finishes, including specific products and manufacturers.

d) I have found evidence of only one type of communication device specified (APX00000039) and purchased (see Figure L.8) for the replacement lifts - a 'telephone autodial'. This appears to be an emergency communications system. These systems are required for all passenger lifts by in BS EN 81-1: 1998 *Safety rules for the construction and installation of lifts — Part 1: Electric lifts* and provide telephone communication from the lift car to an external service centre e.g. in case of occupants becoming trapped. I have found no evidence that a firefighting intercom (three-way communication between the ground floor lobby, machine room and lift car) was specified, as would be required for a firefighter lift.

Materials	Order To	Order N/0	T&C	Order Date
Telephone AutoDial	WNO	64716		25.5.05

Figure L.8: Telephone AutoDial row in order progress sheets (p3-10 APX00000094)

L4.2.19 **Finally**, I have considered the commissioning certificates (Table L.3) which list out all of the inspections and tests undertaken. These specifically state that the firefighting lift design requirements are not applicable to the Grenfell Tower lifts, as shown in the excerpt in Figure L.9 below.

b) If the lift is a firefighting lift , confirm that it has been designed in accordance with BS 5588 : Part 5: ☑ N/A ○ Yes *

c) If the lift is a firefighting lift , confirm that it has been tested in accordance with BS 5588 : Part 5: ☑ N/A ○ Yes

Figure L.9: Commissioning certificate for HO91 section 14 (APX00000095)

L4.2.20 The Apex scope of works does not provide any evidence for the provision of a fireman's switch in Grenfell Tower, which is required to comply with a CP3 1971 fire lift. In the '*Scope of works - general requirements'* (APX00000037) the option for *'Fire Fighting Control Only'* is not ticked.

L4.2.21 The order progress sheets include a row for 'Firemans switch' as well as the 'Fire control indicator' that would be located within the lift car and illuminated on activation of the fireman's switch. Both are left empty on the sheets for the main lifts (Figure L.10), indicating no specific fire fighter control equipment was ordered by Apex for the lifts.

Materials	Order To	Order N/0	T&C	Order Date	Quote Req	Required On	Revised Date	Date Received
Direction arrows								
Firemans switch								
Pit switch	Apta							
Overload indicator	STENT	"						
Fire control indicator								
Door closing buzzer								

Figure L.10: Rows in order progress sheet for components associated with firefighter control of the lift (p3-10 APX00000094)

L4.2.22 I have found no evidence in the Apex 'outline scope of works' (APX00000081) which lists equipment and components to be replaced or retained in the works, or that any existing fireman's switches were to be replaced or retained.

L4.2.23 I have also found no evidence in the commissioning certificates of testing of the function of a fireman's switch/fire fighter control switch.

L4.2.24 The Apex evidence therefore conflicts with the Butler and Young 2005 lift specification (CST00000384) which included a '*Firemans Control*:'. It also conflicts with my own observation of switches at ground and second floor level; with the latter control marked with the words "fire control" (See Figure L.11).

Figure L.11: Photographs from WSP site investigation report (MET00019973) showing both ground level (left) and level 2 (right) switches were embossed with 'FIRE CONTROL' in red lettering

L4.2.25 Instead, under the special requirements heading in the Apex *'Scope of works - general requirements* document (APX00000037) *'Fire Recall'* is ticked.

L4.2.26 There is no reference to 'fire recall' in any of the firefighting lift descriptions in CP3 1971, Approved Document B, BS 5588-5 or the current BS EN 81-72 *"Safety rules for the construction and installation of lifts. Particular applications for passenger and goods passenger lifts. Firefighters lifts"*. Therefore, this function is not a requirement for a BS5588-5 firefighting lift or a CP3 1971 fire lift. See Section L3.5 for how 'fire recall' functionality is described by the design guidance. It should therefore not be labelled a "fire control" switch as the switches observed in Grenfell Tower were (Figure L.11). A recall switch is only relevant for a passenger lift and not a fire lift.

L4.2.27 The Butler & Young specification (CST00000384) does not specify the provision of a fireman's control to any code of practice or design guidance. Therefore, the purpose of the Fire Control switches installed in Grenfell Tower is not defined.

L4.2.28 Whilst the Butler & Young specification makes clear that both lifts are to be under Fire Control, I have no evidence at this stage that both lifts were connected to the Fire Control switch on either the Ground or Level 2.

L4.2.29 I do not know when each of the switches observed ground level and level 2 were installed. Therefore, I do not know, based on the evidence available to me, if one or both existed and were simply retained in 2005, or one or both switches were provided as new in 2005; of if a further change to one or both

switches occurred during the primary refurbishment. The TMO may be able to clarify this in due course.

L4.2.30 Nor do I have any evidence that either lift had a recall which was effected by either automatic fire detection and alarm or a manual recall device. Or if the fire control switches observed on site, were connected to one lift only.

L4.3 Lift Works as part of most recent refurbishment

L4.3.1 Works were undertaken on the lifts at Grenfell Tower as part of the 2012-2016 refurbishment works. This included the provision of new openings in the lift shaft to serve two more residential floors (Levels 1 and 3).

L4.3.2 It appears from the documentation available to me that members of the 2012-2016 design team believed that the existing lifts (the 2005 replacement of which is described above) were firefighting lifts:

L4.3.3 In January 2014, despite Max Fordham stating the absence of an escape hatch and secure dual power supplies on schematics for the lifts, Carl Stokes advised (CST00000552):

"As these are newly refurbished/installed lifts I can only assume that they comply with all the electrical provisions of a FF/Evac lift, otherwise the maintenance/installation company would have raised this item at the time of the work being undertaken."

L4.3.4 Section 3.1.5 of the Exova fire strategy for Grenfell Tower dated 07/11/13 assumes the presence of a firefighting lift. (EXO00001106)

L4.3.5 At this time Appendix 8 of the TMO fire safety management policy of November 2013 (TMO00830598) features a register of all lifts within TMO properties, and lists the two main lifts H090 and H091 at Grenfell Tower as "*firefighting lifts*".

L4.3.6 However, as I have explained in my description of the 2005 lift replacement works, the lifts installed at Grenfell Tower in 2005 could not be fire fighting lifts as they do not have all the critical life safety features required.

L4.3.7 It should also be noted that the TMO have their own definition (in the lift register appended to the earlier policy document) of a firefighting lift, that does not replicate the provisions of any design standard, as excerpted below:

1. *"Minimum car size (1100mm wide x 1400mm deep) for 8 persons capacity (630kg).*
2. *Dedicated power supply serving lift (3 phase). Additionally, ancillary items such as lift alarm, lighting etc. are also served by their own dedicated power supply*

3. *2-way communication on new lifts includes connection to Customer Service Centre / out of hours monitoring service when the lift alarm is activated*

4. *Fireman's Control Switches fitted. When operated this causes the lift to return to ground floor and open to allow the fire fighters access. It stops landing calls being registered and allows the authorised person e.g. LFB operative to take control of the lift (by applying a constant pressure on any call button).*

Lift car and landing doors are composed of stainless steel that is not less than 16SWG thick and over 2 hours fire resistance."

L4.3.8 For the 2015 works, Apex were contracted only to install 4 lift landing openings, 2 each on Levels 1 & 3 (APX00000035, APX00000025). The quotation and appointment letter do not include details of any other works besides the provision of landing doors and equipment on these levels, with no works undertaken on any other level. Therefore, it does not appear that one or more fire control switches were to be installed by Apex as a part of these works.

L4.3.9 In the significant findings sheet associated with the Fire Risk Assessment carried out by Carl Stokes in June 2016 (TMO10017691), there is evidence of a concern about the "fire service controls":

"Can it be confirmed that the fire service controls for the lifts been moved back down to the street level? If not then this must be undertaken immediately."

L4.3.10 Therefore, while a switch was observed in the Ground floor lift lobby there is no evidence that it was correctly connected or programmed to function as intended (see further below where I refer to the police investigation into the lifts). Nor is there evidence that the Level 2 switch was decommissioned. Further, there is no evidence that the Level 2 switch was appropriately labelled as decommissioned -to prevent confusion during an emergency.

L4.3.11 It is not clear at present who was instructed to undertake this work, whether it was completed or indeed how many fire control switches were present at the time. This does provide some evidence that alterations may have been made to the fire control switches, during the 2012-2016 refurbishment works, in relation to the two fire control switches I observed. The type of key to operate the lift switch should be in the form of an 'emergency unlocking triangle' as per annex B of EN 81-1:1998 and EN 81-2:1998. The cross section of this key is the shape of a triangle.

L4.3.12 ADB 2013 section 1.38 is relevant to the interface between a building's fire detection and fire alarm system and other systems. I assume the lifts were not required to be interfaced with the detection system, as they were provided with a manual override switch. I have requested further evidence on this subject.

L4.3.13 The significant findings recorded in the June 2016 fire risk assessment by Carl Stokes (TMO10017691) identified that he understood the lift not to be interfaced with the detection system provided to activate the lobby AOVs.

L4.3.14 The TMO's fire safety policy dated November 2013 (TMO00830598) states that where lifts are installed they shall comply with the relevant standards at the time and when they are subsequently replaced the replacement lift will be compliant with the standards current at the time of replacement:

> **18.2 Fire fighting lifts**
> 18.2.1 As much of the housing stock is medium-rise and high-rise many of the blocks are served by one or more passenger lifts. Where appropriate "fire fighting lifts" are provided within TMO residential blocks. This is to satisfy the requirements of the Building Regulations which consider the height of the building etc. When lifts are installed they comply with the relevant standards at that time and when they are subsequently replaced the replacement lift is compliant with the standards current at the time of replacement. The criteria for a TMO fire fighting lift is set out below-

Figure L.12: TMO fire safety policy section 18.2 (TMO00830598)

L4.3.15 In the same paragraph the TMO go on to define their own criteria for a firefighting lift, which includes in point (4) a description of a "Fireman's control switch". It describes the switch as causing the lift to return to ground, opening to allow fire service access and importantly "*allows the authorised person e.g. LFB operative to take control of the lift*":

> 4. Fireman's Control Switch fitted. When operated this causes the lift to return to ground floor and open to allow the fire fighters access. It stops landing calls being registered and allows the authorised person e.g. LFB operative to take control of the lift (by applying a constant pressure on any call button).

Figure L.13: TMO fire safety policy description of fire control switch (TMO00830598)

L4.3.16 The TMO policy goes on to refer to Appendix 8 of the same document where a comprehensive list of all TMO lifts are provided, bold type indicating a firefighting lift.

> Attached at **Appendix 8** is a comprehensive list of all TMO lifts (fire fighting lifts as described above are indicated by bold type).

Figure L.14: TMO fire safety policy reference to appendix 8 (TMO00830598)

L4.3.17 Below is an extract from Appendix 8 showing the entry for Grenfell Tower in November 2013. Lift no H090 and H091 are both entered in **bold type** indicating they are TMO firefighting lifts. The third lift H092 which is not listed in bold, appears to be the small hydraulic lift demolished in the 2012-2016 works.

APPENDIX 8

Location of all TMO Lifts

Address	Equipment	lift no.	Location
Grenfell Tower, W11	Passenger Lift	H090	"A" L/H lift
Grenfell Tower, W11	Passenger Lift	H091	"B" R/H lift
Grenfell Tower, W11	Passenger Lift	H092	S.S. Office

Key

Lifts in bold text are fire-fighting lifts

Figure L.15: Excerpts of TMO fire safety policy appendix 8 showing HO90 and HO91 as firefighting lifts (TMO00830598)

L4.3.18 In summary, there is no evidence from the 2012-2016 refurbishment that any works other than the provision of extra landing doors on the new residential levels as outlined in Section 3 of my report were carried out. Therefore, no meaningful alteration of the fire safety features was made in the most recent refurbishment.

L4.4 Evidence from site inspections

L4.4.1 On the 15th March and 18th of April 2018, WSP undertook investigations of the HO90 and HO91 lifts in Grenfell Tower on behalf of MPS. The findings of their investigations are described in WSP report "Operation Northleigh – Site Investigation Report" and "Operation Northleigh Site Visit" (MET00019973). Their investigation was conducted in four separate visits to both Grenfell Tower and to the MPS exhibit storage facility and included testing of lift controller equipment and autodiallers at the MPS storage facility.

L4.4.2 In Figure L.16 below I show my photo of the lift control switch at Level 2, along with a close up photo taken by WSP (MET00019973).

Figure L.16: Fire control switch as noted on Level 2 lobby (left: my observations, right: WSP site inspection report)

L4.4.3 On the Ground floor, the single control switch provided is clearly labelled "Fire Control" and with a green "flag" in the face plate (See Figure L.10 below). I do not know if it controls both lifts at Ground level or not.

L4.4.4 In Figure L.17 below I also show my photo of the lift control switch at Ground level, along with a close up photo taken by WSP.

Figure L.17: Fire control switch as noted on ground level lobby (left: my observations, right: WSP site inspection report)

L4.4.5 They advise that for the Level 2 (Walkway) switch:

"*A drop type key is used to both operate the fireman's switch and to open the landing doors of the lift in an emergency.*

The notches on the release key align with similar notches inside the box in order to operate the switch. This is to prevent access by unauthorised persons.

It was not possible to operate the fireman's switch using the release key."

L4.4.6 WSP removed the faceplate to discover that there were "*no wires connected to the fireman's switch*" (see Figure L.18).

L4.4.7 With the faceplate removed, WSP checked the operation with the release key. It was *"very difficult to align the key to the slots in the brackets to operate the micro switch. The micro switch was not bi-stable i.e. it was spring loaded and returned to its normal operating position."*

L4.4.8 Regarding the Ground level switch, they advise that the fireman's switch was difficult to operate.

L4.4.9 Therefore, WSP removed the faceplate to determine the reason for failing to operate the switch.

L4.4.10 WSP discovered that the mechanism was seized and damaged/deformed (see Figure L.18).

L4.4.11 This corresponds with the evidence given in the hearing on the 4th July 2018, by Secrett: "*I've put my express lift key or drop key into the box that operates it and I'm trying to switch it on, which would engage the fire lift operation."* (see also his evidence, quoted above, from Transcript 4th July 2017 at p.192-193).

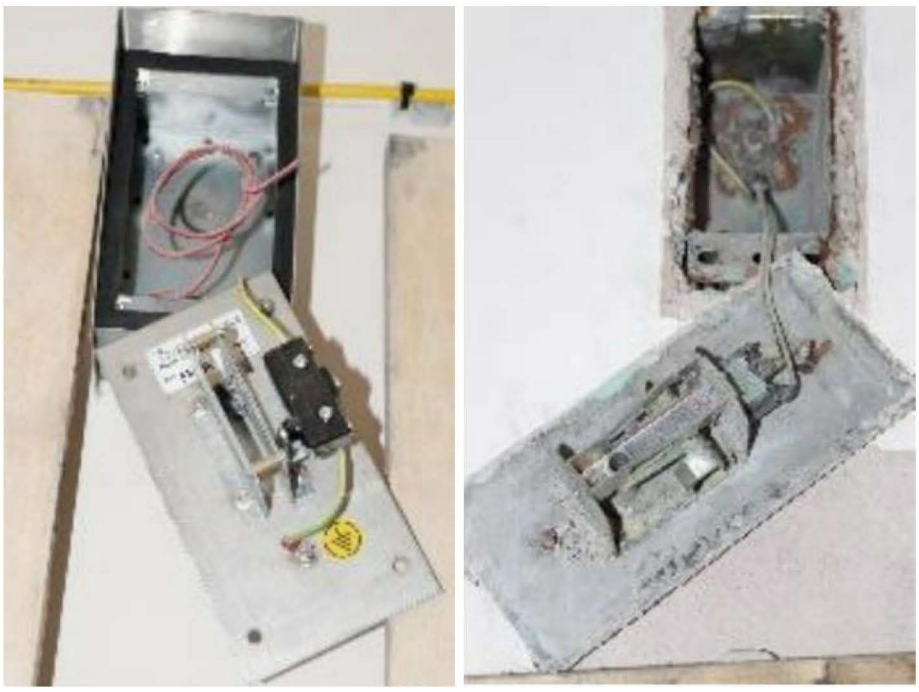

Figure L.18 left: Level 2 switch with faceplate removed. Right: Ground level switch with faceplate removed (MET00019973)

L4.4.12 The single Ground floor switch and single Level 2 switch are not the exact same model of switch, as indicated by differences in their markings and presence of a 'flag' indicator on the ground floor switch only. Both switches installed at Grenfell Tower are clearly not the type operated using triangular type keys in accordance with BS EN 81-72.

L4.4.13 Both switches feature the circular entry point for a drop/express type key instead, clearly visible on both faceplates. The WSP report confirms that a drop/express type key is used to operate these switches – which they physically checked at Grenfell Tower.

L4.4.14 I have found an example of a "Firemans" switch with this exact lettering and green flag on the face plate, in an electrical + lifts products guide by A+A Electrical Distributors Ltd (7th Edition). I have reproduced "Firemans switch FSE1" below which is called an "Express" fireman's switch.

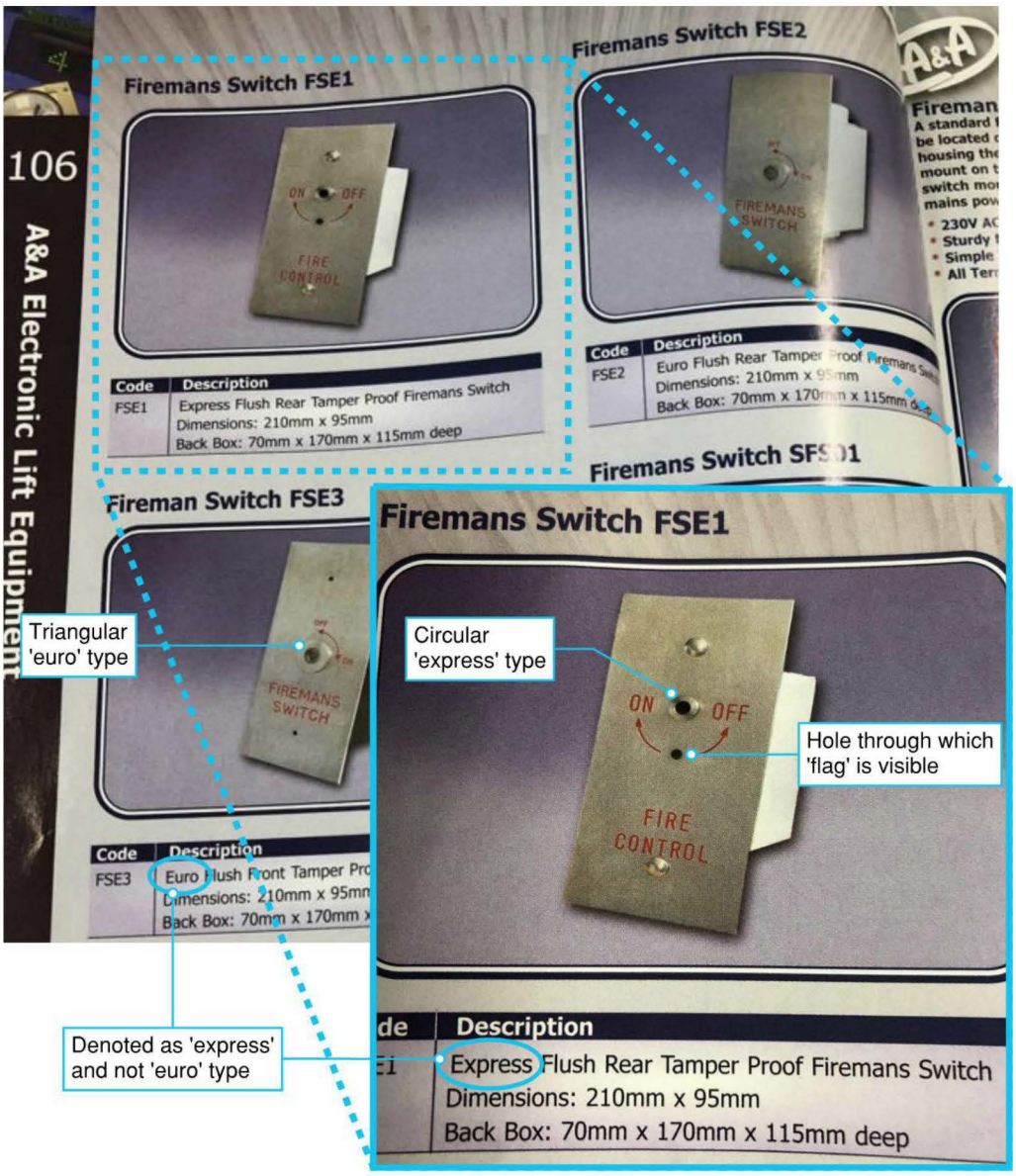

Figure L.19: A+A Electrical Distributors Ltd catalogue showing various switches including an identical model to that I observed at Ground level.

L4.4.15 Therefore, the Level 2 switch could not be used to take any form of control of the lifts by LFB on 14th June 2017.

L4.4.16 The ground level switch, although seized and damaged, did contained a wired connection. WSP inspected the lift controllers in the lift plant room for evidence of interfaces with either fire switches or automatic fire detection and alarm systems:

a) One interface between a fire switch to both lift controllers was observed – no evidence of which specific switch (Ground or Level 2) was interfaced with either of the lift controllers was presented, nor evidence of the observed connection being operable.

b) An interface between a fire detection and alarm system and both lift controllers was present – no evidence was presented of which fire detection and alarm system was interfaced with the lift controllers, nor evidence of the observed connection/interface being operable.

L4.4.17 Therefore, in addition to the evidence the ground level switch was *'seized and damaged/deformed'* which may have prevented its operation by LFB, further evidence is also required to confirm the control sequence achieved by operation of the ground level switch for one or both lifts.

L4.4.18 WSP also make the following further observations for the switches:

"As the fireman's switch on the 2nd floor (walkway) was not connected to the controllers we can only assume that it was never tested at regular intervals....

As the mechanism on the fireman's switch on the ground floor was defective then we can assume this had not been examined by the lift service company at regular intervals"

L4.4.19 WSP interrogated the lifts' event logs (where actions and faults associated with the operation of the lifts are recorded) during a visit to the MPS storage facility on 16th May 2018. WSP made the following observations:

a) The controller was programmed with an action for '70: fire alarm recall' as well as '68: fire service'.

b) The event log from lift HO90 did not contain any entries under these codes, and therefore did not receive a signal to initiate those actions.

c) The event log from lift HO91 did not contain any entries under these codes, and therefore did not receive a signal to initiate those actions.

L4.4.20 The report then concludes that:

L4.4.21 *"We can safely assume that the lift controllers did not receive any signal for a recall to the designated landing (Log 68) and that the lifts were not switched to fireman's Service (Log 70)"*

L4.4.22 The compliance of testing and maintenance of the fire safety systems in Grenfell Tower by the responsible persons with the Regulatory Reform (Fire Safety) Order 2005 will form part of the Phase 2 investigations.

L4.4.23 **Summary of the firefighting lift features**

L4.4.24 Table L.4 below sets out the full requirements for compliance with ADB 2013 for a firefighting lift i.e. according to the relevant standards at the time of the refurbishment in 2012-2016.

L4.4.25 The table compares the relevant standards with onsite observations, as well as the specification and documents associated with the works to the lifts as installed in 2005.

Table L.4: Firefighting lift provisions in Grenfell Tower

Specification	Description & relevant standard	Provision in Grenfell Tower
Fire service communication system	An intercom system in the lift car for interactive two-way speech linked to the fire service access level and the firefighters lift machine room. The lift communication system should be separate from the fire service communications system. BS EN 81-72:2003 Cl.5.12.1 BS 5588-5:2004 Cl.8.4	Does not appear to have been provided: Both an emergency voice communication system and retained existing intercom system is required in the 2005 refurbishment specification (CST00000384) though it is not clear that this is provided for fire safety. The order progress sheets (APX00000094) show that only an autodialler (not a firefighting intercom) was ordered for the lifts. Commissioning certificates for either of the main lifts (APX00000095/96) do not include inspection or testing of any communication facility. WSP did not identify any firefighting intercom components in the motor room or at the landings during their site investigations for the MPS (MET00019973).
Signage	Signage stating do not use for goods or refuse. BS 5588-5:2004 Cl. 7.2.7	Not known.
Extent of service	Must serve all habitable levels. BS 5588-5:2004 Cl. 7.2.4 BS EN 81-72:2003 Cl.5.2.2	Appears to have been provided: Based on Studio E drawings that indicate access at each level; and my post fire inspection of the lobbies on each level (Appendix C).
Protection	Must have: A protected lobby with protected stairs; and A protected enclosure with a fire resistance as defined in the relevant guidance; and Access to firefighting stair within 7.5m of the firefighting lift. Fire resisting lift doors of not less than 60 minutes BS EN 81-72:2003 Cl.5.1.1, Annex B BS 5588-1:1990 Cl.35.3 ADB 2013 Table B1, Diagram 52	Does not appear to have been fully provided: A protected lobby is provided to a sufficient standard, except for the provision of fire doors as described in Appendix I. Access to the protected stair was measured as within 7.5m There is no evidence in the specification, scope of works or order progress sheets for the works in 2005 or in 2015 of any of the landing doors requiring or achieving any fire resistance rating.

Specification	Description & relevant standard	Provision in Grenfell Tower
Everyday use	May be used as a passenger lift, but not for moving refuse or goods. Doors must never be propped open. BS 5588-5:2004 Cl. 7.2.4 BS EN 81-72:2003 Cl.7.1	Appears to have been provided: A refuse chute was provided for residents to prevent transport of refuse using the lift. No evidence of other operational controls (e.g. tenant handbook guidance).
Firefighter control	Fire-fighting control switch - calls the lift immediately to the entrance/exit storey and then only allow it to be controlled by the car control panels. BS 5588-5:2004 Cl.8.1 BS EN 81-72:2003 Cl.5.8	Evidence of 2 firefighting switches (Ground and Level 2). No evidence of installation of switches, connection to lift controllers or commissioning of either switch. FRA significant findings from June 2016 (TMO10017691) suggest that the controls had previously been operating from Level 2 rather than from ground/fire service access level. The specification document includes a requirement for firefighter control functionality and switches, as outlined in L4.2.8. The "scope of works – general requirements" document (APX00000037) features an option for 'Fire Fighting Control Only' as well as 'Fire Fighting Lift to BS 5588', which are both left unselected. Rows in the order progress sheets (APX00000094) for 'Fireman's switch' and 'Fire control indicator' are both blank, indicating these were not ordered, supplied or installed during the works. Recent evidence supplied by WSP for MPS (MET00019973) shows no wired connection to the Level 2 switch. Therefore, this switch could not function as a firefighting switch. Recent evidence supplied by WSP for MPS (MET00019973) shows the mechanical mechanism for the ground level switch was seized. Therefore, this switch could not function as a firefighting switch. The connection of this switch to either of the lift controllers has not yet been confirmed. This is required.
Primary power	The primary electrical supply to a fire-fighting lift should be obtained from a sub-main circuit exclusive to the lift and independent of any other main or sub-main circuit. BS 5588-5:2004 Cl.14.1	Appears to have been provided: Exclusive primary supply is shown on the electrical distribution schematic (RYD00094162).

Specification	Description & relevant standard	Provision in Grenfell Tower
Secondary power	The secondary power supply shall be sufficient to run the firefighters lift at the rated load and the time requirement referred to in Cl. 5.2.4. It is a prerequisite that the source of the secondary power supply shall be located in a fire protected area. BS EN 81-72:2003 Cl.5.1.5 & Cl 5.9 BS 5588-5:2004 Cl.14	Does not appear to have been provided: A secondary supply is not shown on the electrical distribution schematic (RYD00094162). The scope of works document shows that interface with a backup supply was specifically not selected (APX00000037). WSP did not find a secondary supply in their site investigations for the MPS (MET00019973).
Electrical supply	The firefighters lift primary and secondary electrical power supply cables shall be fire protected and separated from each other and other power supplies. The level of fire protection shall be at least equal to that given to the lift well BS EN 81-72:2003 Cl.5.1.6 & Cl.5.9 BS 5588-5:2004 Cl.14	Does not appear to have been provided: No evidence in 2005 specification (CST00000384) that the contractor was required by contract to install alternate electrical supplies or to provide specific fire protection to the power distribution system. No evidence in scope of works, order progress sheets or commissioning certificates (APX00000094/95/96). Recent evidence supplied by WSP for MPS (MET00019973) indicates they observed no equipment for a secondary power supply during their inspection of the lift motor room.
Lift cars	Firefighting lift cars should be provided with a means of external rescue of trapped firefighters in the lift car BS EN 81-72:2003 Cl.5.4	Does not appear to have been provided: According to design team correspondence, the lift cars were not provided with escape hatches (CST00000552). The lift specification, scope of works and commissioning documents do not include any facility for escape from the lift car (CST00000384, APX00000037, APX00000095/96). WSP did not identify an escape hatch in either lift car during their site investigations for the MPS (MET00019973).
Lift well	Electrical equipment in lift well and car should be protected against water. Measures should be taken to avoid or minimise water penetration BS 5588-5:2004 Cl. 7.2.8 BS EN 81-72:2003 CL. 5.3	Does not appear to have been provided: The lift specification, scope of works and commissioning documents do not include any water ingress protection measures (CST00000384, APX00000037, APX00000095/96). WSP did not identify any water protection measures during their site investigations for the MPS (MET00019973).

Specification	Description & relevant standard	Provision in Grenfell Tower
Lift machinery spaces	The machinery space should not be sited below the lift well and is most effectively protected by incorporation within the firefighting shaft BS 5588-5:2004 Cl. 7.2.9	Appears to have been provided: I observed the lift machine room at roof level, which is confirmed by the 2015 inspection report (JRP00000023).
Speed	The firefighters lift shall reach the furthest floor from the fire service access level within 60 s, BS EN 81-72:2003 Cl.5.2.4	Appears to have been provided: The rated speed is reported as 2m/s in the scope of works documents (APX00000037) and commissioning documents (APX00000095/96) as well as a 2015 inspection report (JRP00000023). Therefore, time to level 23 from ground level is approximately 33s
Operation time	A firefighting lift is designed to operate so long as is practicable when there is a fire in parts of the building beyond the confines of the fire-fighting shaft. The lift control shall continue to function for a period equal to that required for the structure BS 5588-5:2004 Cl. 7.2.4 BS EN 81-72:2003 Cl.5.1.2 (c)	Does not appear to have been provided: No evidence in 2005 specification (CST00000384), and no evidence in scope of works, order progress sheets or commissioning certificates (APX00000094/95/96) that the lift is designed to meet these provisions.
Testing	The operation of the evacuation and fire-fighting lift switches should be tested once a week and should be repaired or replaced if found to be faulty. BS 5588-12:2004 Cl..3.6	In Phase 2 of the Public Inquiry I will investigate the testing and maintenance activities undertaken as required by the Regulatory Reform (Fire Safety) Order 2005.
Lift capacity	8 Persons (630kg) BS EN 81-72:2003 Cl.5.2.3	Appears to have been provided: 12 persons (900kg) as outlined in the lift specification, scope of works, commissioning certificates 2015 inspection report (CST00000384, APX00000037, APX00000095/96, JRP00000023 respectively)
Minimum size	1100mm wide by 1400mm deep BS EN 81-72:2003 Cl.5.2.3	Appears to have been provided: The specification document included a drawing (CST00000384) for a lift car of dimensions 1400mm x 1450mm. However, the "scope of works – general requirements" document states the lift car to be 1400mm x 1400mm (APX00000037).

L5 Assessment of evidence of firefighter lift control in firefighter hearing evidence and CCTV imagery

L5.1 First use by firefighters

L5.1.1 According to the evidence given in the hearing on 4th July 2018, FF Secrett was first to use the firefighter control switch situated on the Ground floor lobby. He confirmed he was the firefighter shown entering the lobby and trying to operate the firefighting control function on the CCTV image (see Figure L.20) of the ground floor at 01:01. His evidence was:

"I've put my express lift key or drop key into the box that operates it and I'm trying to switch it on, which would engage the fire lift operation."

Figure L.20: CCTV image of ground floor lobby at 01:01:35 (INQ00000138)

L5.1.2 When describing the action of the lift key in the firefighter switch at the ground floor lobby (p192-193 of Transcript, 4th July 2018), he stated:

I remember it was -- it was hitting a stop. Normally when you put it in and you twist it, you feel sort of a positive click where it throws a lever over which engages it, but it wasn't doing that; it was just hitting some sort of stop on the key. The mechanism wasn't -- it wasn't connecting to the mechanism. It wasn't working.

L5.1.3 He then called the lift using the conventional landing control, stating in his evidence (p192 of Transcript, 4th July 2018):

"I think by that stage I'd accepted defeat that it wasn't going to work, so I called it as a member of the public would call the lift."

"With the fire lift operation, nothing [happened], and when I called it normally, the lift -- I can't remember if the doors opened straight away or if the lift came down, but when I called the lift the sort of conventional way, it came and the doors opened."

L5.1.4 Firefighter Brown in his evidence given on 29th June 2018, describes how he witnessed Secrett using the firefighter switch (p3 of transcript, 29th June 2018):

"Crew Manager Secrett basically put the key in -- to operate a fire lift, you will have a panel which actually says -- it will say either "Firefighter's lift" or "Fireman's lift". Once you put the key in and turn it, it's essentially a complete override of the lift and it should give us complete overall control of that lift, and that lift should descend immediately down to the ground floor."

L5.1.5 However, he confirms that this was not what happened with the lift following Secrett's attempt at activating the firefighting control at the switch at the ground floor lobby (p3 of transcript, 29th June 2018), i.e. it did not descend to the ground floor. He said:

"It stopped off at a floor above the ground floor."

L5.1.6 This is confirmed by my review of the CCTV evidence which shows the lift stopping at level 5 before returning to the ground floor, at approximately 01:01.

L5.1.7 Furthermore, firefighter Badillo describes in his evidence given on 29th June 2018 how he also witnessed Secrett attempting to initiate firefighting control of the lift at the switch at the ground floor lobby (p73 and 76 of transcript, 29th June 2018):

"That's Crew Manager Secrett attempting to get the firefighter lift to work."

"I believe what he's doing there is attempting to call the firefighter lift and realising it's not working, so calling the lift down anyway."

L5.1.8 When asked to describe the action of the lift, he stated (Transcript, 29th June 2018 p74):

"Like I said, it didn't work, so it just continued as a normal lift."

L5.1.9 In accordance with normal tactics, firefighters use lifts to access the firefighting Bridgehead 2 storeys below the fire floor. This permits firefighters to rapidly pass up the building with their equipment without exerting themselves excessively or using up their breathing apparatus air supply.

L5.1.10 It is against the high rise firefighting tactics for fire fighters to use a lift to access a floor where fire is known to be. This is because of the dangers of fire fighters exiting a lift into a lobby where fire or hot smoke may be present.

L5.2 Subsequent uses

L5.2.1 Firefighter Badillo

L5.2.2 Later on, firefighter Badillo (as described in his evidence given on 29th June 2018) attempted to use the lift to perform a rescue on level 20 (Transcript, 29th June 2018 p117):

"I decided to go up and try and get to the 20th floor to get her little sister."

"The quickest route I thought was possible, which was jumping in the lift."

L5.2.3 This is confirmed by CCTV imagery showing firefighter Badillo entering a lift at ground level, as shown in Figure L.21:

Figure L.21: CCTV image of ground floor lobby at 01:27:39 (INQ00000103)

L5.2.4 He then describes how the lift did not go immediately to level 20, as selected, but to level 15 (Transcript, 29th June 2018 p.120):

"(QC): You say in your statement that the lift, you having got into it, stopped at the 15th floor. Is that right?

A: That's correct."

"*The doors opened and a big rush of black smoke filled the lift."*

L5.2.5 Firefighters Badillo and Dorgu and CM Secrett

L5.2.6 In his evidence given on the 5th July 2018, Secrett describes how at approximately 01:35, he and firefighters Badillo and Dorgu used the lift to get further up in the tower (Transcript, 5th July 2018 p71 and Figure L.22):

"I can't remember if I made it solely or we discussed, but we was going a long way up the building, and it's not in policy but I wanted to use the lift to break the back of the journey going up there."

Figure L.22: CCTV footage from South Lift of Secrett, Badillo and Dorgu entering lift at Level 2. Timestamp 01:36 (INQ00000141)

L5.2.7 Secrett then describes (Transcript, 5th July 2018 p72-75) how the lift stopped unexpectedly during the journey on level 6 instead of the level requested, level 15 (Noting that comparison between the evidence of Secrett, Dorgu and Badillo suggests that it was, in fact, Level 8 on which the lift stopped):

"the lift doors opened and immediately -- yeah, it filled with fairly thick smoke

And also it was a surprise that we stopped at the sixth because I pressed floor 15. I thought we was going to the 15th and it stopped at the sixth unexpectedly.

I had an educated guess that someone's called the lift. There would be no other reason for it to stop."

L5.3 Lift behaviour when not in motion

L5.3.1 When giving evidence on 4th July 2018, CM Secrett was shown a CCTV image from within lift 2 (see Figure L.23) and asked to explain what he saw.

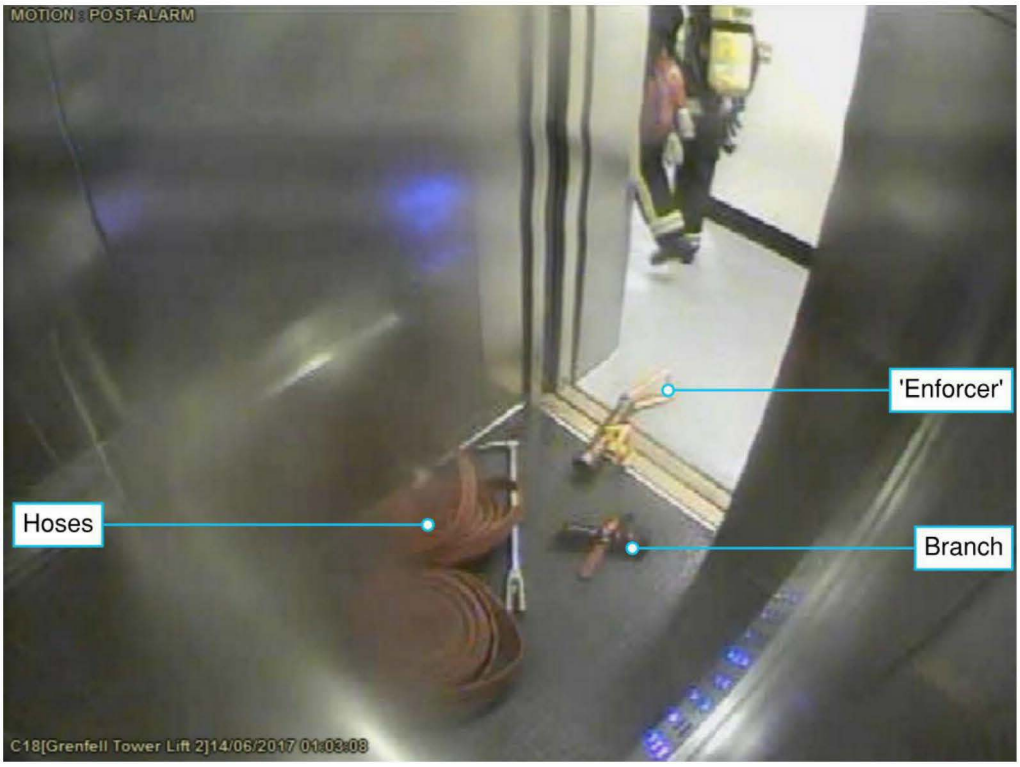

Figure L.23: CCTV image from within lift 2 at 01:03:08 (INQ00000149)

L5.3.2 To which he responds (Transcript, 4th July 2018 p202-203):

"*Yes. So it looks like we've all got out of the lift. That piece of equipment in the lift door is what we call the enforcer, which is breaking-in equipment, and someone's put that there on purpose to stop the lift going because we didn't have control over it. If they hadn't have put that there, the lift could've been called and subsequently all our equipment would've gone and we would've lost the lift. So it's been put there as a temporary measure to keep some sort of control over the lift.*"

L5.3.3 Once the equipment has been removed from the lift, a single reel of hose is left in the lift doors to retain this control as indicated below:

Figure L.24: CCTV image of hose reel in lift doors. Timestamp 01:03 (INQ00000150)

L5.4 Evidence showing normal operation of the lifts

L5.4.1 CCTV footage (MET00012593), replicated in the following figures, identifies that residents were using both lifts to exit the building until at least 01:26. These specific CCTV stills in (MET00012593) do not include images of LFB using the lift. In MET00005348, Badillo explains that they exited Grenfell Tower just as pumps made 20 (so at 01:31). Badillo tried to get to level 20 in the lift but got stuck at level 15 where he observed a lot of smoke, causing him to walk down the stairs.

L5.4.2 The Fire Action Notices observed to be adjacent to lift controls instructs occupants not to use the lift in the event of a fire (Figure L.29).

L5.4.3 The footage at 01:26 (Figure L.27) also indicates significant amounts of smoke exiting one lift car as the residents exit the lift at ground floor.

L5.4.4 Shortly after this time, at 01:38, CCTV footage indicates heavy smoke logging within that lift car.

L5.4.5 At some time during the fire, the lift moves to Level 10 where it appears to have been disabled by the fire.

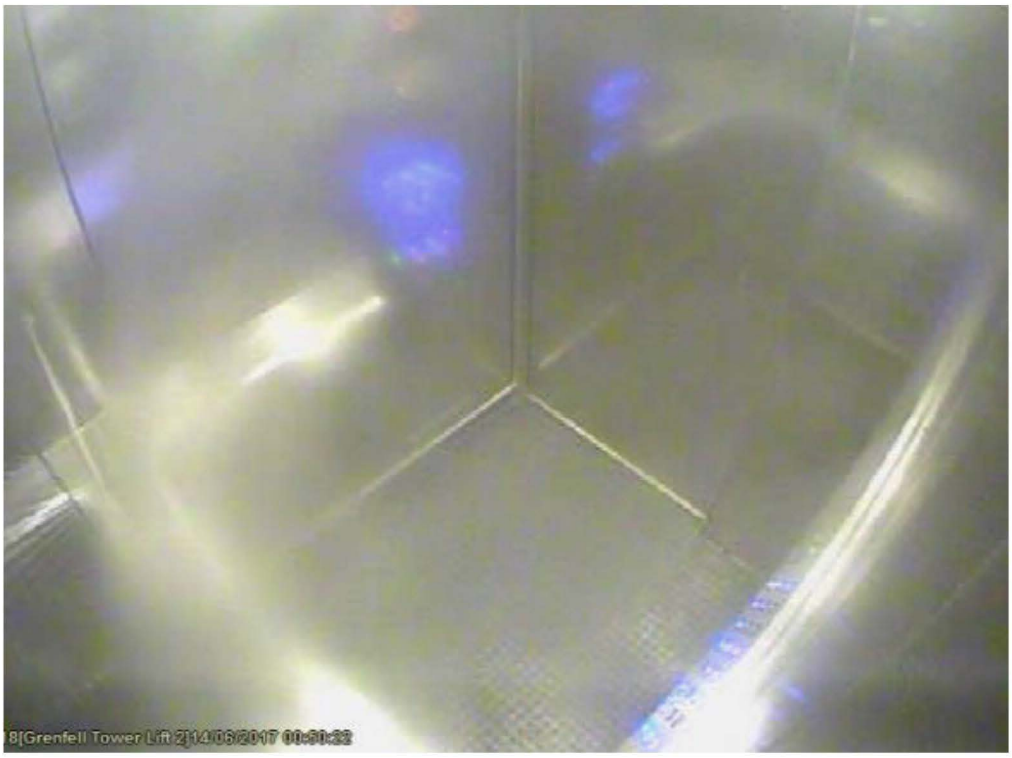

Figure L.25: CCTV footage from inside the lift before the fire (MET00012593)

Figure L.26: Residents escaping the lift as it is affected by smoke at 00:58 (MET00012593)

Figure L.27: Residents escaping using the lift at 01:26 (Ground) (MET00012593) Smoke leaking from lift doors circled in red

Figure L.28: Conditions inside the lift at 01:37 (MET00012593)

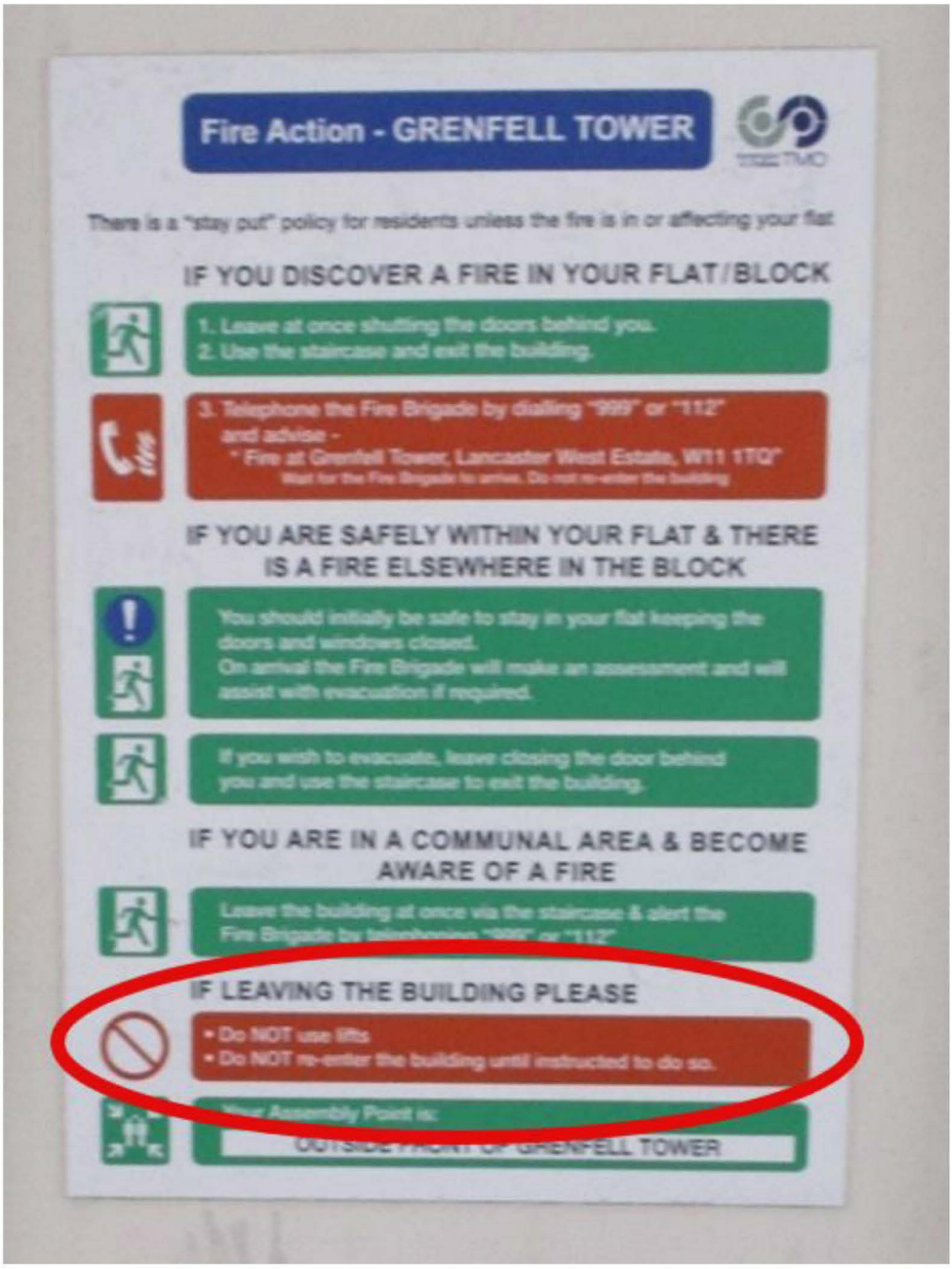

Figure L.29: Fire Action Notice on Level 3

L5.5 Evidence regarding operation of the level 2 switch

L5.5.1 There is no evidence of any attempt to operate the fire control switch at level 2 (the floor that served as the bridgehead in the early stages of the fire), either in the CCTV images, or as mentioned by the firefighters in their oral evidence.

L5.6 Comparison of expected and observed behaviour

L5.6.1 In Table L.5 I present my comparison of the expected behaviour (as outlined in the relevant design guidance) of a lift under firefighter control, with selected evidence from firefighters, corroborated by the CCTV images presented in Section L5.

L5.6.2 At specific (and at different) times during the fire, each lift failed. The Public Inquiry has appointed a lift expert to carry out a detailed investigation into the design, construction, maintenance, and operations of the lifts. All these issues will be further examined by the lift expert, including the issues I have raised to date.

Table L.5: Comparison of expected and observed behaviour

Scenario	Expected behaviour		Evidence of observed behaviour as per section L5 of this report	Conclusion
	1974 design guidance	2005 & 2017 design guidance		
Immediately after the firefighting switch is activated at fire service access level	***BS 2655-1:1971*** *"operation of the fire switch to bring the firemen's lift car to the fire control level without delay and with doors parked open."*	***BS 5588-5:1991*** *"3) All lifts within the firefighting shaft should return as soon as practicable to the fire service access level* *...* *4) On arriving at the fire service access level, all lifts within the firefighting shaft other than the firefighting lift should be retained there with the lobby and car doors kept in the closed position (after opening for the discharge of passengers)."*	***SECRETT*** *"With the fire lift operation, nothing [happened], and when I called it normally, the lift -- I can't remember if the doors opened straight away or if the lift came down, but when I called the lift the sort of conventional way, it came and the doors opened."* ***BROWN*** *"It stopped off at a floor above the ground floor."* ***BADILLO*** *"it just continued as a normal lift."*	The evidence shows the lift did not return immediately to ground upon operation of the fire control switch. It arrived at ground level after use of the usual landing control buttons. Furthermore, it stopped at another floor to collect a passenger before reaching the fire service access level.

Scenario	Expected behaviour		Evidence of observed behaviour as per section L5 of this report	Conclusion
	1974 design guidance	**2005 & 2017 design guidance**		
After firefighters enter the lift and select a floor	***CP3 1971*** *"firemen can obtain the use of a lift without interference from the landing call points"* ***Section 20 Guide 1970*** ***"*** *firemen can obtain immediate control of the lift without interference by the ordinary call points"* ***BS 2655-1:1971*** *"Whilst under 'fire control' all landing call-points and control switches shall be rendered inoperative and sole control vested in the car control station"*	***BS 5588-5:1991*** *"g) 1) Landing call buttons and car control stations within the firefighting shaft, with the exception of the car door controls, should be rendered inoperative."* *"h) sole control should then be vested in the firefighting lift car control station"*	***BADILLO*** *"I decided to go up and try and get to the 20th floor to get her little sister" "The quickest route I thought was possible, which was jumping in the lift."* *"(QC): You say in your statement that the lift, you having got into it, stopped at the 15th floor. Is that right?* *That's correct."* ***SECRETT*** *"it was a surprise that we stopped at the sixth because I pressed floor 15. I thought we was going to the 15th and it stopped at the sixth unexpectedly.* *I had an educated guess that someone's called the lift. There would be no other reason for it to stop."*	The evidence shows the lift car responding to other landing call buttons and 'sole control' not being given to the lift car controls. This is shown by the lift stopping at floors not selected by the firefighters themselves.

Scenario	Expected behaviour		Evidence of observed behaviour as per section L5 of this report	Conclusion
	1974 design guidance	2005 & 2017 design guidance		
The lift car action upon arriving at a floor	(No specific guidance on action when arriving at floor)	***BS 5588-5:1991*** *"h) 4) If the car is stationary at a landing, it should be possible to control the opening of the doors only by the application of continuous pressure on the "door open" car control."*	***BADILLO*** *"The doors opened and a big rush of black smoke filled the lift."* ***SECRETT*** *"the lift doors opened and immediately -- yeah, it filled with fairly thick smoke* *And also it was a surprise that we stopped at the sixth"*	The evidence shows that once arriving at a floor, the lift doors opened without any input from the 'door open' car control.
The lift car action once open at a landing	(No specific guidance on action when open at landing)	***BS 5588-5:1991*** *"h) 4) Once fully open, the doors should remain open until a new call is registered on the car control station*	***SECRETT*** *"we've all got out of the lift. That piece of equipment in the lift door is what we call the enforcer, which is breaking-in equipment, and someone's put that there on purpose to stop the lift going because we didn't have control over it. If they hadn't have put that there, the lift could've been called and subsequently all our equipment would've gone and we would've lost the lift. So it's been put there as a temporary measure to keep some sort of control over the lift."*	The evidence shows that to ensure the lift stayed available for use at the bridgehead, firefighters improvised to ensure the lift remained at level 2. Under firefighter control, the lift should have remained with doors open at level 2 until further direction via the car controls and this measure would not have been required.

L6 Conclusions

L6.1.1 It is my opinion that the installed lifts were not compliant with ADB 2013 (Nor BS 5588-5), and therefore *'firefighting lifts'* were not provided in Grenfell Tower.

L6.1.2 It is likely that *'fire lifts'* as per CP3 1971 were present. It is yet to be confirmed if both lifts were a "fire lift" as per CP3 1971.

L6.1.3 As the lifts were not specified to meet the standard of a fire-fighting lift, they could not be used for evacuation. Firefighters would not use a "fire lift" for human transport due to its lower safety standard.

L6.1.4 But, in any event, it is also clear that the lift installation features that were, in fact, present were defective and did not operate as intended during the events of 14th June 2017.

L6.1.5 The lift installed in Grenfell Tower did not operate as a fire lift in that:

a) It failed to return to ground when LFB attempted to operate the fire fighter's override switch.

b) It remained in general operation and was used by residents for evacuation.

c) Both of the lift cars were observed during my post fire site inspection to be located at the 10th floor. I have found no explanation in the fire fighter witness statements or LFB command logs to explain the position of the lift in the post fire inspection.

d) The continued function of the lift allows me to conclude it was not interfaced with the detection system provided to the lobby on each floor.

e) The manual fireman's switch interface that was provided did not function as intended.

L6.1.6 As I will set out in Section 19, the failure of the lift to operate as a fire lift meant that:

a) The LFB was unable to take direct control of the lift, as required by their firefighting tactics.

b) Residents were able to use the lift, even though smoke had contaminated the car and shaft.

c) Despite a functioning lobby smoke ventilation system, coupled with a full firefighting lift, being critical to facilitate rescue, this rescue facility was not available in Grenfell Tower on the night of the fire.

L6.1.7 Given the potential significance of the lift deficiencies at Grenfell Tower, I recommend that the adequacy and compliance of the lifts is investigated in further detail at Phase 2 by an expert with specific expertise in lift design, construction and maintenance.