Heathrow Airport Holdings Limited

Kelly Review into the circumstances related to the closure of Heathrow Airport on 21 March 2025

May 2025

TABLE OF CONTENTS

1.   **INTRODUCTION BY RUTH KELLY**

The fire at North Hyde and closure of Heathrow

In the late evening of Thursday 20 March 2025, a fire started at a National Grid 275kV High Voltage electricity substation, which supplied a nearby 66kV substation operated by SSEN,[1] in North Hyde in West London, outside but close to the perimeter of Heathrow Airport.

The National Grid 275kV substation contained three supergrid transformers,[2] two of which we have subsequently learned were either completely destroyed by the fire or so badly damaged that their repair will take many months. We have also learnt that the third transformer's connection was also temporarily lost to the transmission network because it had been connected to the same circuit as one of other transformers directly impacted by the fire.[3]

The incident at the National Grid substation was unprecedented. The Chief Executive of National Grid stated after the event that they could not remember a transformer failing like this in his 30-plus years in the industry and described a fire taking out an entire substation as incredibly rare.

The overriding objective of the Heathrow teams responding to the outage was to ensure the safety of everyone affected by the power loss at Heathrow and this was achieved. But significant disruption was experienced by approximately 200,000 passengers, including those planning to depart from Heathrow on Friday 21 March and those who were already travelling to Heathrow on long haul flights, which had to be diverted. There were many other impacts too, not least financial losses caused to airlines and other businesses within Team Heathrow who operate at the Airport and to the Airport itself.

In the aftermath of the outage, Heathrow Airport Holdings Limited commissioned this review to establish a clear, fact-based account of what occurred, assess the response, and identify what lessons must be learned. Our objective has been to establish a robust timeline of events and to conduct a rigorous evaluation of decision-making processes, communication strategies and governance structures relevant to the incident, as well as Heathrow's preparedness for an event of this kind.

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[1]   Scottish and Southern Electricity Networks.
[2]   These transformers have been referred to as SGT 1, SGT 2 and SGT 3 in the *North Hyde Review Interim Report*, of the National Energy System Operator ("**NESO**"), dated 6 May 2025 ("**Interim NESO Report**")
[3]   Interim NESO Report, para 5.11

This report sets out our findings and provides a series of recommendations intended to strengthen the Airport's resilience and its ability to respond effectively to future incidents. It is essential that Heathrow remains one of the most reliable and trusted transport hubs in the world, and that passengers, staff, and stakeholders can be confident in its ability to operate safely and securely and to respond effectively to challenges such as this one.

We have marked in the Report where matters are reserved (because they contain information within them that might present security risks to Heathrow or others if published). We have kept these reserved sections to a minimum. We understand these reserved matters will be discussed in full with Heathrow's regulator the Civil Aviation Authority and key public bodies, including the Department for Transport and NESO.

Acknowledgements

I would like to thank all Heathrow colleagues who were interviewed and helped us during the Review to gather facts and provide us with their suggestions on areas for improvement. Those suggestions have informed our recommendations.

I would also like to thank my fellow Review Committee members and independent non-executive board members of Heathrow Airport Holdings Limited, Joan MacNaughton and Mark Brooker, for their insights and depth of contribution throughout this process - from the questions they posed in the fact-finding, constructive challenges they have raised to test initial findings, through to their help forming the conclusions we have jointly reached.

We would also like to extend our collective thanks to our external lawyers Pinsent Masons LLP and in-house legal colleagues who aided us in this review.

Ruth Kelly

Chair, Kelly Review Committee of Heathrow Airport Holdings Limited Board

Independent Non-Executive Board Member

May 2025

2.   **EXECUTIVE SUMMARY**

2.1   **Our central conclusions about the incident**

2.2   We have reached the following conclusions about the events on 21 March 2025:

2.2.1   The decision taken by the Airport, approximately 90 minutes after the power outage, to stop operations immediately was correctly made and essential to protect the safety and security of people, as well as the integrity of the Airport and the UK border.

2.2.2   In the early hours of 21 March, it was also reasonable to decide to stop operations until 23:59 that day, especially as decision-makers had in mind that if operations at the Airport could safely resume sooner, the timetable could be brought forward – as in fact did happen.

2.2.3   After consultation with airlines, Heathrow began accepting limited types of flight arrivals from 16:00 into select terminals and permitted a limited number of departures from 20:00. It then reopened fully on 22 March 2025. There may have been opportunities to open parts of the Airport slightly sooner (but for limited operations only) than in fact occurred on 21 March. This likely would have been only by a maximum of a couple of hours or so because of the time needed for critical systems to be checked and confirmed as operational after power was restored.

2.2.4   The timing and extent of reopening on 21 March was impacted by other highly relevant factors running in parallel throughout that day. Principally, these related to whether it would be possible for the Airport to restore connection to a resilient supply of power from North Hyde during that day (so the Airport could return to its original three electricity supply points), while not jeopardising a full resumption of operations the next day, 22 March. Although the decision to attempt to restore such a connection may have extended the time in which operations were stopped, this was the correct decision.

2.2.5   Due to the challenging nature of recommencing a full flight schedule in the course of the day, we do not consider an earlier reopening of parts of the Airport would have had a significant impact on passenger disruption. The vast majority of flight cancellations and the impact to passengers would likely still have occurred.

2.3   **Preparedness and resilience**

2.4   On the question of whether Heathrow was adequately prepared, we have concluded that:

2.4.1   There was a well-established Command & Control structure for major incidents which overall worked well. We have made a number of recommendations on opportunities for improvements. They would not have altered the outcomes for this incident, whether to prevent the closure or enable the Airport to restart its operations sooner.

2.4.2   There were a large number of pre-prepared contingency plans which were used in the response and sped up the return to full recovery.

2.4.3   There was a strong organisation-wide response and team effort, which assembled highly competent personnel to tackle complex technical and operational challenges posed by the power outage.

        (a)   Leadership gave important strategic direction at the right times and Heathrow's incident response teams were enabled, expert and well-drilled, prioritising passenger and colleague safety at all times.

        (b)   Although there was very significant disruption caused by the power outage on 21 March, Heathrow's response collectively delivered outcomes which enabled

operations to resume efficiently and smoothly in what were unprecedented circumstances.

2.5   We have made several recommendations designed to facilitate maximum effectiveness in responding to future disruptive events, including those relating to power supply to the Airport.

2.6   On whether the Airport should have anticipated the incident better, we have considered aspects of the Airport's High Voltage electricity resilience in outline. We recommend further work in this area.

2.7   We make the following initial observations in that context:

2.7.1   Heathrow had assessed its High Voltage electricity supply as resilient due to it having three separate intakes from the National Grid, all with multiple connections to the Airport and multiple transformers at the National Grid/SSEN substations providing redundancy in the event of failure. Heathrow therefore viewed this type of power outage (entire loss of power from one intake) as a low likelihood event for the purposes of its risk assessment.

2.7.2   It was known within Heathrow at a technical level that the structure of the Airport's own internal High Voltage electricity network meant that loss of power from one intake would result in a suspension of operations for a significant period (for at least eight hours) while the internal network was reconfigured to run the Airport using the two remaining intakes. This is a result of the way the infrastructure at the Airport has been developed over 75 years. There is no immediate fix to this problem, in part because the Airport is operating at full capacity with only limited operational overnight windows (about six hours) to carry out works to improve resilience and within a highly constrained footprint.

2.7.3   Whilst the overall risk of a loss of supply had been appropriately understood, details about the length of the possible outage and precise impact on systems in this scenario were less well-known by those outside the technical team. Enhancements to processes are already underway so that low likelihood but high impact risks of this kind can be subject to increased oversight by functions and leadership.

2.7.4   We have noted that investments relating to resilience of assets, infrastructure and power at the Airport are regularly part of larger programmes of work (for example, to reduce fossil fuel usage or to expand capacity). Prior to the incident, projects had commenced, which are ongoing, that will increase the resilience of High Voltage electricity supply at the Airport. We have not found evidence of any recent investment proposals specifically relating to electrical power resilience being declined by the Airport.

2.7.5   Certain programmes that would have included elements to improve resilience of electricity supply have been delayed (most notably Airport expansion and certain projects impacted by the COVID-19 pandemic).

2.7.6   Based on the evidence we have been able to consider in this Review, none of these delayed programmes would have avoided the need to close Airport operations for a period of time on 21 March.

2.7.7   Heathrow has identified the need to develop at a system / subsystem level five-to-seven year masterplans for critical utilities, including power, in a model which does not depend on further significant infrastructure developments.

2.7.8   We recommend a detailed review of opportunities to invest in areas that would further shorten the time for recovery from a critical incident of this type. This should include a review into whether there are additional sources of backup power that can be proportionately retrofitted into an airport like Heathrow in the short to medium term as well as part of longer-term strategies for energy resilience, growth and net zero.

2.7.9   We also recommend that Heathrow prioritises its engagement with its airline partners and the CAA and other stakeholders around the need for investment in resilience, so that a shared understanding can be reached on this topic as soon as possible, taking account of the features of the Airport's current infrastructure assets, its location and intensity of operations as well as the various legitimate but competing needs for further investment.

SECTION 1 – INTRODUCTION

3. **PURPOSE OF REVIEW AND TERMS OF REFERENCE**

3.1 When confirming the launch of the Kelly Review process into closure of the Airport on 21 March, Heathrow Chairman Lord Paul Deighton said**:**

> *"To fully understand what happened, I have asked Ruth Kelly, former Secretary of State for Transport and an independent member of Heathrow's Board, to undertake a review. The Kelly Review will analyse all of the relevant material concerning the robustness and execution of Heathrow's crisis management plans, the airport's response during the incident and how the airport recovered the operation with the objective of identifying any improvements that could be made to our future resilience."*

3.2 On 27 March 2025, the Board of Heathrow Airport Holdings Limited (**"HAHL"**) agreed Terms of Reference for the Review. Following this, these were supplied to the House of Commons Transport Select Committee, the Civil Aviation Authority, the Department for Transport and NESO.[4]

3.3 The Terms of Reference were published on Heathrow's website on 10 April 2025 and can be found at Appendix 3.

4. **PROCESS OF REVIEW**

4.1 **Review Committee**

4.2 The biographies of the Review Committee have been set out in Appendix 4. The Review Committee members are all Independent Non-Executive Directors of HAHL.

4.3 **Evidence received during Review**

4.4 Contemporaneous and other relevant data was requested by the Review Committee from Heathrow, which was reviewed by the Review Committee.

4.5 Over the period 2 April 2025 to 17 April 2025, Pinsent Masons LLP (**"Pinsent Masons"**), engaged as external lawyers to assist the Review, held an initial round of information gathering discussions with multiple Heathrow employees, who provided information about Heathrow's systems and processes and about Heathrow's response to the power outage. Pinsent Masons then held follow-up meetings with a number of those Heathrow employees to gain additional information. Pinsent Masons provided detailed feedback from those meetings directly to the Review Committee.

4.6 Ruth Kelly and other members of the Review Committee met with several key Heathrow employees over the period 28 April 2025 to 2 May 2025 with Pinsent Masons.

4.7 In addition, Pinsent Masons and the Review Committee have considered a substantial amount of documentation relevant to the incident and the Chair of the Committee and Pinsent Masons visited the relevant operational sites.

4.8 In accordance with the annex to the Terms of Reference, the personal details of the Heathrow employees who were involved in the incident response and who spoke to the Review will not be published in this Report. The exceptions to this are the Chief Executive Officer Thomas Woldbye and the Chief Operating Officer Javier Echave, who cannot be anonymised due to the relevance of their roles. We appreciate their willingness to be named in this Report, given the high-profile nature of the incident and its aftermath.

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[4]   National Energy System Operator, established under the Energy Act 2023

4.9   A summary of our key findings and our recommendations is included as Appendix 1.

4.10   A glossary of terms used in this Report is included in Appendix 2.

SECTION 2 – CHRONOLOGY OF EVENTS

5. **SUMMARY OF EVENTS OF 20 – 22 MARCH 2025**

5.1 We have set out below a detailed chronology of the events of 20 – 22 March from the point of the fire to Heathrow's full recovery of operations. In summary:

5.1.1 During the half hour period between the power outage being identified and the decision to activate the Command & Control structure, the Duty Airport Operations Manager ("**AOM**") coordinated with Heathrow specialists in the Airport Operations Control Centre ("**APOC**") and across the Airport to gather the necessary information to build situational awareness, essential to managing the critical incident. The Duty AOM also coordinated with emergency services, including Aviation Police and the London Fire Brigade. This enabled the Duty AOM, and shortly afterwards, the Chief Operating Officer, to make a thorough assessment of the risks to safety and security, based on the information known at the time.

5.1.2 The decision at approximately 01:15 to stop operations at the Airport until 23:59 on 21 March 2025 was made on the basis that Heathrow did not have confidence that the Airport could be operated safely and securely and the security of the border maintained. Heathrow engineers then worked to reconfigure Heathrow's power supply network so that the remaining two High Voltage supply points powered the parts of the Airport that had lost power from Intake A (the intake in Heathrow's network that is connected to North Hyde).[5] This was a complex process requiring many hours of work. Once power was restored, Heathrow's systems had to be brought online in a controlled manner (to prevent further local outages) and then tested. The critical systems were confirmed as tested and validated in Terminals 3 and 5 by 13:00 and in Terminal 4 by 17:00.[6] Terminal 2 returned to operations by the start of the following day.

5.1.3 The resumption of operations on 21 March occurred in three distinct phases (in consultation with airlines):

(a) From 16:00 Heathrow opened for repositioning of aircraft (crew members only) so that aircraft could be in the correct positions when the Airport expected to open fully on 22 March.

(b) From 18:00, Heathrow opened for repatriation flights (crew and passengers) so that previously diverted aircraft could land at Heathrow and disembark passengers and unload baggage.

(c) From 20:00, Heathrow opened for a small number of flight departures facilitated by the Airport in coordination with airlines.

5.1.4 In parallel, other work progressed which was designed to restore equivalent levels of resilience in the High Voltage power supply to the Airport as it had had prior to the fire at North Hyde. At 13:15, based on information from SSEN, which Heathrow's engineers assessed as meaning that a resilient power supply was again available at North Hyde, Heathrow decided to reconfigure its network back to the three-supply configuration. Having made this decision, Heathrow began the complex process of reconfiguring its network again. However, at approximately 22:00 on 21 March, Heathrow received additional information from SSEN that led Heathrow's engineers to assess that the North Hyde supply was not in fact resilient, contrary to Heathrow's earlier understanding. Heathrow therefore cancelled the plan to switch back the supplies. For the remainder of 21 March and through

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[5]   Further explanation of this can be found at paragraphs 8.3 - 8.7.
[6]   Heathrow's Terminal 1 has been permanently closed to passengers since 2015 and has been used since then as a facility to warehouse the baggage system that serves the Terminal 2 operation. More information about the terminals is below at paragraph 7.7.

the night of 22 March, the Airport prepared for full operations starting at 04:30 on 22 March, on the basis of power being supplied by its two other High Voltage sources.

5.2   Throughout the incident, Heathrow decision-makers set the following objectives which the Review was told guided their response:

5.2.1   ensuring people, colleagues and staff are safe and secure;

5.2.2   ensuring that the environment and assets are safe, including integrity of the UK Border;

5.2.3   minimising disruption to passengers;

5.2.4   being in operation by opening time at 04:30 on 22 March; and

5.2.5   resuming operations earlier than that on 21 March if possible.

5.3   Having partially resumed operations on 21 March, Heathrow fully opened on 22 March at 04:30 with all terminals in operation.

6.   **THE INITIAL RESPONSE AND CHRONOLOGY OF LATER KEY EVENTS**

6.1.1   **20 March 2025, 23:40** – **Fire first identified by Heathrow** – members of the Heathrow team in APOC first saw the fire on CCTV. The fire was not on the Heathrow site, but at this time its precise location was not known.

6.1.2   **20 March 2025, 23:55** to **21 March 2025, 00:21** – **Multiple systems lose power** – the Duty AOM, located in APOC, received reports that multiple systems had lost power. It was not known at this time that the fire had caused the power outage. The systems reported as lost or running on back-up power included:

(a)   Critical safety systems. For security reasons we have not specified the details of these systems in the unreserved sections of this Report, which can be found in Reserved Appendix 5. Using the anonymised names given in the Reserved Appendix, the critical safety systems that were identified as having lost power at this time were: Critical Safety Systems 1, 2, 3 and 4.

(b)   Loss of lights in Terminal 4;

(c)   Loss of power to the majority of the Central Terminal Area, including Location A[7] which houses critical communications servers for safety systems and also the back-up control room;

(d)   Loss of power to traffic lights around the Airport;

(e)   Loss of critical safety systems in the main vehicle tunnel (Tunnel Critical Safety Systems);[8]

(f)   The Air Traffic Control Tower and runway lights were operational but running on back-up supply (and as such would enable emergency landings);

(g)   The Airside Operations Facility had lost power but was running on back-up supply;

(h)   Fire East, one of two fire stations at the Airport, did not have power. This would not impact the ability of the Airport to land aircraft in emergencies (because of the

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[7]   The name of this location has been reserved for security purposes.
[8]   The details of these systems have been reserved for security purposes.

other airside fire station) but immediately reduced the Airport's ability to run full operations;

(i)   The baggage systems were not powered in Terminals 2 or 4, but at this time the baggage systems were powered in Terminals 3 and 5.

The Duty AOM immediately identified contingency plans that needed to be put in place to mitigate the risks from the systems that had been lost.

The Duty AOM was shortly afterwards informed by the Aviation Police that the London Fire Brigade had declared a major incident in relation to a substation in Hayes. The Duty AOM was told that London Fire Brigade estimated it would be six hours before they could tackle the fire, as the electrics at the substation needed to be isolated first. The Duty AOM was informed that circa 70,000 homes were affected, as well as hospitals.

The Duty AOM liaised with the ACE (the Airport Control Engineer) about the substation fire. At this point, the engineers began to assess what they needed to do to reconfigure Heathrow's power network. The timescale they gave the Duty AOM at this point was a *minimum* of two hours until power was back.

The Duty AOM liaised with the Airfield Duty Manager, who provided a status update on airfield systems. The Duty AOM also received updates from the Security Operations Manager regarding systems that had been affected and the contingencies they had put in place.

6.1.3   **21 March 2025, 00:03 – Heathrow makes first contact with SSEN** – the Heathrow Engineering Team called SSEN, who reported that they had lost the whole of North Hyde. SSEN said they had heard reports of a fire and Heathrow informed SSEN that it could see the fire on the CCTV.

6.1.4   **21 March 2025, 00:13 – AOM receives update on critical systems -** at 00:13, with a member of the Aviation Police now co-located in APOC, the Duty AOM held a meeting with those in APOC to receive a situation report on the status of systems and contingencies. At this time, it was still estimated to be six hours before London Fire Brigade could start to tackle the fire, critical safety systems had been lost (including Critical Safety System 2, Critical Safety System 1, Critical Safety System 4, and Critical Safety System 5), and certain buildings including Location A (which, as noted above, houses critical servers), Airfield Operations Facility[9] and Fire East (one of two fire stations at the Airport) did not have power. The traffic lights around the Airport had also been affected. Terminals 2 and 4 had also lost power to their baggage systems.

6.1.5   **21 March 2025, 00:21 – Command & Control (Silver and Bronze) activated** – the Duty AOM activated the Command & Control structure at this time by activating the F24 alarm system. This activates Silver Command and Gold Command is placed on standby. See paragraphs 9.1 - 9.10 for details of the Command & Control structure.

Following the issuing of the F24 notification, the Duty AOM spoke to the Silver Commander and a senior member of the Operations team to update them on the situation.

Heathrow's Aircraft Flow Manager also spoke to air traffic control services about the impact if Heathrow had to stop operations. The view reported from air traffic control services was that if Heathrow was going to make the decision not to accept arrivals, it would need to do so sooner rather than later in order to give long-haul flights a chance to divert.

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[9]   Further details relating to this location have been reserved for security purposes.

6.1.6 **21 March 2025, 00:30 – AOM receives further update -** the Duty AOM received a further update from Heathrow teams that Fire East, Airfield Ops, Terminal 2 and Terminal 4 were without power.

6.1.7 **21 March 2025, 01:08 – COO arrives at Heathrow** - the COO arrived at Heathrow, having been notified of the incident by the F24 alarm system.

6.1.8 **21 March 2025, about 01:15 – Meeting starts during which the decision is made to stop Airport operations until 23:59** – a call was held with senior individuals, including the COO of Heathrow. The COO received a situational report from the Duty AOM. The Duty AOM (1) [*part of this sentence has been reserved for security purposes*] and (2) considered that Heathrow could not safely operate for passengers and colleagues. It was reported in this meeting that Terminals 2 and 4 were without power, and Terminals 3 and 5 were powered but certain Airport-wide critical safety systems had lost power. Based on this information, the COO determined that he did not have confidence that he could operate a safe and secure Airport. The COO decided to stop operations until 23:59 on 21 March 2025.

6.1.9 **21 March 2025, 01:44 - Notice to Aviation issued** – Notice to Aviation (**"NOTAM"**) was issued, confirming operations at Heathrow suspended until 23:59. Via Air Traffic Control, this NOTAM has the effect, amongst other things, of alerting aircraft already travelling to Heathrow that the Airport has suspended its operations.

6.1.10 **21 March 2025, 01:52 – Gold Command activated** – Gold Command was activated via F24 notification.

6.1.11 **21 March 2025, 02:14 – Heathrow issues first media statement –** Heathrow issued a media statement confirming that it was experiencing a significant power outage across the airport. The statement confirmed that the Airport was closed until 23:59 on 21 March.

6.1.12 **21 March 2025, 02:41 – 06:25 – Engineering team undertake plan to switch over power supply from the Intake A substation (where outage has occurred from National Grid, via SSEN substation)** – having developed a switching schedule to reconfigure the network from the Intake A to the other two supplies to the Airport, the Engineering team undertook the required switching activities with the support of UK Power Network Services (**"UKPNS"**), Heathrow's private network service provider contracted to maintain Heathrow's internal High Voltage electricity distribution network (who were already on site for other purposes). These switching activities are described in further detail below at paragraphs 8.13- 8.19. The Engineering team's actions were based on existing contingency plans and switching schedules in the event of power loss.

6.1.13 **21 March 2025 – 07:43 – Engineering team commence reconfiguring and re-energising of wider Heathrow network -** this involved controlled re-energising of 11kV and other lower voltage substations.

6.1.14 **21 March 2025, about 09:00 to 10:56 – Power to Terminals 2 and 4 restored** – the power was restored to Terminals 2 and 4 as a result of the switching being completed. The Engineering and IT teams then proceeded to systematically check systems.

6.1.15 **21 March 2025, 10:00 to 12:31 - SSEN informs Heathrow it can return to North Hyde supply** – at 10:00 SSEN called Heathrow engineers to inform Heathrow that SSEN was ready to put Heathrow back on its regular supply. SSEN said it had two transformers available. At 12:31 SSEN confirmed that North Hyde was being fed by a substation at Iver, at which there were four transformers available. SSEN confirmed there were no single points of failure with this supply or capacity issues. Reconnecting to North Hyde would now require Heathrow to reconfigure its internal network, effectively reversing the process described above at paragraph 6.1.12.

6.1.16 **21 March 2025, 13:00** – **Critical safety systems restored in Terminals 3 and 5** – at this time, checks of Critical Safety Systems 2, 3 and 4 were completed, with critical systems established in Terminals 3 and 5. This enabled decisions at 13:15 to allow repositioning flights to start from 16:00.

6.1.17 **21 March 2025, 13:15 – Decision made to reconfigure network back to three supplies / Confirmation that critical systems in Terminals 3 and 5 are operational** – following discussions between senior leadership and the Engineering team and a Gold Command call, the decision was made to reconfigure the network back to Intake A to achieve a business-as-usual state. At this time, it was estimated this would take 10 – 12 hours. Separately, on this call it was confirmed that critical systems were operational in Terminals 3 and 5. The systems were still coming back on in Terminals 2 and 4. It was estimated that repositioning flights could start from 16:00.

6.1.18 **21 March 2025, 14:00 – Community Call[10] confirms partial reopening of Terminals 3 and 5** – at the Community Call, Heathrow confirmed that repositioning flights would begin from Terminals 3 and 5 from 16:00 and repatriation flights would be accepted from 18:00. At this time, Heathrow stated there would be no departure flights on 21 March. Heathrow confirmed it was planning full operations for 22 March.

6.1.19 **21 March 2025, 14:30 – BA requests slots for eight departures post 20:00 -** Heathrow began to communicate with British Airways regarding the possibility of those flights departing and further assessments are carried out by the Command & Control team.

6.1.20 **21 March 2025, 16:30 – Confirmation provided to Gold Command that Terminal 5 will be open for passengers at 17:00 –** to allow for the 20:00-onwards departures.

6.1.21 **21 March 2025, 17:00 – Terminal 4 confirmed as operational** – on Community Call, Terminal 4 was confirmed as able to be operated safely to receive repatriation arrivals. Heathrow also confirmed on this call that eight departure flights would be operated from 20:00.

6.1.22 **21 March 2025, 18:01** – **First repositioning flight lands at Heathrow** – the first repositioning flight landed at this time (Heathrow having reopened for repositioning flights at 16:00).

6.1.23 **21 March 2025, 20:00 – Departures from Terminal 5** – the first of eight departures with passengers began from Terminal 5.

6.1.24 **21 March 2025, 21:52 to 21:58 – Heathrow seeks and is given further information from SSEN regarding resilience of supply available -** the Engineering team called SSEN to inform them that they were going to start reconfiguring their network to reconnect to Intake A (having spent the time since the decision was made at 13:15 undertaking the preparations for this). On this call SSEN advised they were about to carry out switching activities with the National Grid. SSEN informed Heathrow that the Iver supply would not be available until 22 March and the supply from North Hyde would be from a single transformer (and therefore a single point of failure) until the following morning. As noted below, following this, the Engineering team and Silver Command concluded at 22:30 that this single transformer did not provide a resilient power option for the Airport to restore its Intake A supply.

6.1.25 **21 March 2025, 22**:**19 – First repatriation flight lands at Heathrow** – having reopened for repatriation flights from 18:00, the first repatriation flight landed at this time. The three repatriation flights that arrived at Heathrow were processed through Terminal 4.

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[10]   See paragraph 17.16.

6.1.26 **21 March 2025, 22:30 – Decision made to stay on two-supply configuration** – based on the information from SSEN provided at 21:58, Engineering team concluded that North Hyde was not a sufficiently resilient supply and the decision was made to remain with the two-supply configuration.

6.1.27 **22 March 2025, 04:30 – All Heathrow terminals operational** – all Heathrow terminals were open and fully operational.

SECTION 3 – CONTEXTUAL MATTERS

7. **POWER IN THE CONTEXT OF THE OPERATIONS OF AN AIRPORT**

    Overview of Heathrow

7.1 A number of Heathrow employees referred to Heathrow as a small city. Heathrow is the UK's only hub airport and in 2024 was the most connected airport in the world.[11] It has two runways, which are the busiest in the world.   As a hub airport, Heathrow combines direct passengers, transfer passengers and freight to enable long-haul aircraft to fly to destinations all over the world. Heathrow is the busiest passenger airport in Europe and the fifth busiest airport globally.

7.2 Heathrow is regulated by the Civil Aviation Authority (**"CAA"**) under the Civil Aviation Act 2012. Under this regime, the CAA establishes what the Airport can charge per passenger and the Airport's capital expenditure is agreed on a periodic basis through a process involving both the CAA and airlines. Capital projects are also subject to extensive scrutiny and controls by both airlines and the CAA. Additionally, the CAA also sets service quality standards that Heathrow must meet.

7.3 In 2024 a record 83.9 million passengers used Heathrow Airport. Heathrow typically operates approximately 1,300 flights per day and welcomes approximately 200,000 passengers per day.

7.4 Heathrow is not only a hub for passengers. It is also the largest UK port by value with 1.6 million tonnes of cargo valued at over £215 billion passing through it in 2024.

7.5 Despite the significance of these operations, Heathrow operates on a relatively small geographic footprint, compared to other airports. In total, Heathrow is 12.3 square kilometres in size, having gradually expanded over the last 75 years.

7.6 Heathrow works with a number of partners and stakeholders to deliver the full functionality of the Airport, as illustrated in the diagram below in respect of a passenger journey through a terminal:

Diagram 1

7.7 Heathrow has four operational terminals:

    7.7.1   Terminal 2 was opened in 2014. It measures 40,000 square metres.

    7.7.2   Terminal 3 was opened in 1961. It measures 98,962 square metres.

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[11]   According to OAG Megahubs Index 2024, as reported in Heathrow's annual report 2024.

7.7.3 Terminal 4 was opened in 1986 and underwent a major refurbishment in 2009. It measures 105,481 square metres.

7.7.4 Terminal 5 opened in 2008. It measures 353,020 square metres.

7.8 There are multiple ways for passengers to access the Heathrow terminals, including via the Heathrow Express and the London Underground, and via a road tunnel to the Central Terminal Area for Terminals 2 and 3. For periods during the incident response the Heathrow Express was limited to Heathrow staff only. Heathrow also worked with the police to put road closures in place to prevent people coming to the Airport, including via the M4 spur. Power to the CTA tunnel was also critical to be re-established safely and resiliently before Terminals 2 and 3 could be fully operational.

7.9 Heathrow operates two parallel runways. These are generally operated so that arriving aircraft are allocated to one runway and departing aircraft to the other. Heathrow's Long-Term Growth Programme includes a third runway.

7.10 As Heathrow has grown gradually over the last 75 years, so has its IT infrastructure. Today, for example, there are approximately 1,250 data centres and Network Node locations at Heathrow.

Heathrow's safety culture

7.11 Heathrow has a very well-developed specialist safety function. Over a number of years, that function has provided a second line of support to those in operational roles on safety issues. During the incident, members of the safety team were also members of incident response teams so could provide specialist input on safety topics if needed.

7.12 Heathrow measures its safety culture in a number of ways. It works with an external organisation, Safe365, to measure its scores against a Safety Culture Index and the safety team has promoted the adoption of this measurement tool to Team Heathrow partners (i.e. those operating at the Airport who are not directly employed by Heathrow). Heathrow's own most recent score exceeds industry comparators. A separate recent external audit under ISO 45001:2018 (the international standard for occupational health and safety management systems) concluded that the Airport "*once again confirmed its position as a best-in-class organisation, demonstrating an unwavering commitment to occupational health and safety excellence*". The audit also recognised a culture of continual improvement in a safety context.

Safety systems for operation

7.13 During the Review, we have heard from Heathrow employees about various different modes in which an airport can operate safely. There are contingency plans to enable the Airport to close safely (e.g. evacuation plans), as well as to enable limited operations, such as to allow aircraft to land on the airfield. Different levels of safeguarding are required depending on the mode of operation the Airport wishes to achieve. In relation to the different modes of operation over 21 – 22 March 2025 (discussed below at paragraph 13.8) the following considerations for safety systems apply:

7.13.1 Repositioning flights - this is a process to enable aircraft to move their locations so that they are in the right place for the start of their schedules the next day. It requires fewer systems to operate safely because it does not involve passengers, only air crew. By reference to **Diagram 2** below, it requires safety systems for some but not all of the processes running across the bottom of the diagram.

7.13.2 Repatriation flights - these enable the return of passengers to Heathrow following diversions to other airports and need safety systems in operation across the whole of the bottom of the diagram.

7.13.3 Full operations – this requires safety systems to operate across the whole of the diagram. Heathrow personnel will also assess wider considerations. For example, in the early hours

of 21 March, traffic lights on roads used to travel to and from the Airport were not working because of the North Hyde power outage affecting the surrounding area. Even if the Airport had retained full power, this would have affected safety considerations about whether full operations were possible to commence on the morning of 21 March.

7.14   As discussed in further detail below, North Hyde powered a number of these critical safety systems across multiple terminals, impacting the time it took to open any mode of operation at terminals which otherwise had power.
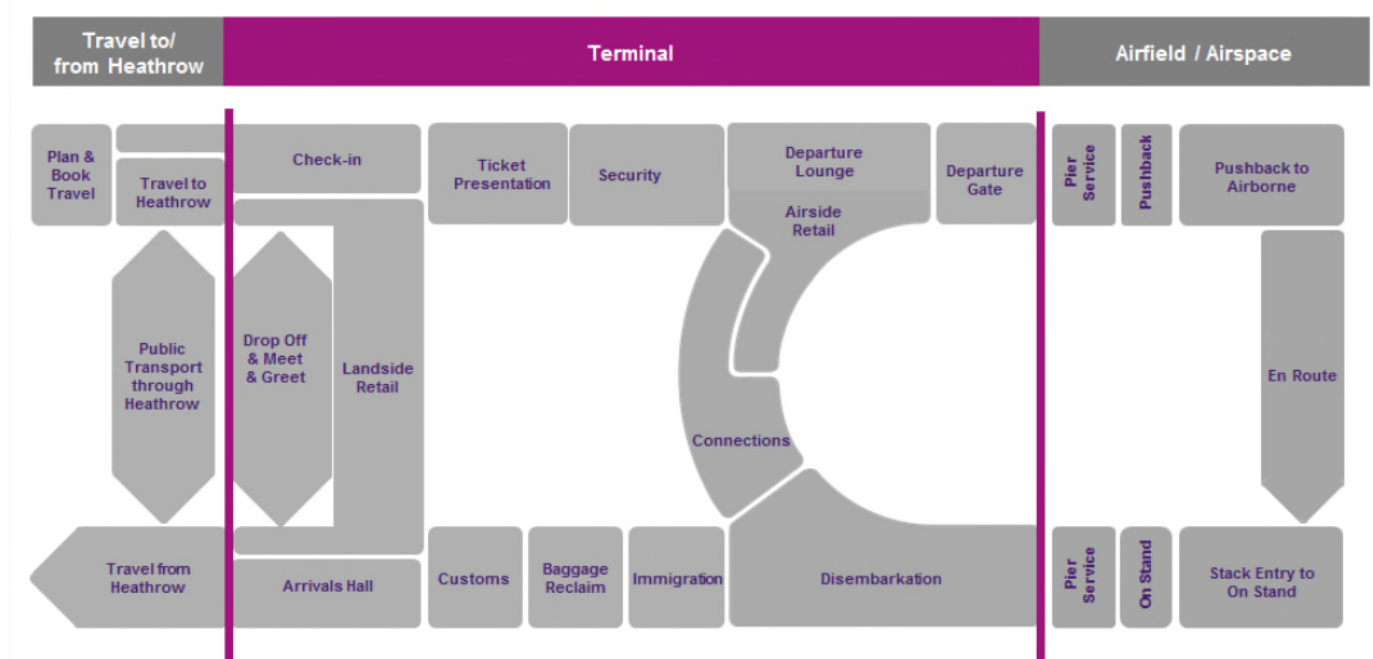

Diagram 2

7.15   There are multiple logistics considerations to reopening the Airport. When full power was restored during the course of 21 March 2025, safe processes needed to be adopted to enable critical people for the Airport's functioning to return to relevant parts of terminals or elsewhere on the Airport campus – for example: ground handlers, security staff, baggage handlers and others – many of whom had either previously been evacuated from facilities or advised to stay at home until they received instructions to attend work. The Review has concluded that this inevitably extended the period between the point power was restored to a terminal (or its safety systems) and it being possible to operate safely.

Type of Aircraft Movements at Heathrow

7.16   The below diagram shows how Heathrow compared in 2024 with other international airports in relation to its ratio of long-haul flights (in Diagram 3 below, **"LH"**) to its short-haul (**"SH"**) operations. Long-haul flights are categorised as those over 6 hours.

7.17   37% of Heathrow's flights are long-haul. Operationally this means decisions need to be taken with sufficient certainty about how well the Airport will function many hours ahead. The risk of projecting the safe reopening of an airport too soon will be that long-haul flights might leave their points of origin and, should the airport not in fact be safe to open as those flights are on their journeys, they will need to be diverted to alternative airports or return to their points of origin, causing additional passenger disruption. The Review considers that Heathrow's high percentage of long-haul flights means that more weight should be placed on this consideration compared with some other airports.
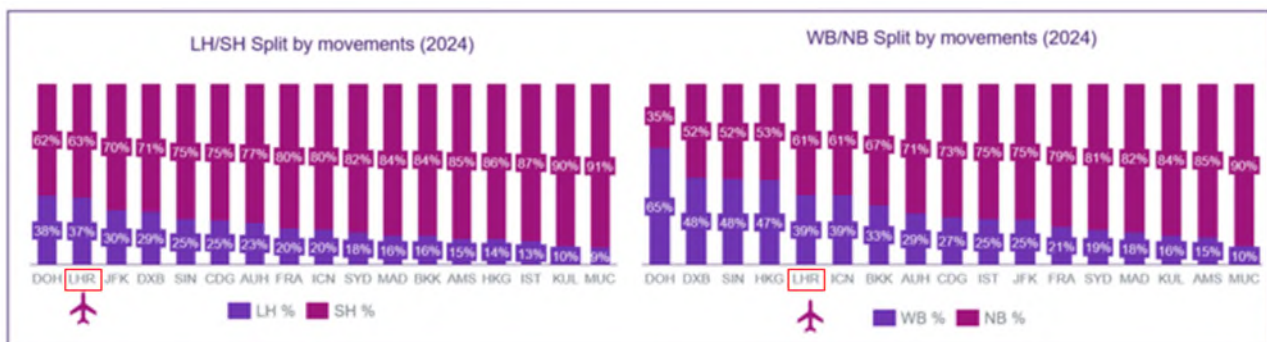
Diagram 3

7.18   39% of flights arriving or departing from Heathrow are on Wide Body Aircraft (in Diagram 3, **"WB"**), as opposed to Narrow Body Aircraft (**"NB"**). WB planes are typically those used for long-haul flights but they require special terminal stands to accommodate their size. The total number of those stands across the UK and Europe is limited. As a consequence, operationally if an airport opens prematurely, a large number of WB aircraft may have commenced their journeys to the airport but there will be limited capacity for them to safely disembark at other airports if the airport in fact cannot accommodate their arrival. This is another feature of Heathrow's flight movements that is a relevant consideration in respect of some issues in this Review.

Standard Operating Hours

7.19   Heathrow's usual operating hours for flight departures are between 06:00 and 22:50 and for arrivals between 04:50 and 22:55 each day.

7.20   As a consequence, there is only about a six-hour night-time window in each 24-hour period where critical systems to operate the Airport ordinarily can be offline, restarted or re-energised (or certain High Voltage switching can take place – see paragraphs 8.13 - 8.19 below). Major construction and maintenance interventions are also constrained to this narrow window, which impacts both the deliverability and cost of projects.

8.   **OVERVIEW OF HEATHROW ELECTRICAL POWER SUPPLY**

8.1   We outline in this section how Heathrow received its electrical power, up until the power outage at North Hyde in the late evening of 20 March 2025. Understanding this power configuration has informed our assessment of the decisions taken by Heathrow personnel after the power loss, as well as driven a number of our related enquiries into Heathrow's preparedness. Please also see paragraphs 20.1 - 20.18.3 below.

8.2   Heathrow's power requirements are significant. During our meetings with Heathrow employees, those employees emphasised to us the importance of having a resilient power supply – meaning, in simple terms in relation to each of Heathrow's three separate power supplies, that if part of that supply failed, it had a secondary electrical supply source at that relevant supply point to continue to supply Heathrow (see paragraphs 20.15 - 20.18.3 for further detail). For this reason, at the time of the incident, Heathrow's three separate power supplies each had multiple transformers connected to the National Grid and each had multiple points of connection (provided by interconnectors) from those transformers to Heathrow. The original power design of the Airport relies on third-party electricity suppliers for the resilience of the power supply (rather than building full self-sufficiency with electricity systems solely controlled by the Airport). Many employees that we spoke to confirmed their belief that this provided Heathrow with a resilient supply of electrical power into the Airport and in fact gave the Airport an over-availability of supply, with built-in contingency, appropriate for its operations.

8.3   **High Voltage Electricity supplied to Heathrow**

8.4   Heathrow has three main high-voltage ("**HV**") electricity supply points or power sources (also known as Bulk Supply Points ("**BSPs**")), all of which are ultimately connected to the National Grid via three grid supply points (**"GSPs"**).   The high voltage transmission system is operated by the National Electricity System Operator (**"NESO"**), using wires owned by National Grid Electricity Transmission PLC (**"NGET"**). NGET is responsible for the operation of the GSPs. The voltage of that electricity is then reduced at substations by step-down voltage transformers, such that it can then be supplied to Heathrow via the lower voltage distribution system owned and operated by SSEN. SSEN and NGET's wires are used for the purpose of facilitating this supply. To illustrate this further, and as explained in NESO's Interim Report, the North Hyde site has four substations, all of which are owned by NGET.[12] There is a 275kV substation which is operationally controlled by NGET, as well as three lower-voltage substations which are operationally controlled by SSEN.[13] The 275kV substation has three supergrid transformers (**"SGTs"**) which are owned by NGET and which step down the voltage to the lower voltage substations.

8.5   One of these lower voltage (66kV) substations (operationally controlled by SSEN) feeds Heathrow's Intake A, as shown in Diagram 4 below.

8.6   Diagram of Heathrow campus and its HV supply points (3 power sources)
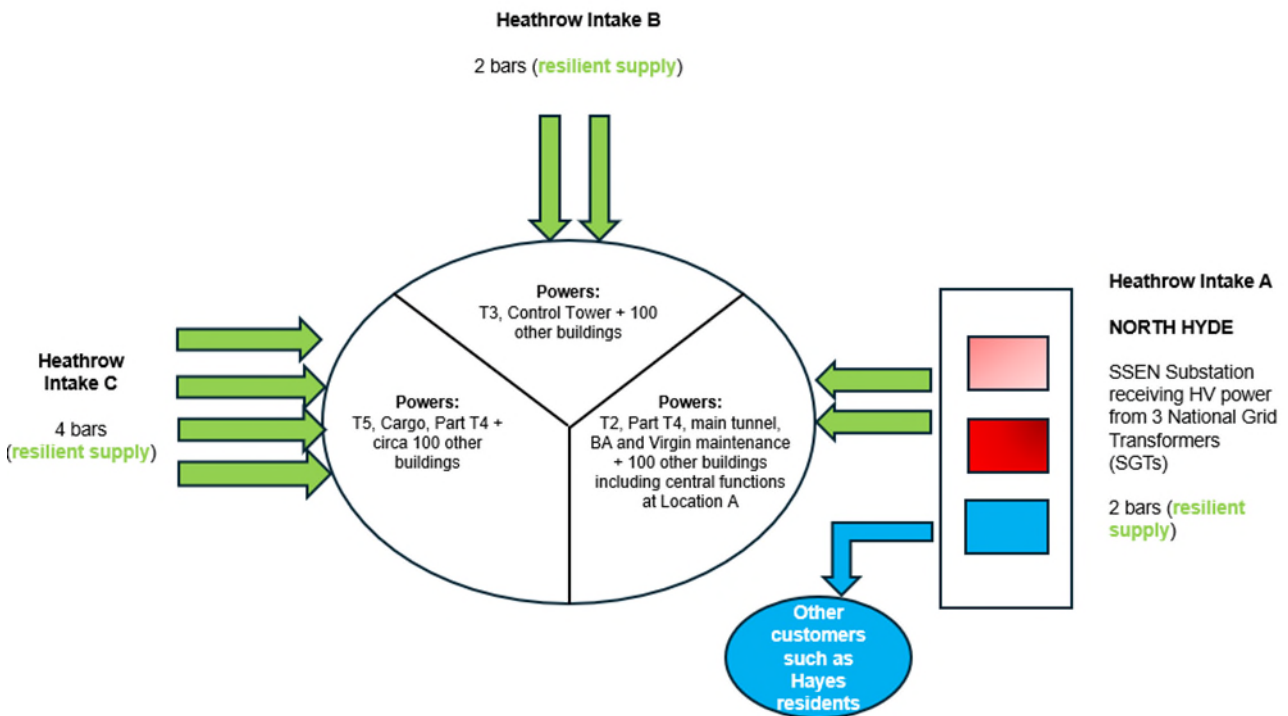
Diagram 4

8.7   To ensure continuity and resilience of supply in accordance with recognised UK network engineering standards,[14] SSEN provides power to Heathrow from North Hyde via two electricity supply cables

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12   NESO Interim Report, paragraphs 5.2 – 5.8.
13   While the SSEN compound is located on the same site as the NGET Substation, SSEN does not have any control or ownership of the assets operated by National Grid Electricity Transmission.
14   Engineering Recommendation P2/8

(known as busbars) (as shown in the Diagram above). One is the primary cable and the second provides redundancy in the case of an outage on the primary electrical supply, providing N-1 contingency, or resilience, to Heathrow (see paragraph 20.17 below). Resilience in power distribution terms means that there should not be a single point of failure – there is back-up provided – such as via multiple transformers and multiple busbars, each with adequate capacity to continue to supply.

8.8   Details about the electricity supply resilience that Heathrow understood was being provided by the North Hyde substation are discussed further in paragraphs 20.15 - 20.18.3 below.   In summary, each of the three supply points in Diagram 4 above has resilience built in both at the National Grid level and relevant substation level (because these are fed by multiple transformers – in the case of North Hyde, there are three transformers as shown in the diagram above)[15] and by having separate busbars from each such supply into the relevant part of the Airport.

8.9   The unprecedented nature of the North Hyde fire (from an electrical infrastructure perspective) is that all three of the supergrid transformers failed at the 275kV National Grid substation. This meant that there was no supply to the lower voltage substation that feeds Heathrow.

8.10   The details of how power came to be restored via North Hyde is also key to understanding certain decisions taken by Heathrow personnel during the day and evening of 21 March. These decisions were not based only on whether there was supply available from North Hyde, but also whether there was supply available that Heathrow assessed to be sufficiently *resilient*. This resilience was considered essential for the safe running of the Airport so there was no risk of a single point of failure and possible repeat loss of power causing further disruption. Some key details are as follows:

8.10.1   As discussed in NESO's Interim Report,[16] SSEN was able to re-energise its North Hyde substation by 09:49 on the morning of 21 March using an interconnection to another substation at Iver. This meant there was supply available, but not necessarily (for Heathrow) resilient supply. On its own, the Iver interconnection would be a single point of failure for the North Hyde supply. The Iver interconnection might also have had insufficient capacity (a measurement in electrical supply terms known as MVA (**megavolt-amperes**)) to power both Heathrow and the other customers reliant on the North Hyde supply.

8.10.2   By lunchtime on 21 March, however, Heathrow engineers understood from their counterparts at SSEN that resilient power was available at North Hyde again. The information provided to Heathrow engineers at that stage was that the Iver interconnection **and** a transformer at the National Grid substation at North Hyde were both available. This led the Heathrow team to prepare to reconfigure back to three supply points during the afternoon and evening of 21 March.

8.10.3   Following the calls that Heathrow engineers had with SSEN engineers on the evening of 21 March, issues emerged which informed the decision of Heathrow at 22:30 on 21 March not to switch the configuration of its network back to North Hyde.

(a)   SSEN confirmed that the HV supply from North Hyde would be reliant on a single point of failure until the morning of 22 March.

(b)   SSEN confirmed that there would be ongoing network switching activities by National Grid. Heathrow engineers considered that these activities carried a risk of interruption of the supply to the Airport. These activities have been subsequently confirmed in NESO's Interim Report.[17]

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[15]   The details of the substations feeding the other intakes have not been included in the diagram.
[16]   See paras 5.21 and 5.22 of the NESO Interim Report.
[17]   See para 5.22 of the NESO Interim Report.

8.10.4   As has become known subsequently, it was not until 00:55 on 22 March that the only operational National Grid transformer at North Hyde was in fact energised and connected to the wider transmission system.[18]

8.10.5   When the North Hyde transformer was re-energised, the interconnector circuits from the Iver substation were switched out, leaving the North Hyde 66kV substation being fed from a single transmission circuit. Subsequently, from 19:22 on 22 March, NGET and SSEN made an additional circuit available via Iver to supply the North Hyde 66kV substation.[19] The other two transformers at North Hyde remain out of service as at the date of issuing this Report.

8.10.6   Throughout 21 March and into the early hours of 22 March, Heathrow personnel also needed to factor in that the fire at North Hyde was not fully contained. This inherently raised doubts as to the resilience of the North Hyde BSP. The London Fire Brigade later confirmed it had ceased firefighting at 17:13 on 26 March.[20]

8.11   **The allocation of HV Power across the Heathrow campus**

8.12   As illustrated in Diagram 4 above, one intake primarily feeds Terminal 5 (marked as Intake C), another Terminal 3 (Intake B), and another Terminals 2 and 4 (Intake A, supplied by North Hyde). Each supply point also powers many other buildings and areas, and, between them, they power central Airport-wide systems. In the case of the North Hyde supply point at the time of the fire, it meant power was lost to geographic locations (such as Terminal 2 and part of Terminal 4) and also lost to some of the IT networks that operate across locations or critical servers or systems that enable them to function safely.

8.13   **Switching between supplies**

8.14   Any change to the configuration of where a part of the Heathrow campus receives its HV power requires a process of switching across Heathrow's internal distribution network, within which there are approximately 250 substations. UKPNS provide operation, repair, replacement and maintenance services to the internal distribution network as Heathrow's expert service provider.

8.15   As explained below at paragraphs 12.1 - 12.24, on 21 March Heathrow undertook switching of its internal distribution network to restore power to those parts of the Airport which had lost power from North Hyde. Heathrow has detailed contingency plans for these types of scenarios, which were implemented in response to the power outage as discussed below at paragraphs 16.1 - 16.8.3.

8.16   We have heard from Engineering employees in the course of the Review what the switching process involves. It is complex and requires control engineers physically to attend multiple locations and follow specific sequences to ensure the process is safe for people and does not cause damage to assets or infrastructure (which are significant risks if HV power is rerouted across a network in an uncontrolled manner). Heathrow has a system to undertake remote switching, however this still requires a person to go to the relevant internal substation to carry out checks on the area prior to switching and to confirm with the control room before each switch.

8.17   Ordinarily systems would be powered down in a safe and controlled way before the switching sequence starts. That could not happen on 21 March because the power loss occurred suddenly. After the switching, Heathrow's internal distribution network is re-energised and systems must be powered up again in a controlled way and tested to ensure they are safe. In the event of a sudden loss of power, there are greater uncertainties over the powering up process because systems may not have been powered down in a controlled way and may have suffered damage. It may increase

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[18]   Referenced as transformer SGT2 in the NESO Interim Report.
[19]   See para 5.23 of the NESO Interim Report.
[20]   See para 5.19 of the NESO Interim Report.

timescales too, if systems need to be reconfigured once power is restored after a sudden uncontrolled loss of power.

8.18   One Engineering employee illustrated this process by comparing it to the fuse box in a domestic home. If every appliance in the house were on and the main breaker tripped, when power is turned back on the breaker may trip again because all the appliances are still on. Applying this analogy to Heathrow, the Engineering team had to switch everything off before restoring power and then switch all systems back on again and test that the uncontrolled powering down had not impacted the systems.

8.19   The time that it takes to undertake the switching depends on the switching sequence that is required. Switching is something that can happen in the ordinary course of business. However, switching to enable the reconfiguration of Heathrow's electrical power network away from one of its three supplies is a significant and time-consuming undertaking. As we explain in more detail at paragraphs 6.1.12, 6.1.13, and 6.1.14 above and at paragraphs 12.2 - 12.7 below, on 21 March the entire process of powering down, switching, powering on and testing systems took between 10 – 12 hours.

8.20   **What about back-up power?**

8.21   Heathrow has a range of back-up power systems to ensure uninterrupted power to critical parts of the Airport for it to operate safely for periods of time in the event of a temporary disruption to power provided via Heathrow's internal distribution network (and SSEN and National Grid upstream).

8.22   For example, diesel generators provide instantaneous back-up power supply to the Airfield lighting and the Control Tower for up to seven days – providing the longest period of emergency back-up within the Airport to enable aircraft to land that need to. There is also battery back-up to provide Uninterruptible Power Supply (**"UPS"**) to certain systems across the Heathrow campus, such as escape lighting. These back-up systems at Heathrow are safety systems and many are designed to allow Heathrow to land aircraft and evacuate passengers safely, rather than operate as usual for any length of time. In the event of a power loss, the time that back-up power is available depends on the systems and type of back-up each has. Some systems may have back-up power for 90 minutes, others for four hours. This may also vary by location across the Airport, as well as by the age of the asset and the back-up power source.

8.23   When the fire at North Hyde started, Heathrow was told it would be at least six hours before the London Fire Brigade would be able to start tackling the fire. By this point, almost all emergency back-up power sources which supported systems or locations powered by North Hyde would have been exhausted (with the exception of the Airfield-related back-up systems). See also paragraphs 16.1 - 16.8.3 and 20.36 below in relation to back-up power sources at the Airport.

9.   **HEATHROW'S CRITICAL INCIDENT RESPONSE: COMMAND & CONTROL**

9.1   **Command & Control structure**

9.2   In responding to the power outage, Heathrow activated its Command & Control Structure. To provide context to our findings, this section of our Report provides an overview of Heathrow's critical incident response processes. We assess the effectiveness of these later in the Report at paragraphs 15.1 - 15.28.

9.3   Heathrow Command & Control is constructed of three teams: Bronze, Silver and Gold Command. Each team has a specific remit. Each works on a shift rotation system. The Gold Command team focuses on strategic level decision-making, external communications and actions. Silver Command focuses on the tactical level and Airport-wide communications. Bronze Command focuses on the operational level, with the Bronze roles aligned with operational business units and the Command structure providing additional coordination and resource to manage the incident.

9.4   An incident is typically divided into two phases: the Initial Operational Response, which occurs in the first 90 minutes of an incident (summarised in Part 1 of this Report at paragraph 5.1.1), and Response and Recovery, which occurs after that first 90 minutes (where our core findings are in Section 4 of this Report at paragraphs 12ff - 19ff). The decision whether to stand up Command & Control and the level of activation (Gold, Silver, Bronze) is decided by the Duty AOM.

9.5   The AOM is a rostered role and based permanently at APOC. APOC is a 24/7 facility from which Heathrow conducts its operational planning, monitoring and day-to-day oversight of operations. APOC is a central command room, which was implemented following the Report of the Heathrow Winter Resilience Enquiry, which was published in March 2011, following a review chaired by Professor David Begg ("**Begg Report**").

9.6   Other critical post-holders sit alongside the AOM in APOC. Notably in this incident the AOM was supported by the Airport Control Engineer and other electrical engineers, who are also permanently rostered in APOC.

9.7   Command & Control is activated by the AOM via an F24 phone alarm system.[21] Once a command team is activated, they have 90 minutes following the activation to convene (but are expected to convene as soon as possible).

9.8   The key roles within the Command & Control structure include the following:

   9.8.1   **Gold Commander** – Guidance Document 1[22] describes the Gold Commander as being in command of the strategic tier of Heathrow's response, by reference to a list of strategic imperatives. This includes a strategic imperative to protect passenger and colleague welfare, safety, and security. The Gold Commander's role includes being responsible for prioritising and facilitating necessary resources, while empowering the Bronze and Silver tiers to execute their respective actions.

   9.8.2   **Silver Commander** – the Silver Commander is the primary link between the Silver Command Team and the Gold Command Team. They should provide regular high-level updates to the Gold Commander, support and enhance the operational response to an incident, make tactical decisions and steer the recovery strategy. The Silver Command Team includes other specific roles, such as Silver Communications. Other specialist functions will be called into Silver Command roles depending on the nature of the incident. For this incident, Silver and Bronze Command included Engineering and IT specialists. Specialist cells were formed for different aspects of the handling of the incident.

   9.8.3   **Bronze Command** - the leadership of Bronze Command is the Duty AOM.

9.9   Command & Control Plan 1[23] identifies that the Command & Control structure empowers operational-level teams to make decisions, carry out tasks, and ask for support where needed, delegating upwards where necessary.

9.10   The Gold Command team is comprised of some members of the Heathrow Executive Committee, as well as certain other experienced individuals, often with many years of experience handling critical incidents at Heathrow. Heathrow employees explained that the CEO and COO are not rostered on to the Command & Control structure, because these roles sit separately from and above the Command & Control structure. The CEO is not on the Gold roster because they also need to be available to liaise with the Board, Department for Transport and other stakeholders. As the

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21   The F24 phone alarm system is an emergency notification system that when activated calls the phone numbers of individuals listed for incident response purposes (including those who hold Command & Control responsibilities). It can be activated at different levels, such as only to Silver and Bronze command level.
22   The name of this document has been reserved for security purposes.
23   The name of this document has been reserved for security purposes.

accountable person with ultimate responsibility for aerodrome safety under the Airport's CAA licence and functional responsibility to run the operation, the COO is therefore also not on the Gold roster.

9.11 **Heathrow Decision Model**

9.12 Heathrow trains those in the Command & Control structure on the use of the Heathrow Decision Model. The Decision Model provides the following steps, which can be repeated as more information is gathered:

9.12.1 Gather information and intelligence

9.12.2 Assess risks and opportunities and develop objectives

9.12.3 Consider powers, policies and procedures

9.12.4 Identify options and contingencies

9.12.5 Take action and review.

9.13 The Decision Model is intended to align with the Emergency Services Joint Emergency Services Interoperability Principles ("**JESIP**") Joint Decision Model, to enable Heathrow to better coordinate with external partners in emergency services so that there is a consistent structure. The Decision Model is intended to provide a common approach and language for decision-making and to empower decision-makers and to ensure that they make the best of their experience and intuition by providing balance and structure.

9.14 Heathrow makes template A3 pads available in APOC with the Decision Model printed on them, for employees to use during incidents. Multiple Heathrow employees who were involved in the incident response referred to using these pads or the Decision Model.

SECTION 4 – ISSUES DURING THE EVENT

> *Note: This section contains details of a number of critical safety systems, the names of which have been* ***redacted*** *for security reasons in the body of the Report.*

10. **DECISION TO STOP OPERATIONS AT AIRPORT**

10.1 As noted in the chronology above, the decision to stop operations was made at a meeting that began at about 01:15 on 21 March 2025, attended by the COO and others.

10.2 The decision to stop operations was taken by the COO, Javier Echave. At this time, Gold Command had not been activated, but Silver and Bronze had. As explained below, at paragraphs 14.1 - 14.4, the CEO, Mr Woldbye, was not involved in the decision-making. Mr Echave confirmed to the Review that the decision whether to stop operations is within his authority as the accountable manager on the Airport's CAA operating licence with responsibility for aerodrome safety. In making this decision, Mr Echave had the benefit of expertise from Engineering and Operations personnel present (including the Silver Commander) and the latest situational awareness update from the Duty AOM in APOC.

10.3 Mr Echave explained that the fundamental question for him was whether he could have confidence in Heathrow's ability to operate the Airport safely and securely and maintain the integrity of the border. The other individuals who were involved in the decision-making confirmed that these were the primary considerations. The relevant factors at this time were:

10.3.1 A significant number of systems across the Airport had failed. These included critical safety systems, including Critical Safety Systems 2, 3 and 4, and a large number of units of Critical Safety System 1. Heathrow employees who spoke to the Review emphasised that Heathrow needs certainty that its systems are working, which means these systems must be tested and validated as operational. If it does not have that certainty, it must assume they are not.

10.3.2 Systems such as the runway lights and Air Traffic Control Tower were operating on generator back-up power. See paragraph 8.22 for more information on these back-up systems. Other back-up power systems had been automatically activated, including escape lighting in the terminal buildings.

10.3.3 London Fire Brigade were estimating that it would take them six hours to begin fighting the fire (although it appears subsequently this meant fighting the fire within the perimeter of the substation, pending it being safe to do so from an electrical safety perspective).

10.3.4 Fire East, one of two fire stations at the Airport, did not have power.

10.3.5 Baggage systems were not operating in Terminals 2 or 4.

10.3.6 The Engineering team had reported it would take a minimum of two hours to get power back. As noted above at paragraph 8.17, this would require all systems to be powered down, restarted and tested.

10.3.7 Approximately 130 flights were at that time already travelling to Heathrow. The number of flights on their way would continue to grow exponentially. Prior to the 01:15 meeting, Heathrow had spoken to air traffic control services about the impact if Heathrow were to close and was told that if Heathrow was to zero-rate itself, i.e. not accept arrivals, it would need to do that sooner rather than later to allow long haul flights a chance to divert.

10.4 No Heathrow employee reported to the Review that they disagreed with the decision to close the Airport, including members of the Executive, members of the Engineering team and members of the Operations team. Mr Woldbye reported that he agreed with the decision taken to stop operations,

due to the enormous uncertainty and the risk of personal injury if passengers were allowed to come to the Airport.

10.5   Based on the above factors, the decision taken to stop operations was the only reasonable decision available in the circumstances. It was supported by information gathered by the Duty AOM. This enabled senior leadership to make a prompt decision, with safety and security the foremost considerations.

> *Key finding 1: the Review Committee considers that the decision to stop operations was the only reasonable decision available in the circumstances. It was made with safety and security as the foremost considerations. Given these are reasonable considerations and it was correct for them to be prioritised, it follows that there was no alternative to closing the Airport.*

11.   DECISION ON LENGTH OF CLOSURE OF OPERATIONS

11.1   The decision made at about 01:15 on 21 March was to stop operations until 23:59 that day. The Review has considered whether the decision to stop operations for that length of time was reasonable.

11.2   The COO explained that the rationale for the decision to stop operations for that length of time was to prevent aircraft arriving and people coming into the terminals when the Airport was not ready to hold them.

11.3   The scenarios discussed at the 01:15 meeting were either to stop operations until midday on 21 March or until 23:59. The decision-makers were aware that the fire at North Hyde had not been contained and any recovery of electrical power would take some hours. They were concerned that if passengers were told the Airport would be opening at midday, they would begin to travel to the Airport in the morning and they would not be able to be held safely either inside or outside the Terminals. Given the volumes of passengers arriving and departing on any day, the Airport can only operate safely if they flow through the Airport at a rate sufficient to prevent backlogs, which would otherwise quickly overwhelm the facilities available and pose safety and security problems.

11.4   The decision was taken to stop operations until 23:59 on the basis that the Airport could resume operations earlier if possible.

11.5   A number of Heathrow employees, including the COO, referred to lessons that had been learnt from an earlier snow event in 2010:

11.5.1   Snowfall on 18 December 2010 resulted in the closure of Heathrow, with the Airport operating on significantly reduced capacity until 22 December 2010. This resulted in the cancellation of over 4,000 flights.

11.5.2   The snow event was the subject of a review that culminated in the publication of the Begg Report in March 2011. In particular, the Begg Report found that there had been failures in communication and coordination within Heathrow and between Heathrow and the airlines, and that confusing and conflicting messages caused incorrect signals to go to airlines and passengers. In addition, there had been a slow reaction to terminal congestion.[24]

11.5.3   As a result of this experience, a number of the Heathrow employees that we spoke to noted the importance of giving certainty in communications to airlines and passengers, rather than giving an earlier time and having to push it back, which would create uncertainty and lead to people travelling to the Airport, thereby increasing the risk to safety. We were told that Heathrow was expecting approximately 1,300 flights and 200,000 passengers to be using the Airport on 21 March. We heard from Heathrow employees that the airlines had

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[24]   The Begg Report also made recommendations in relation to Heathrow's emergency planning, response and recovery which we understand have since been enacted.

provided positive feedback on this communication (discussed further below at paragraph 17).

11.6   The decision to stop operations until 23:59 on 21 March was made with the primary objective of preventing risks to the safety of passengers. The decision-makers were careful to avoid creating expectations that flights would operate from an earlier point when Heathrow did not have confidence that this would be possible. We also consider that it was reasonable for the decision to include a qualification so that an earlier opening time could be later announced if it transpired it was possible. This appears to be a well-reasoned decision, demonstrating lessons learned from the snow event.

> **Key finding 2:** *The decision to stop operations until 23:59 on 21 March was a prudent and well-reasoned decision based on the circumstances at that point in time. It was made with safety as the primary objective.*

12.   DECISIONS ON RESTORING AIRPORT OPERATIONS – POWER SUPPLY DECISIONS ON 21 MAY

12.1   Initial decision to switch to two-supply configuration

12.2   Following the power outage the Engineering team began work on developing a schedule of switching activity to reconfigure the network to operate without the supply from North Hyde (which supplied Heathrow Intake A). While the Engineering team had the benefit of pre-existing contingency plans relating to switching, they described the development of the necessary sequence for switching as a very complex task, requiring the switching to be done in a very specific order - with approximately 250 substations there are numerous permutations of how the supply could be reconfigured.

12.3   Although the initial conversation between the Heathrow Engineering team and SSEN happened shortly after midnight and the Engineering team began development of the switching plan, the Engineering team allowed a short time for SSEN to resolve the problem if possible, rather than proceeding immediately into the task of reconfiguring the networks, which as noted above takes several hours.

12.4   The Heathrow team had additional support on 21 March from UKPNS who coincidentally had extra resource on site that night for planned works on the internal distribution network. Developing and executing the switching plan took a number of hours. In summary, everything connected to North Hyde had to first be switched off (see explanation above at paragraphs 8.17 - 8.18 above). Part of the switching sequence, relating to the Airport's primary substations on the Airport's internal distribution network, took place between 02:41 – 06:25. Other switching steps were necessary thereafter to re-energise the wider network systems in a controlled manner. The systems then had to be tested as they began to come back online from about 09:00 on 21 March.

12.5   At 03:30 on 21 March Heathrow lost partial access to Remote Access System 1[25] relied upon by the Engineering team to connect remotely to certain systems (including the systems to remotely switch HV breakers). The system was affected by overheating at Location A itself caused by loss of power to air conditioning "chillers" used to cool servers. The impact on the Remote Access System 1 only affected two or three of Heathrow's internal network substations, which had to be switched using the local (rather than remote) controls. As noted at paragraph 8.16, in any event, the switching process requires a person physically to visit the relevant sites to carry out checks. The switching locations are widely distributed across the Airport campus. Had Remote Access System 1 or chillers in Location A been on UPS, the ability to carry out remote switching at the affected sites may have slightly reduced the time the switching took (although it was estimated to us that this would have been by less than an hour).

12.6   The decision to switch supplies was made in light of information from SSEN that they would not have power restarted at Intake A for hours. At this time, the feedback from London Fire Brigade (as noted

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[25]   The details of this system have been reserved for security purposes.

above at paragraph 6.1.2) was that they would not be able to start to tackle the fire for six hours. The focus for the Engineering Team at this time was to restore power to Terminals 2 and 4 and to other critical systems that had been powered by Intake A.

12.7   The decision to switch to two supplies was made at a time of considerable uncertainty and after allowing time for SSEN to resolve the situation if possible. The decision was made by those with expertise in the power systems, including highly experienced senior personnel who attended Heathrow in the early hours of the night having seen the F24 activation. We were told by several members of the Heathrow team that the back-up power for some systems may have only lasted a matter of a few hours. Based on the evidence we received, the decision to reconfigure the network to two supplies was unavoidable in the circumstances, not least that the fire at North Hyde was still not under control.

> **Key finding 3:** *The decision to reconfigure Heathrow's electricity distribution to two supplies was the only reasonable decision available in the circumstances given the need to restore resilient power to the Airport. The decision was then executed as promptly as possible.*

12.8   **Decision-making relating to reverting to normal configuration**

12.9   At 10:00 on 21 March SSEN contacted Heathrow to inform them that Heathrow could reconnect to its regular supplies, i.e. North Hyde, and have power supplied by two transformers. However, Heathrow employees reported that it was not until 12:31 that Heathrow had clarity on how the supply available from North Hyde would be resilient (i.e. with sufficient capacity and not a single point of failure). At that time, SSEN confirmed that they had resilient power supply for Heathrow at North Hyde via two interconnectors to another substation at Iver, which itself had four transformers.

12.10   The opportunity to revert to the three-supply configuration was discussed by Gold and Silver Command at 13:15 on 21 March, following the confirmation from SSEN that a resilient supply was available from North Hyde. The decision was taken to revert to the three-supply configuration because this would mean that the Airport was more resilient with three independent HV power supplies before restarting full operations on 22 March. It would also be less disruptive and safer to undertake that switching while the Airport was currently closed (as the switching would take longer than the usual overnight closure window). It was estimated it would take another 10 hours to revert to the three-supply configuration (because of the additional time to safely power down systems that had been re-energised from the earlier switch to the two-supply configuration).

12.11   While the decision-makers recognised that reverting to the three-intake configuration would extend the time in which operations were stopped in parts of the Airport by a matter of a few hours, they considered the added resilience offered by the three-intake configuration was worth this time and would avoid a further suspension of operations in the future. The decision to revert to the three-intake configuration mainly impacted Terminal 2.[26] As a result of the decision, Heathrow's engineers ceased starting up systems in Terminal 2 and instead began powering down the systems in a controlled way in order to prepare for the switching. The decision may therefore have impacted the ability to reopen Terminal 2 on 21 March (as we discuss further below at paragraph 13.19). However, at the time this decision was made, Terminal 2, in any event, was not expected to reopen in time for any significant level of operations on 21 March due to the time required to test and validate all systems in the Terminal as safe and to recharge all UPS batteries. It had been communicated to the airline community prior to this decision that Terminal 2 (and Terminal 4) would not operate on 21 March.

12.12   We were told that the decision-makers viewed this decision as separate to the decision to reopen Terminals 3 and 5 for repatriation and repositioning flights. Based on the evidence presented to us,

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[26]   This is because the Engineering team reconfigured the network (during the process described above) so that Terminal 4 was not dependent on North Hyde, so that reconfiguring back to three supplies would be simpler in the event that the supply from North Hyde was reinstated.

we conclude that the two decisions were possible to execute in parallel during the timeline of 21 March, so there was no conflict between them.

12.13   The decision to revert at this time to the three-supply configuration was a reasonable decision made on the basis of the information supplied by SSEN. It was correct for the Airport to have sought to secure the most resilient medium to longer-term power solution (which would also avoid the risk of a later further disruption to passengers, airlines and other businesses and stakeholders as a result of carrying out another reconfiguration of the electricity supply to the Airport on a different date). By the time the decision could be reached to switch back to the three-supply configuration, it is highly unlikely that a different decision (to stick with two supplies) would have enabled significantly more flights to be reinstated on 21 March than in fact occurred.

> **Key finding 4:** *The decision to reconfigure the network to revert to the normal three-supply configuration was reasonably made with the objective of ensuring the Airport had the most resilient power supply available, including over the longer term. While this decision may have extended the time in which operations were stopped for parts of the Airport by a matter of a few hours, a different decision would not have resulted in a significantly larger number of flights being operated on 21 March 2025. We consider the decision was nevertheless the correct one.*

12.14   **Decision to stay with two-supply configuration**

12.15   Following the decision to switch back to three supplies, the Engineering team enacted the plan to reconfigure the network. They ceased the work of starting up systems in Terminal 2 (the other terminals at this time already being operational or undergoing safety testing) and began shutting down systems to allow the switch over in the evening. By 21:52 on 21 March, the Engineering team were almost ready to switch the network over (after which they would begin bringing everything back online, re-energising the network, and then testing it). The timeframe for carrying out the switching had been moved back to this point to allow for a generator to arrive to be used as a back-up power supply for Heathrow's main tunnel in case the switching affected it. The main tunnel is critical for safe access to and from the Central Terminal Area of the Heathrow campus (see further below at paragraph 13.3.3).

12.16   At 21:52 a member of the Engineering team called SSEN to notify them that they would be switching the network. On this call SSEN informed Heathrow that they were going to be conducting separate HV switching themselves. Heathrow called SSEN back at 21:58 to confirm further details. On this call SSEN said that the other substation supply into North Hyde would not be available until the following morning and that Intake A, if reconnected, would therefore have a single point of failure – the single remaining transformer at North Hyde, at the site where the fire had started the previous evening. The two other supergrid transformers at North Hyde were not in operation.

12.17   This new information about the lack of a resilient supply was escalated by the Engineering team to Silver Command and the decision was made to cancel the planned switch and remain with two supplies. The window of time was also reducing for Heathrow to carry out the switching and enable the Airport reliably to resume full operations at the start of the following morning on 22 March.

12.18   While the decision to cancel the planned switch was not escalated to Gold Command or the CEO or COO, all the Heathrow employees the Review spoke to confirmed they believed that this was the correct decision because of the lack of resilient power from North Hyde (and in light of the decision to reconnect to North Hyde having been made by Gold Command earlier in the day on the basis that the supply from North Hyde was resilient). The decision also aligned with the directive that had been set by Gold Command to reopen full operations on 22 March. It was necessary at this point to make a quick decision. Very shortly after the decision was made the Gold Commander was updated and the Silver and Gold Commanders continued to check in regularly throughout the remainder of the night.

12.19   Subsequently, at 00:24 on 22 March SSEN informed Heathrow that they thought the fire at North Hyde had restarted.

12.20　We are of the view that the decision taken to cancel the switch back was reasonable in the circumstances, given that SSEN could not confirm that the North Hyde power supply would be resilient. Additionally, although this information was only known after the decision was made, the fire at North Hyde was not fully under control.

12.21　We observe that Heathrow and SSEN personnel were not in contact about power configuration issues during the afternoon and early evening on 21 March (a period between about 14:00 and the call between control rooms at 21:52). We do not consider this gap in communications had any material impact on the decisions ultimately taken in the late evening of 21 March to remain on two power sources, because it became clear to Heathrow personnel that a change back to three power sources would not provide the resilient power Heathrow needed for the next day's operations. However, given the significance of the configuration work being undertaken by Heathrow and the potentially changeable situation at North Hyde, we consider it may have been helpful as a further safeguard during this complex process for the Heathrow team and SSEN to liaise regularly to confirm nothing had changed from SSEN's perspective on the re-supply of resilient power from North Hyde. As the Review has not gathered information from SSEN on this point, we are not able to comment on whether SSEN were in a position to pass information sooner to Heathrow which may have assisted decision-making.

> **Key finding 5:** the decision to cancel the planned reversion to the three-supply configuration and maintain the two-supply configuration was reasonably made on the basis of a lack of availability of a resilient supply at North Hyde.
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> **Recommendation 1:** the Review Committee recommends that where the Airport is facing a critical incident that involves a third-party supplier, and there is a significant impact to Heathrow, there should be regular communication between relevant Heathrow contact points and that supplier over the course of the critical incident, as a precaution in case additional information from the supplier impacts situational awareness. This may also help to ensure they are receiving timely updates from the relevant supplier of any change of position.

12.22　A lesson learned from the incident is the need for more regular communications with the critical supplier(s) involved during the incident – in this case the communications with SSEN and potentially further upstream with National Grid. Whilst there were good working relationships between the control engineers at Heathrow and their counterparts at SSEN, there were times during the incident where more interaction between SSEN and Heathrow could have been useful. The problems faced by Heathrow engineers related to information their counterparts at SSEN were able to provide during the incident about whether and when a resilient HV supply of electricity would be restored from North Hyde on 21 March. This may have been as a result of the information available to those SSEN control engineers at different points in the incident (for example, if information available to them was contingent on updates they received from National Grid). See above at paragraph 8.10*.*

12.23　We consider a broader relationship between Heathrow and its critical energy supplier SSEN (and upstream with National Grid) highly desirable in relation to issues that might impact supply of HV electricity, any potential interruptions to supply and related resilience topics. Better commonality of understanding, and a more developed relationship at senior level, might not have prevented the unprecedented nature of this incident nor materially impacted the time taken to recover the Airport to full operations. However, it may be beneficial for various types of incident in future. Specific areas for the Heathrow Executive team to consider include:

12.23.1　Regular bilateral management communications between Heathrow and SSEN and National Grid.

12.23.2　Requesting more detailed information about resilience issues affecting the upstream supply of electricity by SSEN (including enquiries as appropriate with National Grid) as well as sharing information about Heathrow's own risk assessments relating to interruption in the supply of HV power and its impact on the Airport.

12.23.3 A shared understanding of each other's critical incident plans, so these might achieve an equivalent level of interoperability between Heathrow and SSEN (and with National Grid too in appropriate circumstances) to that which Heathrow has developed with its emergency services partners.

12.23.4 Reviewing whether any similar enhancements might be useful for the relationship with other key utility suppliers to ensure a good working knowledge of those supplies and Heathrow's needs respectively.

12.23.5 Guidance to the relevant levels in the Command & Control chain about establishing effective communications with senior counterparts in key suppliers during an incident, including requesting a lead point of contact.

12.24 As indicated by our remarks above, we consider that equivalent considerations to those described above should apply to Heathrow's relationship with National Grid, to the extent appropriate and where this improves all parties' overall understanding and preparedness for critical incidents where each are impacted. Equivalent considerations should also apply to Heathrow's relationship with all other critical suppliers.

> **Recommendation 2:** *the Heathrow Executive Team should consider enhancements to the commonality of understanding between Heathrow and SSEN and development of the relationship with SSEN at a senior level, including the considerations set out in paragraph 12.23 of the Report. Equivalent considerations should apply to Heathrow's relationship with National Grid and all other critical suppliers, to the extent appropriate and where this improves all parties' overall understanding and preparedness for critical incidents where each are impacted.*

13. COULD TERMINALS 3 AND 5 HAVE REOPENED EARLIER?

13.1 The Review has considered the information available to it to assess whether Terminals 3 and 5 could have been opened earlier.

13.2 From the start of the incident, when the power outages occurred at 23:55 on 20 March, it was apparent that Terminals 3 and 5 were not affected in the same way as Terminals 2 and 4. This is because Terminals 3 and 5 were primarily powered by supplies other than Intake A. However, the Heathrow employees who were spoken to during the Review explained that, while Terminals 3 and 5 appeared powered, certain critical safety systems were affected Airport-wide.

13.3 The following relevant factors informed the decisions around timing of reopening Terminals 3 and 5:

13.3.1 **Objective set to restore flight operations** – at an early stage of the incident and then again at 10:00 on 21 March, the Command & Control leadership teams had set objectives which included restoring flight operations within the day of the incident. The priority in the objectives was maintaining safety for passengers and colleagues alongside security considerations and compliance with other essential obligations. It was agreed on the 10:00 Gold Command Call that the priority for reopening would be repositioning and repatriation and then the restart of scheduled departures, reflecting what was understood about airline priorities. From approximately 07:30 on 21 March Heathrow had created a dedicated scheduling team to consider what flights could be facilitated on 21 and 22 March, and also to track the diversions of aircrafts and passengers. Heathrow also established a dedicated team to focus on scheduling for the days following the incident.

13.3.2 **Critical safety systems not operating and tested until 13:00** – as noted above, when the power outage occurred, this affected certain Airport-wide critical safety systems as well as the visibility of the effectiveness of others. This included a large number of units of Critical Safety System 1, and Critical Safety Systems 2, 3 and 4. Manual contingencies were available to be put in place for these systems. Two Heathrow employees in operational roles commented that the manual contingencies for these systems are very

resource heavy and there were not sufficient people available throughout the night to put so many contingencies in place at the same time. Heathrow relied on support from Police in relation to certain of these manual contingencies. Having lost multiple systems requiring complex and time-consuming manual contingencies, Heathrow took the view (which we consider was the reasonable and only view to take) that it needed to have these critical systems operating and tested before it could restart operations in Terminals 3 and 5. Operating multiple systems on back-up contingencies increases the risk to safety.

These systems began returning to power at approximately 10:30. The checks on these systems were confirmed as completed at 13:00.

13.3.3　**Central Terminal Area tunnel** – critical safety systems were also lost in the Central Terminal Area tunnel, which provides access to (among other areas) Terminal 3. The power outage affected systems in the tunnel for which Heathrow has minimum operating standards, including Tunnel Critical Safety Systems. A pump used to remove surface water from the tunnel also failed. The inability to use the tunnel affected the ability to use Terminal 3 because the tunnel is the main access route for passengers to reach Terminal 3. A decision was made to operate the tunnel on a restricted basis due to manual contingencies. As at 17:00 on 21 March the tunnel was still operating on a restricted basis. Because of the impact on the tunnel's systems, the incident response teams identified a risk that the critical systems in the tunnel could again be affected by the planned switch back to three supplies. Therefore, Heathrow arranged for a generator to be brought to the tunnel to supply back-up power (see further at paragraphs 21.11 - 21.15. As noted above, the switch did not go ahead and the tunnel was opened at 00:45 on 22 March.

13.3.4　**Ongoing discussions about switching network configuration** – as noted above, at 10:00 on 21 March, SSEN informed Heathrow that it could reconnect to the North Hyde supply, from which two transformers would be available. Heathrow then queried with SSEN whether it could put in a short-term parallel connection between two of its substations, which would allow it to switch supplies without interrupting the supply to the Airport. There were then a number of internal discussions with Heathrow's incident response teams regarding the opportunity to switch back to three supplies, how this could be achieved, and whether they were comfortable that the supply was resilient. It was not until 12:31 that SSEN confirmed to Heathrow the nature of the supply from North Hyde such that Heathrow was comfortable this would be a resilient supply (although SSEN later provided additional information to Heathrow, leading Heathrow's engineers to conclude the supply was not in fact resilient at 22:00). Based on our review of the chronology of events and our discussions with Heathrow employees, it is possible that there may have been some delay (a maximum of a couple of hours or so) caused to the reopening of Terminals 3 and 5 during the window while the opportunity to revert to the original network configuration was being discussed and considered. However, given the complexity of this issue, we do not consider the time spent on these discussions was unreasonable. This enabled good decisions to be taken, based on the best available information at that point in time during the incident, which needed to be appropriately tested. Any delay in this respect may have ultimately had no impact, because the critical safety systems described above were still being brought online and tested during this time.

13.4　Having assessed all the factors above, we consider the key issue affecting the timing of reopening Terminals 3 and 5 was the restoration of the critical safety systems, including Critical Safety Systems 1 , 2 and 3. The loss of critical safety systems in the Central Terminal Area tunnel provided further complication to the reopening of Terminal 3 for any operations beyond repositioning and repatriation, as discussed below at paragraphs 13.8 - 13.14.

13.5　We discussed with Heathrow employees the relevant critical safety systems, the details of which have been reserved for security reasons. These are IT systems, which also have an engineering aspect. [*These sentences has been reserved for security purposes.]* Multiple Heathrow employees commented on the lack of visibility over which of these critical safety systems were affected and this made responding to the incident more challenging. For the avoidance of doubt, we understand that

the loss of power to these critical safety systems did not affect the ability for aircraft to land in emergency situations. However, these systems were assessed as required to be in place to operate any flights on a normal operations basis.

13.6 We consider it reasonable to have taken the decision that Terminals 3 and 5 could not be safely operated for passengers while multiple complex contingencies were being operated in parallel on critical safety systems (Critical Safety Systems 1, 2 and 3). Those critical systems were confirmed as restored and tested at the 13:15 Gold Command call.

13.7 As we have noted above, the decision to reopen Terminals 3 and 5 for select flights was communicated on the Community Call at 14:00 on 21 March. Heathrow began accepting repositioning arrivals from 16:00 and repatriation flights from 18:00. We have referred above to the logistical arrangements required to restaff the Airport at paragraph 7.15. There are clearly also equivalent considerations for airlines to ready themselves (and, in the case of repatriation and departures, passengers) for flights. In our view, the length of time between the decision to partially reopen and the accepting of arrivals was reasonable in the circumstances.

Key finding 6: *the time taken to restart operations at Terminals 3 and 5 was driven by the need to restore critical safety systems, on the basis it was not considered safe to operate the Airport with manual contingencies in place. These systems were confirmed as tested and restored by 13:00 and at 14:00 Heathrow announced on a Community Call that it would begin accepting flights from 16:00. Between 10:00am and 12:30pm, discussion and consideration of the opportunity to convert back to the three supply configuration may have delayed the reopening of Terminals 3 and 5 by a maximum of a couple of hours or so. We do not find the time spent on this assessment to be unreasonable, given the complexity of this issue. Any such delay may not have impacted the time taken to test and restore the critical safety systems, which were the key issue in reopening Terminals 3 and 5. Standing up cumulatively a number of manual contingencies had practical and risk consequences – especially in order to handle any normal volume of passengers through a terminal building.*

Recommendation 3: *the Review Committee recommends that Heathrow review and, if possible, enhance its ability to monitor whether critical safety systems are operational following a power outage.*

Recommendation 4: *due to the importance of these critical safety systems if there is a major disruptive event at the Airport, the Review recommends that Heathrow implements a review into the effectiveness of back-up power supplies for these systems (including how long the supplies last) to establish if enhancements are reasonably practicable. Heathrow should also review which similar enhancements to UPS (or the recharging of UPS) are proportionate and practical to implement for any other operational systems. (For further discussion of the impact of UPS, see below at paragraphs 21.2 - 21.10.)*

The results of these review(s) should be reported to SORC.

Recommendation 5: *the Review Committee recommends that Heathrow develop a list of all critical safety systems for which power is supplied by each High Voltage intake, building on the lessons learned from this incident for North Hyde.*

13.8 **Why were repositioning and repatriation flights prioritised?**

13.9 As noted above, Heathrow chose to prioritise repositioning and repatriation flights ahead of scheduled departures. An explanation of these flights is given at paragraph 7.13. We have considered whether it was reasonable to prioritise these flights above other operations. It is clear that repositioning flights are much simpler to operate as they do not have passengers, and do not require baggage or security lanes. For flights with arriving passengers, Heathrow must ensure security of the border, as well as the safety and security of people moving through the Airport. We were also told that if Heathrow did not prioritise repositioning flights, this could lead to passengers having their flights cancelled multiple times due to ongoing scheduling disruption.

13.10   At a 10:00 Gold Command team call, it was agreed that repatriation flights would be a priority because of the importance of helping passengers get back to their intended destination. Heathrow was also in discussion with airlines throughout the day on when flights would be able to operate and, for example, received inputs on British Airways' preferences for the sequence of flights.

13.11   Heathrow accepted the arrivals of seven repositioning flights on 21 March, with the first arriving to Heathrow at 18:01 (although Heathrow was able to (and advised it could) accept arrivals from 16:00). Heathrow accepted the arrivals of three repatriation flights, with a total of 628 passengers, with the first repatriation flight arriving at 22:19 (although Heathrow had communicated that it could accept repatriation arrivals from 18:00). The repatriation flights were all processed through Terminal 4 (which by this time had been tested and confirmed as operational).

13.12   Following the reopening of Heathrow for repositioning flights at 16:00 and for repatriation flights at 18:00, Heathrow did not decline any requests by airlines to operate such flights. The number of repositioning flights and repatriation flights operated was determined by the airlines, most of whom had by this point cancelled their schedule for the day. Heathrow consulted with airlines and took account of their operational needs as far as possible, in terms of scheduling preferences, once resumption of services on 21 March became a viable option.

13.13   Although Heathrow had previously announced it would not be operating departures with passengers on 21 March, it ultimately operated eight British Airways outbound flights with passengers that day, beginning at 20:00. This followed inputs from the Airport's CEO earlier in the day, who had asked Command & Control leadership to consider whether there was an opportunity to open safely and securely for some outbound flights. The CEO had emphasised that whether it was safe and secure to do so was a technical operational decision. The Command & Control leadership reviewed the position on outbound flights and confirmed they could safely operate a number of outbound flights. Heathrow was able to operate these outbound flights in a controlled environment. We were told that this helped to give the airlines confidence that they would be able to operate a full schedule the following day. A total of 1,009 passengers travelled on these flights on 21 March.

13.14   In our view, it was reasonable in the circumstances to prioritise repositioning and repatriation flights. Heathrow also operated some departure flights when it was confirmed that it was safe to do so. In circumstances where parts of the Airport were still being tested and some manual contingencies still in operation, it was reasonable in our view not to open the Airport for full operations immediately from the time at which individual terminals were confirmed to be safe. When these flights were operated some Airport systems were still being tested, for example systems in Terminal 2. Members of the Heathrow Technology team (who had been responding to the issues with the critical systems described above) also had reported that they could not be certain that the planned switch over to the three-supply configuration (intended for later that evening) would not affect IT systems in Terminals 3 and 5. It was reasonable in those circumstances to operate only limited flights. This would mean fewer passengers and the ability, for example, to ensure, if manual contingencies needed to be deployed, there would be sufficient resources to protect passenger safety at all times.

> **Key finding 7:** *the decision to prioritise repositioning and repatriation flights was a reasonable decision in the circumstances and was coordinated with airlines as far as practicable. While it was reasonable in light of the safety objective not to open for full operations, Heathrow kept under review whether it could operate additional flights, which it did by operating eight departure flights with passengers.*

13.15   **Terminals 2 and 4 and return to full operations**

13.16   From an early stage on 21 March discussions at Command & Control level reflected that Terminals 2 and 4 would not be able to be operated that day. The systems in Terminals 2 and 4 were in a more uncertain state than in Terminals 3 and 5, because they had been shut down when power was lost. As this was not a "clean" shutdown there was potential risk of damage to those assets, which needed to be tested as they were brought online.

13.17   From the time power went out, Terminals 2 and 4 had escape lighting operating on UPS (see above at paragraphs 8.21 - 8.23). However, back-up systems are designed to allow safe evacuation, not for full operations. By 09:00 on 21 March, the batteries in the back-up supplies for emergency lighting had been drained. There was therefore a risk that, if power was lost to these areas, they would have no escape lighting. Those UPS systems needed to be recharged before the assets in those terminals could be checked by the specialist teams. The process of bringing these terminals back to operational status therefore took longer than Terminals 3 and 5.   However, by 17:00 Terminal 4 had been approved for full operation and accepted three arrival repatriation flights, which all landed after 22:00 on 21 March.

13.18   The planned switching back to the three-supply configuration would have affected the power supply to which Terminal 2 was connected and therefore required systems to be powered down in a controlled way to prepare for the switch on the evening of 21 March. There would then be a brief power outage, after which the systems would be brought back online and tested. The Engineering team assessed that the switch back would not risk a power interruption to Terminals 3, 4 or 5 and so the systems in these terminals did not need to be powered down before switching (see above at paragraph 12.11). There was, however, a risk identified that switching could affect critical systems in these other terminals.

13.19   One Heathrow employee reported that, had SSEN confirmed there was no resilient supply available at North Hyde at 12:31 on 21 March, the Engineering team would have continued to restart systems in Terminal 2 (rather than powering them down to prepare to switch back to the North Hyde supply) with the result that the systems would have been operational again from approximately 18:45. Although passenger movements may have been able to restart in the hours afterwards, given this would have been relatively late in the day (with all airline slots having already been cancelled earlier that day) in our view this would not have enabled a significant number of flights to operate. We note our findings at paragraphs 13.11 - 13.13 above that after reopening Terminals 3, 4 and 5, Heathrow accommodated all requests for slots from airlines which resulted in the operation of 18 flights. We have set out our conclusions at paragraph 12.11 above about the competing considerations that applied to the decision to revert to the three-supply configuration.

> **Key finding 8:** *Heathrow relied on information from SSEN to make a reasoned decision to revert to its most resilient network configuration. This may have delayed the point at which Heathrow could resume full operations because of the work required to prepare for this reconfiguration.   We have addressed the reasonableness of the decision to revert to the three-supply configuration in our findings above at Key Finding 4.*

14.   ROLE OF CEO OVERNIGHT ON 20/21 MARCH 2025

14.1   Heathrow's CEO Thomas Woldbye is not on the Command & Control roster, however he is on the list of persons who are notified when an F24 alarm is issued. We are aware of commentary in the media surrounding Mr Woldbye's role in relation to the incident.

14.2   F24 alarms were sent on 21 March to relevant personnel, including Mr Woldbye, at 00:21 (to activate Bronze and Silver Command and to place Gold on Standby) and at 01:52 (to activate Gold). The Chief Operating Officer, Mr Javier Echave, also attempted to call Mr Woldbye several times during the early hours of 21 March.

14.3   Although his phone was on his bedside table, Mr Woldbye reported that it did not alert him to the F24 alarms or to Mr Echave's other calls because the phone had gone into a silent mode, without him being aware it had done so and he was asleep at the time. Records also reflect that his phone was not switched off and that the F24 calls were not answered. Mr Woldbye first became aware of the incident at approximately 06:45 on 21 March, and received a debrief from Mr Echave. As noted above at paragraph 10.2, although Mr Woldbye was therefore not involved in the decision to suspend operations, it was within Mr Echave's authority to make this decision, being the named individual on the CAA operating licence for the Airport.   Neither Mr Woldbye nor Mr Echave considered the decision to stop operations would have changed had Mr Woldbye been involved.

14.4   We are aware of some comments in the media that indicate that on the night of 21 March Mr Woldbye appointed Mr Echave in charge of the incident and then went to sleep. Both Mr Woldbye and Mr Echave confirmed to us that this was not correct. Mr Woldbye expressed to us his deep regret at not being contactable during the night of the incident.

> **Key finding 9:** *Heathrow's CEO Mr Woldbye was not aware of the incident in the early hours of 21 March as he was not alerted to the F24 notifications or to Mr Echave's calls, but this had no impact on the decisions made between 00:21 – 06:45.*
>
> **Recommendation 6**: *the Review Committee recommends that Heathrow consider enhancements that can be made to the notification process of a critical incident (in addition to F24 calls), including options for notifying key individuals via a second means of contact for significant incidents. Heathrow has already taken steps to implement these enhancements since the incident.*

15.   DID THE COMMAND & CONTROL STRUCTURE OPERATE EFFECTIVELY DURING THE INCIDENT?

15.1   All employees spoken to by the Review reported that the Command & Control structure worked effectively throughout the incident. The Command & Control leadership empowered those with technical and operational expertise to make decisions. At all levels of decision-making, it was clear that the primary guiding objective was to ensure safety of passengers, colleagues and assets.

> **Key finding 10:** *the Command & Control structure operated effectively during the incident by empowering those with technical and operational expertise to make decisions. The primary guiding objective for these decisions was ensuring safety.*

15.2   As part of the continual improvement of Heathrow's Command & Control processes and operational resilience plans, we recommend a number of enhancements to the existing processes and procedures.

15.3   The areas for further enhancement can build on existing initiatives that we were told commenced last year to refresh aspects of the Command & Control structure. We do not consider that any of the areas identified for further enhancement would have had any impact on decisions taken during the incident or timeframes for recovery of the Airport on 21 March, had these recommendations been implemented prior to the incident.

15.4   **Rostering of Gold Command**

15.5   Rostering appeared to work well during the incident at the Silver and Bronze levels, with members of these teams working shifts of approximately 12 hours before being relieved. For Silver Commanders, two people also alternated the responsibility in 12-hour shifts. This flowed from the operation of a "shadow" roster, meaning that an individual is on-call for a week, and then after that week they are in a "shadow" role for a week. For an extended incident of this kind, it meant that two Silver Commanders (one rostered to be on-duty and one rostered to be on "shadow") were expected to automatically alternate responsibilities in 12-hour shifts between them.

15.6   It appears that this approach to rostering had not been developed for Gold Commanders, where rostering was handled by a separate administrative process, rather than the Operational Resilience team responsible for all other aspects of Heathrow's Command & Control processes.

15.7   At present, Gold Command level operates on a one-week roster. There are not, however, the same contingencies in place to automatically provide shift cover in the event of a prolonged incident, equivalent to what operates at Silver Command level.

15.8 This meant that one person held the role of Gold Commander for a 24-hour period during a critical time in the incident response before an eight-hour shift pattern was agreed between Gold Commanders for the remainder of the incident.

15.9 We recommend that Heathrow determine the most appropriate model for rostering Gold Commander shifts that ensures adequate resilience in Gold Command during incidents of longer than 12 hours duration. This may involve a similar approach to that currently operated by Silver Command. This would enhance the resilience of the Gold Command function in prolonged critical incidents.

> **Recommendation 7:** *the Review Committee recommends that Heathrow determine the most appropriate model for rostering Gold Commander shifts that ensures adequate resilience in the event of an incident of longer than 12 hours duration.*

15.10 **Training**

15.11 All Gold Commanders had received training in relation to Command & Control processes. This had also recently been increased prior to the incident to support recently appointed Gold Commanders.

15.12 However, training records for Gold Commanders are not kept as a matter of course by the Operational Resilience team. This should be formalised. Compulsory elements of the training programmes should also be clarified.

15.13 In the periods prior to being rostered Silver Commanders are expected to attend decision gyms run weekly by the resilience team at Heathrow. Gold Commanders are also able to join these sessions, but are not expected to do so. We recommend that Heathrow ensure that Gold Commanders receive training on a regular basis. Minimum levels of compulsory training or refreshers might take account of relative levels of experience of different Gold Commanders.

15.14 Because of the relevance of the impact on technology systems during the incident, we consider it would be beneficial for Heathrow to incorporate programmes to upskill those in Command & Control on technology systems. We recommend that Heathrow consider whether this can be incorporated into training programmes.

> **Recommendation 8:** *to enhance training, the Review Committee recommends that:*
>
> a) *Gold Commander training records are formalised and held by the Operational Resilience team;*
>
> b) *compulsory elements of training programmes for postholders in Gold Command are clarified and Gold Commanders should attend regular training;*
>
> c) *Heathrow consider whether measures to upskill those in Command & Control on technology systems can be incorporated into training programmes;*
>
> d) *compulsory training is provided on recording minutes of meetings.*

15.15 **Administrative support for Command & Control**

15.16 Heathrow's Command & Control processes can also roster Support Officers (including Gold Command Support Officers, "**GCSOs**"). Their role is to provide administrative support during a critical incident to log key decisions and minute meetings and calls, such as (in the case of GCSOs) Gold Command meetings.

15.17 We recommend that training is provided to all Support Officers performing various Command & Control roles so that consistent formatting of minutes is achieved. This should follow a similar or equivalent format to the template agenda for Gold Command meetings in the current version of the Guidance Document 1, with key decisions taken and actions allocated during Command & Control

meetings set out in separate sections of the minutes for additional clarity. We refer to Recommendation 8(d) above.

15.18   We also recommend that relevant policy documentation is updated so that it is clear that applicable draft minutes should be provided to relevant Commanders as soon as practicable and in any event within 24 hours of an incident's conclusion for finalisation as an agreed record. We refer to Recommendation 9(d) below.

15.19   **Updates to existing manuals available to those on the Gold Command roster with updated guidance on different roles and postholders and respective responsibilities**

15.20   Existing policy documentation for Gold Command includes Guidance Document 1 and a summary Guidance Document 2.[27] These provide helpful guidance in advance of and during a critical incident.

15.21   We recommend:

15.21.1   Enhancements are made to guidance on the relationships and respective decision-making responsibilities of the Gold Commander, CEO and COO in critical incidents.

15.21.2   Guidance is included in policy documentation on maintaining the resilience of Gold Command in prolonged incidents. This might include examples of when a qualified Gold Commander should not attend APOC in a serious critical incident (if they are not rostered and back-up support has not been requested), so that resilience is maintained for handling an incident that might last more than one day.

15.21.3   Guidance is included in policy documentation on the subject-matter expertise a Gold Commander might wish to have available as support in respect of different types of incident, where they may be less familiar with the underlying subject matter area. This would have the effect of formalising what happened in practice during the course of this incident – where one Gold Commander with less operational expertise had the benefit of support from two qualified Gold Commanders who did.

Recommendation 9: the Review Committee recommends that policy documentation is updated:

a) *to enhance guidance on the decision-making responsibilities of Gold Commander, CEO and COO in critical incidents*

b) *to provide guidance on identifying subject-matter expertise that may be beneficial during an incident.*

c) *to include guidance on maintaining resilience in Gold Command during prolonged incidents.*

d) *to clarify that draft minutes should be provided to Gold Commanders as soon as practicable and in any event within 24 hours of an incident's conclusion for finalisation as an agreed record.*

15.22   **Ensuring that the environment in APOC enables Command & Control teams to work in most effective way possible**

15.23   We heard from some employees who were working in APOC during the incident that APOC became very busy and at times noisy. This is of course understandable in an incident like this that required so much resource. However, we recommend that Heathrow consider whether enhancements can be made to procedures relating to the number of people permitted into APOC during an incident and

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[27]   The name of this document has been reserved for security purposes.

the designation of break-out spaces for specific recovery aspects. This is intended to ensure that the Command & Control teams can work in the most effective way possible.

> **Recommendation 10:** *the Review Committee recommends that Heathrow review its procedures relating to the number of people permitted into APOC during an incident and the designation of break-out spaces for specific recovery aspects to ensure that the Command & Control teams can work in the most effective way possible.*

15.24 **Updating of the Command & Control Plan 1 and Operational Plan 1**

15.25 Each of these documents provide useful guidance and context for Gold Commanders and others in senior roles in Command & Control functions. We recommend that the Operational Resilience team refreshes each of these policy documents.

> **Recommendation 11:** *the Review Committee recommends that relevant incident management and operational resilience plans are reviewed and updated as necessary to take account of learnings from the incident and as part of continual improvement of policy documentation.*

15.26 **Ongoing engagement with law enforcement and other emergency services at Heathrow to maintain the coordinated and consistent approach with these agencies on Command & Control processes.**

15.27 Our Review found that there was strong connectivity and communication (including co-location) between the Heathrow personnel in Command & Control functions and relevant emergency services.

15.28 Heathrow's Command & Control processes were originally modelled on JESIP principles used by emergency services for handling critical incidents. We recommend that the Heathrow Operational Resilience team consider whether amendments are required to Heathrow's Command & Control framework based on any relevant amended and updated JESIP guidance since Heathrow's processes were last reviewed and any consultation with Heathrow's stakeholders in emergency services as appropriate.

> **Recommendation 12:** *the Review Committee recommends that Heathrow considers whether amendments are required to Heathrow's Command & Control framework based on any relevant updates to best practice guidance and any consultation with Heathrow's stakeholders in emergency services as appropriate.*

16. **CONTINGENCY PLANS**

16.1 We were told a large number of contingency plans were activated across the Airport throughout the incident, representing almost 40% of all the contingency plans Heathrow has developed.

16.2 **Engineering**

16.3 There was a plan specifically for Loss of High Voltage Power, which could be used by the ACE to respond to a loss of power, including a loss of power from Intake A. This plan identified steps that the ACE should take in the event of loss of external supply. The plan also identified key assets that would operate on back-up generators in the event of a total power failure. In addition, the Engineering team had a contingency plan specific to switching activities for the Airport's 33kV substations, prepared by UKPNS, which was used during the incident response.

16.4   **Other**

16.5   We were told other specific contingency plans used during the incident included plans for losses of specific critical IT systems (such as Critical Safety System 2), welfare protocols for both passengers and staff, and extended delay and mass schedule cancellation plans.

16.6   These guided Heathrow's various teams in responding to the incident. Because of the dynamic implications of a loss of power event, contingency plans were deployed according to the impacted systems and operations of the Airport. The employees we spoke to did not consider the lack of a single plan had any impact on the response to the incident because practically speaking there were so many different issues that required contingency planning due to the unprecedented nature of the power outage. Combining the contingency plans for all these issues into a single plan would likely have been unworkable and not sufficiently flexible. Heathrow relied on its teams to identify which contingency plans needed to be activated, under the oversight of the Command & Control structure at Bronze and Silver level. We consider this worked well.

16.7   None of our findings on contingency plans suggests there could have been a different outcome on the day or a different timeframe for recovery had there been any additional plans. However, given the extended and unprecedented nature of this critical incident, we have recommended that all lessons learned are fully documented from the feedback and evaluation sessions that respective teams have had following the incident. Specific feedback should also be sought on contingency plans deployed and any enhancements to points of detail should be incorporated into revised versions. We have recommended that a report on those sessions and specific enhancements to written contingency plans should be provided to Heathrow's Sustainability and Operational Risk Committee (**"SORC"**) in due course.

> ***Key finding 11:*** *a large number of contingency plans were activated during the incident and in general these worked well, although we found some areas where improvements would be possible in the light of lessons learned. Lessons learned from different teams should be collated and presented to SORC. None of our findings on contingency plans suggests there could have been a different outcome on the day or a different timeframe for recovery if there had been any additional plans.*
>
> ***Recommendation 13:*** *the Operational Resilience team, together with the COO, should coordinate the preparation of a single report to SORC on the different incident response teams' post-event feedback and evaluation sessions and any specific enhancements to written contingency plans that have been identified as lessons learned.*

16.8   We have the following additional observations on contingency plans:

16.8.1   The Engineering team should consider whether a contingency plan for wider internal network switching activities (in the situation where the UKPNS 33kV substation switching plan has been enacted) would be useful and possible to document, taking account of any lessons learned during this incident. In essence, these were the steps taken after the initial High Voltage switching completed at 06:25, in order to reconfigure and re-energise the remainder of Heathrow's internal network.

16.8.2   A checklist for APOC personnel of the situational awareness enquiries needed during a loss of power event should be prepared to assist duty AOMs in the management of the first 90 minutes of the incident response in respect of power or other utility failures. Using Heathrow's Command & Control Decision Model, the duty AOM executed numerous enquiries in the first 90 minutes of the incident. This relied on the skill and experience of the AOM and the on-duty teams in APOC. It is worthwhile ensuring that this is now documented for future use.

16.8.3   Challenges arose during the incident because multiple systems failed simultaneously, requiring multiple contingencies.

(a)   Some of the contingency plans for individual systems were manual contingencies, complex to execute and adequately resource at the same time.

(b)   As noted above, Heathrow relied on support from Police in relation to certain of these manual contingencies, some of which had significant security implications. We have set out further detail on this in a reserved section of this Report. [*The remainder of this paragraph has been reserved for security purposes.*]

(c)   We were told that operating multiple complex and resource intensive contingencies at the same time carried inherent logistical and safety risks.[28] We conclude that correct decisions were taken in managing the resumption of operations in the afternoon and evening of 21 March in a phased manner. This had the effect of also de-risking the return of operations, if multiple manual contingencies had needed to be stood up. This is principally because the flow of passengers and air crew was kept at reasonable levels in the immediate period after the resumption of operations.

(d)   We have made reserved findings elsewhere in this Report on IT matters (see reserved paragraphs 21.16 - 21.21).   We recommend that the post-event evaluation work undertaken by IT personnel (which we understand is in progress) considers (amongst other matters):

(i)   whether IT contingency plans relevant to a loss of power event could be strengthened. These might include plans:

(1)   that are jointly developed with supply chain partners who are likely to be involved in handling critical incidents;

(2)   that identify which High Voltage intakes power the various IT systems;

(ii)   how information retained on the status of UPS assets and their back up lifespan can be updated or enhanced (including on any registers, schedules and other records); and

(iii)   whether there are particular learning points for specific IT systems that were impacted by the power outage.

Recommendation 14: *the Engineering team should consider whether a contingency plan for wider internal network switching activities (after the UKPNS 33kV substation switching plan is enacted) would be useful and possible to document, taking account of any lessons learned during this incident.*

Recommendation 15: *following the work undertaken by the Duty AOM and others in APOC during the first 90 minutes of the incident response, consideration should be given to whether the steps taken and situational awareness enquiries made on the night can be documented into a useful checklist or guidance document for APOC personnel for future use, either in the event of a power failure or other equivalent incidents (such as utility failures).*

Recommendation 16: *we recommend the ongoing post-incident review being undertaken by IT personnel considers, amongst other matters:*

a) whether IT contingency plans relevant to a loss of power event could be strengthened. These might include plans:

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[28]   [*This footnote has been reserved for security purposes.*]

     i.   *that are jointly developed with supply chain partners who are likely to be involved in handling critical incidents;*

     ii.   *that identify which High Voltage intakes power the various IT systems;*

   b) *how information retained on the status of UPS assets and their back up lifespan can be updated or enhanced (including on any registers, schedules and other records); and*

   c) *whether there are particular learning points for specific IT systems that were impacted by the power outage.*

17. COMMUNICATIONS

17.1 Communications – general

17.2 Heathrow recognised in its immediate handling of the power outage that it would significantly impact passengers, airlines and other stakeholders, whose respective travel, operations and businesses would be severely disrupted.

17.3 Interviewees have relayed to the Review the need for clear and consistent communications, as a lesson learned from the 2010 snow event (see above at paragraph 11.5).

17.4 We have reviewed the communications across the different phases of the crisis.

17.4.1 As noted above at paragraph 6.1.9, the NOTAM was issued at 01:44 on 21 March. The first media statement by the Airport was 30 minutes later at 02:14 as follows:

"Heathrow is experiencing a significant power outage across the airport due to a large fire at a nearby electrical substation. Whilst fire crews are responding to the incident, we do not have clarity on when power may be reliably restored. To maintain the safety of our passengers and colleagues, we have no choice but to close Heathrow until 23h59 on 21 March 2025. We expect significant disruption over the coming days and passengers should not travel to the airport under any circumstances until the airport reopens. We will provide an update when more information on the resumption of operations is available. We know this will be disappointing for passengers and we want to reassure that we are working as hard as possible to resolve the situation."

17.4.2 This messaging was repeated when the statement was reissued at 09:40.

17.4.3 A further update was provided at 12:24, which explained work being done to redirect power to affected areas of the Airport and mentioned the related critical safety issues. It also explained that the Airport's back-up systems were safety systems, which allowed the Airport to land aircraft and evacuate passengers safely but were not designed to allow it to run a full operation. This statement reconfirmed that the Airport would remain closed for the day. Given the multiple issues being dealt with at that juncture by the Command & Control teams, we consider the rationale for this to be robust.

17.4.4 Once decisions were taken to restart operations on 21 March with repatriation and repositioning flights, a further communication was released at 15:34 as follows:

"Our teams have worked tirelessly since the incident to ensure a speedy recovery. We're pleased to say we're now safely able to begin some flights later today. Our first flights will be repatriation flights and relocating aircraft. Please do not travel to the airport unless your airline has advised you to do so. We will now work with the airlines on repatriating the passengers who were diverted to other airports in Europe. We hope to run a full operation tomorrow and will provide further information shortly. Our priority remains the safety of our passengers and those working at the airport. As the busiest

airport in Europe, Heathrow uses as much energy as a small city, therefore getting back to a full and safe operation takes time. We apologise for the inconvenience caused by this incident."

17.5   This last communication on 21 March continued to make clear that Heathrow would not be providing full operations that day and that passengers should only travel if advised to do so by their airlines.

17.6   Overall, we conclude that these communications on the day were clear and transparent. They avoided additional disruption and safety risks being caused by passengers and others travelling to the Airport when it was not ready to accommodate them. The communications were careful not to create expectations that the Airport would be open to passengers before 22 March.

17.7   Finally, once the Airport restarted its full operations on 22 March, the following communication was released at 05:35:

> *"We can confirm that Heathrow is open and fully operational today. Teams across the airport continue to do everything they can to support passengers impacted by yesterday's outage at an off-airport power substation. We have hundreds of additional colleagues on hand in our terminals and we have added flights to today's schedule to facilitate an extra 10,000 passengers travelling through the airport. Passengers travelling today should check with their airline for the latest information regarding their flight."*

17.8   These public communications were well-managed by those within the Gold and Silver Command structures, which included communications specialists.

17.9   **Consistency between external and internal Heathrow communications**

17.10   A decision was taken by the Communications team, approved by Gold Command, to ensure internal and external communications were consistent with one another. This was done to avoid a risk that messages would become blurred. This prevented similar consequences that had arisen in the prior snow incident at the Airport, where communications had created expectations that the Airport would be opening imminently.

17.11   We consider this rationale was correct overall and generally worked well. We make observations below in relation to internal communications, and in relation to possible enhancements for the Airport to consider in future, where this might improve guidance to passengers arriving in terminals.

17.12   **Communications with airlines and other stakeholders: Senior Leadership**

17.13   The COO, Mr Echave, contacted several stakeholders from airlines, the Heathrow Airline Operators Committee Ltd (**"AOC"**), the CAA, the Department for Transport, and Traffic Control at 02:00 on 21 March, shortly after the NOTAM was issued. Mr Echave then continued conversations with several stakeholders throughout the morning.   The CEO, Mr Woldbye, also had conversations with the CAA and Department for Transport, as well as with airlines during the day on 21 March. We understand that feedback received from these communications was positive.

17.14   **Communications with airlines and other stakeholders: Community Calls**

17.15   Community Calls were set up at an early stage, with the first at 03:30 on 21 March.

17.16   These are calls which members of the Airport community can join, including airlines, retailers, members of the supply chain, transport operators and other members of Team Heathrow. They were also open to Heathrow employees.

17.17   Community Calls were held approximately every three to four hours throughout the incident (at 07:00, 10:30, 14:00, 17:00, 21:00 on 21 March and at 00:00 on 22 March). We have been told that Heathrow Command & Control personnel provided an update for 10 – 15 minutes at the start of each call and

then answered questions on each call for as long as there were questions, so that no question from the community was left unanswered by the end of the call.

17.18   The Review has identified the following issues with the Community Calls:

17.18.1   The Community Calls were held on Teams and had a maximum joining capacity of 999. This meant for the 10:30 and 14:00 Community Calls certain people who wanted to join were not able to. We understand the Airport has increased Teams capacity post-incident.

17.18.2   Initially, summary notes were not sent out after the Community Calls. This was remedied later in the day on 21 March. In this respect, the update email provided after the 17:00 Community Call gave the latest operational status to recipients, including the following terminal-by-terminal information:

- *Terminal 3 and Terminal 5* - *power has remained stable, both are fit for purpose and local teams can access for readiness checks.*

- *Terminal 4* - *now operational and local teams can access for readiness checks. Note there is no rail connectivity to or from this terminal.*

- *Terminal 2* - *remains out of service.*

The email following the 17:00 call also provided details on: how airlines should route slot requests via ACL in the usual way; London Underground and Heathrow Express services then running to terminals; and Border Force resources for the rest of the day and the weekend (for Immigration). Where there was not full functionality, this was also noted: the Central Terminal Area Tunnel remained in restricted contraflow and the FIDS (the flight information displays) in terminals were still not working, so there were contingencies of mobile digital units and manual whiteboards being used.

17.19   We have considered whether Heathrow should have operated separate calls for particular members of the community, for example a separate call for airlines, Team Heathrow representatives and others. On balance, we consider having a single Community Call strategy worked best given the intensity of managing this incident. Opinions of people spoken with by the Review varied concerning the benefits of separate communication lines, which may have targeted information to those different communities quicker. However, this would have taken resources away from other essential Command & Control activities and may have led to a risk of misinterpretation if key messages were being expressed in different ways across different parallel calls.

17.20   **Additional communication facilitated with airlines**

17.21   Heathrow also invited members of the AOC and British Airways into APOC during the incident, in order to facilitate communication and allow for those representatives to provide constructive challenge to Heathrow's decision-making during the incident. Interviewees were strongly in favour of the decision to have airline representatives co-located in APOC during an incident for these reasons.

17.22   A number of Heathrow employees reported that they had received positive feedback from airlines about how they had communicated during the incident and had received personal messages of thanks.

17.23   **Possible enhancements to Heathrow's internal communications during the incident**

17.24   The decision to ensure internal and external messaging was consistent had some unforeseen consequences.

17.24.1   This may have impacted a small number of passengers, who arrived at terminals on 21 March when the Airport was closed or for departures rescheduled for later in the evening. Here to Help[29] staff had general communication guidance but consideration might be given to a separate channel of communications to update Here to Help staff on specific information useful for passengers

17.24.2   For example, an employee who volunteered as a Here to Help staff member in Terminal 5 for part of the day on 21 March also mentioned that they were not provided with detailed information on flight departures or repositioning and repatriation flights to relay guidance to members of the public. Because of the employee's seniority they were able to seek out this information quickly by making additional enquiries.

17.24.3   Some personnel reported that there was a delay in some Heathrow staff members who were operating in the terminals being told that Terminal 5 was reopening, with some staff members hearing this from British Airways rather than from Heathrow.

> **Key Finding 12:** *communications during the incident were clear and consistent and built on lessons learned from the 2010 snow event.*
>
> **Recommendation 17:** *we recommend that the Operational Resilience team consider if there is a proportionate solution to provide specific real-time updates to Here to Help and other Heathrow staff members in the recovery phase of critical incidents. This might be done on a location-by-location basis for different Terminals so the most up-to-date information can be provided to passengers and other members of the public in terminal buildings, when other systems such as flight information display systems may not yet have been restored to full functionality.*

18.   IMPACTS OF THE OUTAGE ON PEOPLE

18.1   People at the Airport during the incident

18.2   Because the focus of our Review is on what happened within the perimeters of Heathrow, we have not been able to survey the full range of disruption that approximately 200,000 people experienced on 21 March and the days that followed, for example, in respect of their travel arrangements and onward plans. The Review is conscious its findings should be read in that context and is in no way intended to minimise those significant wider impacts. Our findings in this section collate key relevant data available to the Airport and supplied to the Review.

18.3   As a result of the outage:

18.3.1   No injuries were reported as a result of the incident to any passengers, Heathrow employees or employees of other organisations operating at the Airport.

18.3.2   At the time of the power outage, passengers and Heathrow employees were in the terminal buildings. No passengers were airside due to the time of night the incident occurred.

18.3.3   Terminal staff used contingency protocols to ensure that everyone in the terminals was safe. [*This sentence has been reserved for security purposes.*]

18.3.4   There were also people in hotels next to certain terminal buildings, whom the Airport understands were evacuated in line with the hotels' own policies and procedures.

18.3.5   There was emergency lighting in Terminals 2 and 4 (the terminals that lost power), which activated on back-up power supply. This automatic contingency is time-limited. A number of people were in Terminal 2 where lighting was off while moving through corridors in the

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29   Here to Help is Heathrow's programme to assist passengers in their journeys through terminals at the Airport, where typically Heathrow's non-operational staff volunteer hours to assist the programme.

course of the early hours of 21 March. This included several of Heathrow's security team, who needed to use torch functions on their phones. For a period, these individuals were also without access to toilet facilities, as these were impacted by the power loss. Since the incident, the COO has met with some of the individuals affected to understand more details. Immediate interim adjustments were made after the incident to contingency plans, including issuing all security team members with battery powered torches. We recommend that a review is completed by the COO to understand how many people were impacted, whether emergency lighting was working as it should or whether the UPS had become drained, as well as to check whether there are gaps in emergency lighting coverage in corridors. We recommend that a copy of the COO's report should be provided to SORC.

Key finding 13: *no injuries were reported as a result of the incident, however reports were received of Heathrow employees operating in Terminal 2 without access to lighting and other facilities during the night of 21 March.*

Recommendation 18: *we recommend that the COO conducts a review to understand how many people were impacted by the lack of lighting and other facilities in Terminal 2, whether emergency lighting was working as it should or whether back-up power supplies had drained, and whether there are gaps in emergency lighting coverage in corridors. A copy of the COO's report should be provided to SORC. The report should consider whether any amendments are required to any contingency plans in respect of evacuation protocols or if any enhancements are needed on welfare checks during critical incidents.*

18.3.6   Some passengers continued to arrive at Heathrow on 21 March either because their flights had not been cancelled by the airlines or because they had been transported to Heathrow by coach after their flight was diverted. For example, passengers arrived at Heathrow Terminal 5 by coach after having their flight from Australia diverted to Paris. Those passengers were exhausted and were provided with guidance by Heathrow employees on onward travel into central London. Other passengers had already been travelling for many hours by the time their connecting flights from Heathrow were cancelled.

18.3.7   Many Heathrow employees volunteered for Heathrow's Here to Help service to assist passengers on 21 and 22 March. One Heathrow employee who volunteered for a Here to Help shift on the afternoon of 21 March described passengers having been caused considerable stress by the disruption but also commented that the volunteer response from Heathrow employees was very strong.

18.3.8   Heathrow also received excellent support from Team Heathrow colleagues throughout the incident and supply chain partners in respect of handling technical aspects of the response, including UKPNS and Heathrow's IT service providers and partners.

18.4   **Details of disruption from Heathrow's records**

18.5   The suspension of operations on 21 March caused 1,273 flight cancellations and resulted in disruption to approximately 200,000 passengers.

18.6   At an early stage on 21 March, Heathrow suspended its usual rule that if a flight is cancelled due to a technical fault it can be automatically rebooked for the next day. This would have been unmanageable with 1,273 flights in this situation. In the afternoon of 21 March airlines booked slots for the following day. Heathrow's planning team monitored this against capacity, with Airport Coordination Limited on site to assist with this process. Heathrow liaised with airlines that had smaller operations at Heathrow to ensure they understood the processes.

18.7   Heathrow returned to business-as-usual operations on 22 March. The following table shows the cancellations on 21 – 23 March, with the days either side for context:

Date	Flights cancelled in advance	Flights cancelled on the day	Total cancellations
19 March 2025	1	3	4
20 March 2025	1	3	4
21 March 2025		1,273	1,273
22 March 2025	93	14	107
23 March 2025	13		13
24 March 2025	4	3	7

18.8   On 22 March Heathrow also operated an extra 74 flights and reported that punctuality of flight operations was at over 80% throughout the day. It was reported to us that most airlines were running a normal operation on Sunday 23 March.

19.   ORGANISATIONAL RESILIENCE - PEOPLE

19.1   Managing a critical incident successfully relies on highly trained, capable and expert people communicating effectively and working collaboratively at pace. Those people also need resilience and back-up support in extended incidents.

19.2   The Review has considered whether Heathrow had the requisite numbers of its people engaged in the response to the incident; whether there were any gaps in knowledge or experience that impacted the handling of the incident; and if there were any deficiencies in the organisational culture. We have dealt with specific comments on Command & Control elsewhere in this Report (see above at 15 and in parts of reserved paragraphs 21.16ff of this Report).

19.3   Throughout the Review, we have heard of a strong organisational culture of collaboration across different teams and functions. We consider this supported the incident response and recovery of the Airport to full operations on 22 March.   Safety was a common thread through the descriptions employees gave of decisions they took or how they and colleagues handled the incident.

19.4   In terms of capabilities and resourcing, we found:

(a)   On-duty APOC personnel in the first 90 minutes of the incident gathered and interrogated situational updates from multiple human and system sources at pace, to enable later decision-making on the suspension of operations at the Airport. Their work in the "golden [i.e. first] hour" or so[30] of the incident also enabled swift later decisions to suspend operations at the Airport, preventing an exponential escalation of disruption caused to passengers and airlines.

(b)   Leading the recovery of the Airport to restore operations were a large number of technical experts in the engineering, IT solutions and resilience functions. This included individuals with decades of experience across different roles at Heathrow.

(c)   There were multiple postholders in Command & Control leadership roles and in different incident response teams with considerable prior relevant experience of handling previous critical incidents at the Airport and from relevant operational or similar roles. Other very experienced Command & Control personnel offered additional support to those rostered during the incident.

(d)   The senior leadership team worked collaboratively during the incident alongside the Command & Control structure, enabling good strategic decisions at various junctures and making important contributions throughout the incident to help

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[30]   The period between 23:55 on 20 March and 01:20 on 21 March.

minimise the impact of the incident and provide appropriate support and challenge.

(e)   There was a strong awareness of effective, clear and real-time engagement with relevant stakeholders throughout the incident – see our section on Communications at paragraph 17ff.

(f)   Heathrow's people worked very collaboratively with a large number of Team Heathrow personnel supporting the Airport with its recovery, including on areas of technical challenge throughout the incident.

19.5   Work was highly pressured over long hours for those involved in the incident. This level of effort was, however, instrumental in enabling the Airport to operate almost as usual on 22 March.

Key finding 14: Heathrow had a sufficient number of highly qualified and trained staff available to deal with the incident on 21 March. Their efforts prevented the disruption from being worse and lessened the effect on the operation of the Airport in the days that followed.

Recommendation 19: the Review Committee recommends that the Chief People Officer consider whether any action is needed in relation to post-incident wellbeing. We recommend that the Chief People Officer seeks views from those involved on 21 March on whether there are changes that Heathrow could appropriately make to support them more effectively during such an incident.

See also observations elsewhere in this Report on team resilience in Command & Control functions.

SECTION 5 – HEATHROW PREPAREDNESS FOR INCIDENT

20.   **COULD INVESTMENT RELATING TO HEATHROW'S ELECTRICAL POWER RESILIENCE HAVE PREVENTED OR MITIGATED THE IMPACT OF THE NORTH HYDE POWER OUTAGE ON 21 MARCH?**

20.1   **Investment at Heathrow – General remarks about decisions affecting electrical power resilience**

20.2   As a significant consumer of electrical power Heathrow is inevitably reliant on third party suppliers, most notably SSEN and ultimately National Grid. Heathrow, like any customer seeking a connection to the National Grid, has paid for a connection and for a certain amount of electrical capacity to be available via the North Hyde supply. Heathrow has paid for a "firm" connection at North Hyde, meaning one that provides resilience (or redundancy). If a disruption to that firm supply occurs, there are obligations on electricity suppliers to reconnect firm power to a consumer like Heathrow (within 24 hours as a backstop). In these circumstances, the obligations remain with the electricity supplier to provide resilient power to Heathrow.

20.3   With those expectations and safeguards in mind, there is a question of how far Heathrow needed to prepare for the eventuality that those obligations were not fulfilled by its suppliers, for whatever reason. This question goes to how far an organisation in these circumstances can and should invest to have back-up power systems in the event of a failure upstream in its electricity supply.   In Heathrow's case, there are wider considerations, including what the Airport is required to have in order to be compliant, for example, with its CAA and other obligations. Within those parameters, there is then a further question of how to balance the competing investment requirements at an airport like Heathrow.

20.4   The Airport is not presently in a position to be self-sufficient for its normal day-to-day energy needs nor has it sought to be. In lay terms, that would likely require it to build its own power station. The infrastructure supplying electricity to the Airport has been designed with multiple layers of redundancy to provide resilience. Much of this redundancy sits within the National Grid and SSEN owned network infrastructure and Heathrow has relied on this redundancy to ensure resilient power supply.

20.5   We recognise that on rare occasions there are failures that lead to interruptions in power supply as occurred on 21 March. Our Review has therefore given initial consideration to how much additional back up coverage Heathrow did have and could (or should) have had in order to cover for those occasions where the suppliers are unable to provide power despite the redundancy built into their network infrastructure.

20.6   A full review of all past investment decisions is beyond the scope of this Review. However, from the investigations we have commissioned we are not aware of any instance in which the HAHL Board has rejected investments related to the Airport's power infrastructure or energy resilience since at least 2014.[31]

20.7   We are also mindful that investment in infrastructure at Heathrow has been significant in recent years and currently is over £1bn per year, which includes investment into asset maintenance and resilience.[32]

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[31]   The review commissioned considered information as far back as 2014 in order to encapsulate relevant periods of expansion planning, COVID-19 and prior reviews of operational resilience.

[32]   Heathrow announces £2.3bn accelerated investment plan to upgrade the UK's international gateway to growth

Recent context for investments in relation to electricity resilience: the impact of COVID-19, past airport expansion plans and Airport operations at-capacity

20.8   We have heard accounts from colleagues of how Heathrow's approach to investment in asset- and infrastructure-related resilience was significantly impacted by the COVID-19 pandemic. In Heathrow's Strategic Business Plan of June 2020,[33] the then CEO of Heathrow wrote:

> *"Our industry is struggling. It's hard to imagine that 2019 was our busiest year ever with 81 million passengers. Now only six months into 2020, we're operating from a single runway, we're consolidating our operations into only two terminals and our daily passenger numbers have shrunk to the thousands. This is a major crisis for global aviation, and no one can be sure of how fast we will recover from it. Heathrow is a business that has safety and sound future planning wired into its DNA. …*
>
> *"The cost savings we are making now will help us to secure as many jobs as possible whilst maintaining the agility to return to growth when passenger demand increases."*

20.9   We heard how Heathrow, with few exceptions, paused capital expenditure during the pandemic across all areas of the Airport, wherever this would not compromise safety or security. Over the 2020 and 2021 financial years, Heathrow reported losses before tax of approximately £3.68 billion and as noted in the comments above from the then CEO, had to prioritise its own financial survival.

Previous planning on infrastructure linked to third runway

20.10   Previous Master Plans at Heathrow have often been linked to plans for a third runway or other major airport development. Witnesses have described how this meant proposals for investment in relation to significant assets, such as for energy resilience, were similarly linked to the expansion plan. Some people highlighted to the Review the challenges faced by larger, strategic infrastructure projects. These include that the Airport is operating at full capacity with only limited operational windows to carry out works to improve resilience or replace or upgrade assets and within a highly constrained footprint.

20.11   As expansion plans did not progress, combined with the effects of the COVID-19 pandemic, this has resulted in some of Heathrow's assets not being upgraded or replaced as quickly as would otherwise have been the case. Since the pandemic the Airport has faced an accelerated need to replenish certain ageing assets.

New approach to planning for investment

20.12   As part of forward planning since the pandemic, Heathrow is now in the process of strengthening its Master Plan, independently of the third runway expansion. This Master Plan is still focused at a high level, rather than considering detailed plans for systems such as fuel, water and energy. The ambition is for master planning to be further improved at a system and subsystem level to reflect detailed plans for the next five to seven years across different parts of the business. This is an initiative of the CEO, which is intended to ensure that improvements in infrastructure (and other areas including resilience) at Heathrow are not dependent on a third runway being built.

20.13   Prior to the incident on 21 March, we understand there was already an intention to start developing a new utilities master plan. We recommend that this work continues as a priority, with appropriate additional resources being given to relevant teams for this exercise, in light of the incident of 21 March.

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[33]   https://www.heathrow.com/content/dam/heathrow/web/common/documents/company/investor/reports-and-presentations/other-business-reporting/Strategic_Capital_Business_Plan_2020.pdf

> **Recommendation 20:** *we recommend that the planned work to develop a utilities masterplan is undertaken as a priority with appropriate additional resources being given to relevant teams for this exercise.*

20.14   We consider below some specific areas relating to High Voltage power resilience that we have discussed with employees in the course of this Review.

20.15   **Resilience of Heathrow's Electrical Power Supply – What Heathrow contracted to receive via North Hyde**

20.16   There were a number of levels to the resilience of Heathrow's electrical power supply. The first level of resilience for Heathrow was that (as described above at paragraph 8.3) it had three separate High Voltage power supply points (or BSPs) to the Airport campus.

20.17   HV power distribution in the UK has a concept of N-1 contingency. This means if power is lost via one asset, there is another asset that can immediately replace it to supply power. This is also known as redundancy. Overall, Heathrow understood it had more than N-1 contingency at North Hyde – in fact it understood that North Hyde BSP had N-2 contingency, because there was resilience both by having multiple SGTs and multiple busbars in the way the HV supply point was configured.

20.18   Overall, Heathrow had assurance over its power supply from the North Hyde BSP before the incident in the following ways:

    20.18.1   First, Heathrow contracted to receive an import capacity (which is the amount of HV power that could be supplied) from North Hyde that significantly exceeded what Heathrow needed to power the parts of the Airport fed by this High Voltage power supply point.

    20.18.2   The North Hyde BSP also offered resilient power to Heathrow in two key ways. First, it had the benefit of three National Grid supergrid transformers (**"SGTs"**) feeding the SSEN substation. Second, it had two 66kV busbars from the SSEN substation into the Heathrow internal distribution network. This meant if one transformer failed another transformer would be available to supply, in full, the power Heathrow needed from its Intake A; and if one bar failed, the second bar had the capacity, in full, to facilitate the delivery of the HV power into the Heathrow network.

    20.18.3   Heathrow's understanding of its North Hyde supply at the time of the incident is summarised in the following diagram:
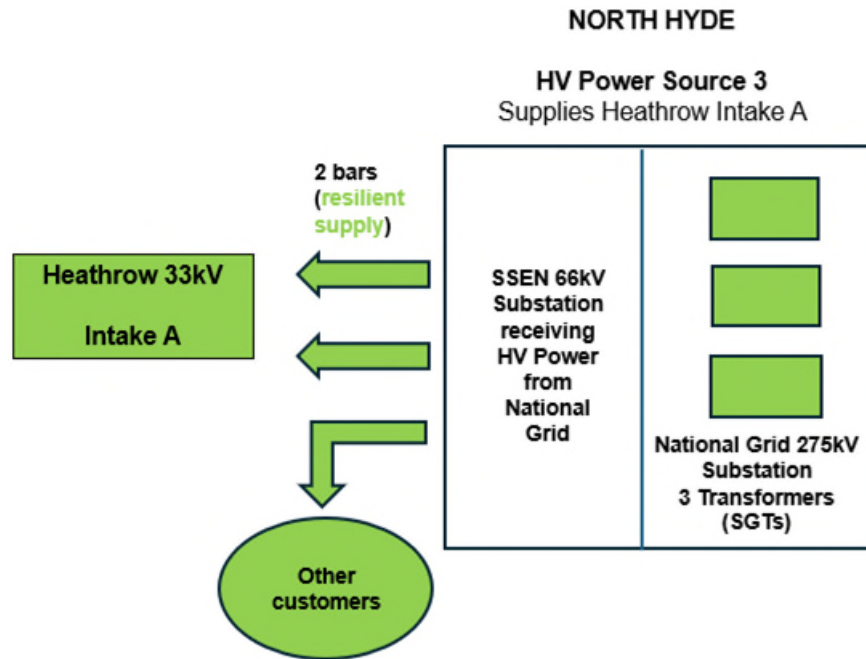
NORTH HYDE

HV Power Source 3
Supplies Heathrow Intake A

Diagram 5

20.19 **Would investment in completion of a 33kV High Voltage ring around Heathrow's internal distribution network have prevented or mitigated the effects of the outage on 21 March?**

Switching activities on 21 March

20.20 Elsewhere in this Report our findings have explained how different BSPs or HV power supplies supply power to different parts of the Airport campus. We have also examined the various switching activities that took place on Heathrow's internal distribution network on 21 March – first, to re-energise the Airport on two of the BSPs in the morning of 21 March, when North Hyde was lost; second, to prepare to re-energise the Airport on all three of the BSPs, when it appeared after about 13:00 on 21 March that North Hyde might return to a supply Heathrow considered sufficiently resilient; and finally, to revert the configuration back to two of the BSPs after 22:30 on 21 March, when Heathrow concluded that they could not be confident there would an adequate, resilient three High Voltage Power Supply solution ready for the start of operations on 22 March.

20.21 Such reconfigurations of Heathrow's internal distribution network inevitably impacted the time it took for the Airport to be able to restore its full operations.

A 33kV HV Ring – Summary of issue

20.22 An alternative configuration to Heathrow's internal electrical power distribution network would be the completion of a full 33kV HV ring. This would feed the three current BSPs into a single distribution circuit, which would power the entirety of the Heathrow campus. The advantage of this configuration is that if there is a loss of power from one BSP, it is easier to pull additional power into the HV Ring from the other BSPs.

20.23 Several Heathrow employees mentioned to the Review that the completion of the 33kV HV ring formed part of Heathrow's long-term energy resilience strategy, particularly related to the expansion plan, but it was paused during the COVID-19 pandemic.

20.24 In light of our findings on the switching activities necessary on 21 March, the Review has undertaken a preliminary examination of whether there were any missed opportunities to invest in the completion of a 33kV High Voltage ring across its internal distribution network. Our comments on the 33kV HV

Ring should be read in the context of our findings on Heathrow's understanding of the resilience of its existing network, as set out above at paragraphs 20.1 -20.7 and 20.15 - 20.18.3.

20.25   The Review has also considered the question of whether, had Heathrow had a full 33kV HV Ring, this would have prevented or mitigated the effects of the outage at North Hyde on 21 March.

<u>A 33kV HV Ring – Initial conclusions in relation to 21 March outage</u>

20.26   Our initial conclusion is that a HV Ring would not likely have prevented the effects of the outage, though it would likely have mitigated them by reducing the time the Airport would need to spend switching between the BSPs.

20.27   For the purposes of this Review, over a condensed fact-finding period, we have not commissioned technical reports on the level of additional resilience a HV Ring might have offered the Airport on 21 March based on its current configuration.

20.28   We have been provided with a provisional view from Heathrow's technical team that a complete HV Ring – based on how Heathrow is configured now with three intakes each supplied with power from different BSPs - would not allow for an automatic or immediate switch between the current three BSPs, partly because of the need to balance different voltages from these BSPs. If a power outage occurred to one of the BSPs (such as occurred on 21 March), even if Heathrow had a full HV Ring it is likely that some switching processes would still be required. However, we were told that the switching required in such a case would be less complex and time-consuming than that required on 21 March in the absence of a complete HV Ring.

20.29   If a sudden power outage occurred and systems were not powered down in a controlled way (which would not be possible in the event of a sudden outage unless every single relevant system was on UPS), those systems would still need to be powered down before being re-energised in a controlled way and then tested. Therefore, there could very well have been disruption to the Airport's operations, even if it had had a full HV Ring at the time of the 21 March incident.

<u>Current investments and Heathrow's status</u>

20.30   Completion of the HV Ring has been a consideration across Heathrow's strategies for additional capacity, expansion and carbon, and how to meet the associated energy (and particularly electricity) requirements. Work to provide a complete HV Ring at Heathrow would be a major project, requiring significant network upgrades. Nevertheless, we have also received evidence that significant preparatory work has recently been sanctioned which includes initial investment (approved in November 2024 as part of the Airport's carbon strategy) and planning activities.

20.31   Further feasibility work by Heathrow's engineering and resilience teams should consider the commercial and operational viability of a project of this kind. We refer to our recommendation that the development of Heathrow's utilities masterplan for the next five to seven years is undertaken as a priority (see above at paragraph 20.13 and Recommendation 20). Initial very preliminary internal estimates by the Airport have suggested costs in the order of or exceeding £1bn might be needed to provide a complete HV Ring (in conjunction with future plans for the Airport to have a direct connection onto the National Grid referenced below at paragraph 20.35). Further technical studies on a HV Ring should be commissioned to report on the extent to which it might mitigate risks for the Airport of a total loss of power from one of its High Voltage Power Supplies or reduce the time the Airport would need to close in such an event.

Recommendation 21: further technical studies on an HV Ring should be commissioned to report on the extent to which it might mitigate risks for the Airport of a total loss of power from one of its High Voltage Power Supplies or reduce the time the Airport would need to close in such an event.

20.32 **Would investment in a direct connection to the National Grid have prevented or mitigated the effects of the outage on 21 March?**

20.33 Since 2023, the Airport's long-term energy strategy has identified the need for a direct connection to the National Grid and extension of the HV network. This is both to achieve net-zero goals and also to future-proof operations against the anticipated substantial increases in electricity demand by the mid-2030s as a result of increased electrification. In its risk assessments over the last year, the Airport also recognised the need for significant work on energy network projects to address these needs.

20.34 We were told that direct connection to the National Grid will enhance the Airport's future energy resilience. Based on evidence we have heard, we understand that the combination of a full HV ring and a direct National Grid connection may enable Heathrow's power networks to automatically reconfigure in the event of a power outage to one HV power supply, thereby mitigating the risk of a power outage and consequential disruption.

20.35 It has been explained to the Review that, in furtherance of its long-term energy strategy, Heathrow has submitted an application to join the queue for a direct connection to the National Grid. This was recommended to the HAHL Board in January 2025 and the HAHL Board approved the steps needed for Heathrow to join the queue for this direct connection. However, it is understood that, under the current process,[34] a direct connection for Heathrow onto the National Grid may not become available until 2037. In this context, Heathrow does not receive any priority treatment in relation to enhancements to its energy resilience. Its protected site status will only apply in the highly unlikely event of a national electricity supply emergency, where the Energy Secretary may implement the Electricity Emergency Code.

20.36 Whether as part of future expansion plans or under Heathrow's energy resilience and carbon strategies generally, the HAHL Board will wish to consider the quantum and timing of investments to increase resilience, including in relation to installing a full HV Ring. We note that any plans for significant investments to upgrade or enhance the Airport's electricity infrastructure will also need to be included in a capital programme which has the overall approval of the CAA and the agreement of airlines to individual projects.

> **Recommendation 22:** *we also recommend that Heathrow prioritises its engagement with its airline partners and the CAA and other stakeholders around the need for investment in resilience, so that a shared understanding can be reached on this topic as soon as possible, taking account of the features of the Airport's current infrastructure assets, its location and intensity of operations as well as the various legitimate but competing needs for further investment.*

21. **COULD INVESTMENT RELATING TO HEATHROW'S BACK UP POWER (UPS AND GENERATOR BACKUPS) AND OTHER IT RELATED INVESTMENTS HAVE MITIGATED THE IMPACT OF THE NORTH HYDE POWER OUTAGE ON 21 MARCH?**

21.1 This section contains our conclusions and recommendations about back-up power systems.

21.2 **Uninterruptible Power Supply backups**

21.3 In the early phases of the incident, as already noted, Command & Control personnel did not have a full understanding of how some critical safety systems, such as Critical Safety System 1, Critical Safety System 2 and Critical Safety System 3, had been affected by the power outage. These are systems that have both an engineering and IT component.

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[34] Ofgem has recently approved a decision to reform the electricity grid connection process.

21.4   We were told that some components of these systems have UPS. However, in relation to some systems, either the failure of the network meant they could not be monitored remotely or power to another component of the system was lost, and that component was not supported by UPS.

21.5   There was also a level of uncertainty in later stages of the incident, when power started to be restored, on the extent to which Critical Safety System 1 systems continued to be affected in Terminal 5. Because incident response teams could not confirm that Critical Safety System 1 was safely operating in Terminal 5, significant manual contingencies would have been required if Terminal 5 were to re-open fully. It appears to us that full reopening would have been impractical to achieve for any significant volume of passenger operations on 21 March.

21.6   At about 03:30 on 21 March, Heathrow lost access to the capability to remotely connect to certain systems (including parts of Remote Access System 1 that would have allowed the Engineering team to remotely switch some parts of the high voltage system, which was a critical activity to restore power to the whole Airport). This system may have been lost owing to overheating in a server room, which was itself caused by loss of power to coolers and fans (see paragraph 12.5 above).

21.7   This is an example of the interdependencies between the assets for which IT and Engineering are responsible. The IT team relies on the Engineering team for assets that keep Heathrow's data centres operational, such as power and air-conditioning chillers. The Engineering team relies on the IT team for assets required for its operations, such as the network and servers. A lesson learned from this incident is the need for systemised processes to ensure the continued sharing of knowledge of their systems between the two teams (in particular relating to their respective risks). We were told that this work is already underway.

21.8   Our overall conclusion on UPS is that further technical assessment is necessary. Having more systems supported by UPS may have allowed those systems to be shut down in a controlled way and mitigate the need for significant testing of those systems, potentially saving a small amount of time.   UPS on systems that gave visibility to APOC on which critical safety systems are functioning and which are not (such as Critical Safety System 2 and Critical Safety System 2) may also have aided decision-making during the incident.

21.9   However, we understand there may be practical challenges with installing further UPS. The Review heard that due to the scale of Heathrow's IT network, it would not be possible to have UPS on every part of it, on an end-to-end basis. That would require an additional maintenance schedule that we were told would not be possible to carry out. It might also require additional cooling systems to facilitate the UPS, which existing infrastructure might not be able to accommodate. As we indicate above at paragraphs 8.20 - 8.23, additional UPS on technology and engineering systems would not likely have been sufficient to enable the Airport to operate on those power sources alone. Nevertheless, we consider a study should be undertaken into the level of UPS at the Airport to identify where enhancements can be achieved proportionately in relation to critical systems. This is included in Recommendation 4.

21.10   We have also referred above to the time required to recharge UPS batteries during the incident (see paragraphs 12.11 and 13.17). We recommend that Heathrow consider enhancements that can be made to the recharging process for back-up power supplies, where applicable. This is included in Recommendation 4.

21.11   **Other sources of back-up power: diesel generators and other solutions such as large industrial batteries**

21.12   Given the scope of this Review, we have not considered from a technical perspective whether the installation of additional diesel generators or large industrial battery back-ups would have mitigated the impacts of the incident.

21.13   As noted above at paragraph 8.22, diesel generators already provide instantaneous back-up power supply to the Airfield lighting and the Control Tower for up to seven days, which enables aircraft to land in emergency situations. [*This sentence has been reserved for security purposes.*] As soon as

a failure is detected in the power supply, the diesel generators engage. This allows the control engineers to switch to the other supply without a power outage.

21.14 As described above at paragraph 13.3.3, to mitigate the risk of a power outage affecting critical safety systems on the night of 21 March, Heathrow arranged for a generator to be brought to the Central Terminal Area tunnel to supply back-up power. Given the importance of the Central Terminal Area tunnel to the Airport, we recommend that, subject to assessment of feasibility and proportionality of costs, consideration is given to the back-up generator for the tunnel being retained on a permanent basis.

21.15 We heard from one engineering employee that the feasibility of installing diesel generators to cover the entire energy needs of Heathrow would require careful consideration. As above, a detailed technical assessment of the feasibility of diesel generators or other battery solutions as a back-up power supply is beyond the scope of this review. However, we recommend that Heathrow incorporate consideration of diesel generators and all other viable solutions as back-up power supply in its utilities master planning, as described above at paragraphs 20.12 - 20.13. This should include consideration of whether generator back-ups should be installed permanently at the Airport for particularly critical infrastructure.

> *Recommendation 23: the Review Committee recommends that consideration is given to the retention of the current back-up generator for the CTA Tunnel; and a report made to SORC on any other areas of the Airport where further diesel generator or other battery back-ups could improve resilience during critical incidents.*

21.16 **Ongoing IT Investment**

21.17 This section of the Report addresses Heathrow's ongoing investment in IT and has been reserved for security purposes.

21.18 [*This paragraph has been reserved for security purposes.*]

21.19 [*This paragraph has been reserved for security purposes.*]

21.20 [*This paragraph has been reserved for security purposes.*]

21.21 [*This paragraph has been reserved for security purposes.*]

> *Recommendation 24: The Review Committee recommends that Heathrow proportionately prioritises the areas for additional IT investment as set out in our Reserved Findings at paragraphs 21.18 - 21.21.*

22. **WAS THIS TYPE OF INCIDENT COVERED BY HEATHROW'S RISK ASSESSMENT PROCESSES?**

22.1 **Introduction**

22.2 Heathrow reports on its organisation-wide 'Principal Risks' in its Annual Report and Accounts for the financial year ending 2024 ("**ARA**"). A Principal Risk is one that is identified as fundamentally affecting the ability of the business to deliver on its overarching objectives. Heathrow assesses the likelihood and impact of a Principal Risk materialising.

22.3 Risks are also identified at a functional level across Heathrow's teams, for example, in the Engineering team.

22.4   **Reporting of relevant risks at the time of the incident**

22.5   The 2024 ARA statement on Principal Risks included a Principal Risk relevant to this incident, under "Organisational Resilience". The ARA noted that the potential causes of an organisational resilience risk include a major critical event that leads to significant operational and business impact, as well as resulting in significant disruption and potential closure of the Airport. The ARA identified that this could result from one of many causes, including loss of resource and loss of a critical supplier or service.

22.6   The incident on 21 March was a major critical event that involved the loss of a critical supply of electricity. We have received confirmation from the business in the course of our Review that this is therefore covered under the Organisational Resilience Principal Risk with the relevant cause set out in the ARA being "'loss of a critical supplier or service".

22.7   Heathrow's internal risk assessment scoring for a major critical or disruptive event of this kind was to rate it as having a high impact but low likelihood.

22.8   **Further initial commentary on major critical event risks**

22.9   The key controls and mitigations relating to a major critical event are listed in the ARA. These mirror to a significant extent those that were deployed in this incident or enabled Heathrow's successful response to the incident. We discuss a number of these relevant controls and mitigations in other sections of this Report. A summary of how the ARA lists these controls and mitigations is as follows:

(a)   Mitigation and contingency planning with development of a series of plans that can be deployed in the event of a disruption.

(b)   Exercising (i.e. scenario-based practice exercises) and post incident review, which supports increased preparedness and continuous improvement of Heathrow's incident response.

(c)   Command & Control aligned to the UK standard of Integrated Emergency Management for disruptive events and aligns with industry best practice by adopting the JESIP Principles (as discussed elsewhere in this Report).

(d)   Collaboration with key partners to develop joint contingency plans.

(e)   The APOC facility which brings together the operational planning, monitoring and day-to-day oversight of Heathrow with its service partners.

(f)   End-to-end understanding by taking a holistic approach to resilience, considering the upstream and downstream impacts of a disruption to support wider organisational resilience.

22.10   We note that Heathrow's published risk reporting does not specify all potential vulnerabilities that may relate to its assets, operations and supply arrangements where there could be a major critical event. We observe this might be impractical because the Airport has such a large asset base and complex operations, as well as there being assets or events outside of its direct control or ownership that could lead to a major critical event. However, we also understand that a key reason the Airport does not share specific areas in detail in its ARA is because the security and safety considerations inherent in reporting on the potential root or underlying causes of major critical events. For similar reasons, we understand details of the Airport's specific controls and mitigations are not published.

> ***Key finding 15:*** *the risk of a power outage as a result of the configuration and resilience of Heathrow's internal distribution network had been identified by Heathrow and appropriate mitigations and contingency plans had been in place at the time of the incident on 21 March.*

22.11 **Summary of further observations on awareness of risks relating to a power outage at time of incident**

22.12 The Review heard from colleagues about Heathrow's awareness of the risk of a loss of HV electricity supply to the Airport.

22.13 In summary, the risk of a major disruptive event was categorised as a high impact but low likelihood risk. One person we spoke to described it as a one in 100-year type of event. The risk of a total loss of supply from North Hyde was considered a low likelihood risk for a number of reasons. The Review heard that the source of HV power at North Hyde was considered to be resilient (see above at paragraphs 20.15 - 20.18.3). There would need to be an unprecedented failure of that entire power source for a major disruptive event to arise for the Airport. Some personnel considered North Hyde should not be categorised as a single point of failure for the Airport because of the resilient supply it provided via multiple SGTs as well as the two busbar lines into Heathrow's internal power distribution network.

22.14 The high impact of a total HV power supply failure was understood by relevant functions.

22.15 The full consequences of a total HV power supply failure through one intake were less well-known by other relevant Heathrow personnel in advance of the incident. In particular:

22.15.1 With the exception of some specialists in relevant Engineering functions, most personnel with whom we spoke were not aware prior to the incident that a total loss of power from an HV intake might involve the Airport losing operations for at least eight hours whilst switching processes, re-energising of assets and systems and safety testing were carried out. Given the large number of functional risks that exist across a business like Heathrow, there may be practical questions relating to whether the precise timing consequences of all types of those functional risks can be more widely understood outside of the functions to which those Principal Risks relate. However, we consider there is a need to facilitate greater focus at Executive and Board level on "red flag" risks, i.e. those that are low likelihood but which could have a significant disruptive effect on the Airport's operations. More in depth discussions of the risk of power outage could have identified the length of time that operations would be disrupted. See our outline recommendations for enhancements here.

22.15.2 The precise interdependencies between Engineering and IT assets that would be affected during a power outage of this scale were also less well known prior to the incident, which informs some of our outline recommendations too.

22.16 Our outline observations and recommendations on risk-related topics are as follows:

22.16.1 Heathrow's risk and assurance team should continue their planned work to enhance the visibility of functional risks up to and including board level. In particular, Heathrow should further elevate high impact, low likelihood functional risks to the Executive Committee for periodic discussion of the overall operational consequences involved and decision on whether current controls and mitigations are adequate. Additional resources should be allocated to this as necessary.

22.16.2 Within Heathrow's risk management processes, there should be enhanced visibility at the Audit Committee and SORC levels of high impact functional risks as a further line of defence (including those with low likelihood). We were told this work is already underway.

22.16.3 To build on ongoing and planned work, we would recommend:

(a) Consideration is given to processes between functions to share insights into each other's functional risks *horizontally* where these might impact wider parts of the

Airport outside of one function. This will help to better evaluate the operational consequences of a risk and to identify enhancements to risk mitigation measures for critical assets, services or operations where there are interdependencies, similar to those seen in this incident in relation to engineering and IT related assets.

(b)   Central collation of key potential single points of failure across the Airport so the existing controls and mitigations for these are quickly visible to everyone involved in the Airport's risk management processes. These can then be regularly kept under review through the appropriate structures in Heathrow's risk management system.

(c)   Similar to the joint contingency arrangements it has with emergency services, the Operational Resilience team should consider opportunities to apply similar principles to arrangements with critical utility suppliers. Part of this work may also enable a deeper mutual understanding of each entity's dependencies and risk assessments, controls and mitigations. We do not consider these steps would have avoided the consequences of the outage on 21 March but they may help to ensure alignment and to enhance suppliers' understanding of Heathrow's needs in respect of the resilience of its utilities supply and to enhance Heathrow's understanding of suppliers' own resilience to deliver the supplies upon which Heathrow is reliant.   They may also improve how the Airport responds to critical incidents collaboratively with relevant members of its supplier base.

Engineering functional risk register

22.17   The Engineering functional risk register at the time of the incident captured a large volume of risks. Some of those relevant to the incident were highlighted to the Review in our fact-finding. Because the functional risk register contains details of specific assets and locations this has been reserved for security purposes.

22.18   One of these functional risks related to the Airport's incomplete HV 33kV Ring:

22.18.1   [*This paragraph has been reserved for security purposes.*]

22.18.2   [*This paragraph has been reserved for security purposes.*]

22.18.3   The risk was included on the Engineering team register and rated as having a high impact and a high likelihood. However, following enquiries made within the Engineering team, the Review has been told that the risk was scored and described incorrectly at the time it was identified in November 2024 and entered on to the register in March 2025 and should have been recorded as a high impact but low likelihood risk.

22.18.4   We are therefore satisfied that this entry on the functional risk register does not contradict the other evidence we have received in the Review that categorised a loss of HV power as a high impact, low likelihood event.

Earlier identification of risks relating to the HV Ring

22.19   In the course of our Review, we have considered the findings of a prior internal review of Heathrow's resilience, across all areas of its assets, infrastructure and operations. A paper on the internal review was presented to the Executive Committee in November 2021. It included a section entitled "*Utility resilience for the future*". Part of this considered forward-looking trends related to the Airport's resilience of HV electrical supply. A relevant extract of the review (part of which has been reserved for security reasons) on this is as follows:

> *"The resilience of our HV electrical supply is likely to be more important as the national grid shifts from a centralised generation network to decentralised. Specifically, further work is needed to complete the 33kv ring to allow switching of the airport load between diverse incoming supplies. [The remainder of this paragraph has been reserved for security purposes.]*

22.20   Following the presentation to the Executive Committee in November 2021, a simplified version of the internal review findings was circulated to the HAHL Board in April 2022 and it was also considered by SORC in May 2022. Papers prepared for the SORC meeting reflect that there was ongoing consideration at the time of the electrical resilience questions raised by the 2021 internal review. An appendix to a paper on next steps following the internal review noted the following on the utilities resilience topic:

> *"There are many opportunities to increase the resilience of the airport, many of which were due to be explored through Expansion. Whilst all current risks are believed to be mitigated, the work on Masterplanning and Resilience should consider these opportunities which would then need to be prioritised within the existing Asset Management Programme."*

22.21   SORC minutes for the May 2022 meeting record a number of next steps in relation to investment decision-making on matters relating to the 2021 internal review.

22.22   See also our commentary above on investment issues relating to the completion of the 33kV Ring as part of ongoing work by the Airport on its energy resilience, carbon strategy and master planning at paragraphs 20.19 - 20.31*.*

22.23   **Other preparedness for a power outage event**

22.24   We have referred above at paragraph 16ff to the contingency plans that were deployed on 21 March to deal with the incident. These plans were critical to Heathrow's ability to recover in the way that it did.

22.25   Heathrow also ran an in-depth resilience training exercise in 2023 on the risk of a National Power Outage ("**NPO**"), which in addition to Heathrow employees was attended by stakeholders from the Airport community and emergency services. This exercise was designed by engineering resilience specialists at Heathrow.

22.26   A report relating to the NPO was produced in November 2024 as a result of this exercise, containing recommendations on communications, technology and other resilience measures.

22.27   This exercise had raised the profile of power resilience issues at the Airport, although the scenario of an NPO was very different from the nature of the incident on 21 March.

22.28   We recommend the Executive Committee considers that the NPO report's recommendations alongside those from this Review.

22.29   Opportunities should continue to be sought by the Heathrow Operational Resilience team to design and carry out similar preparedness exercises with Heathrow's stakeholders and suppliers as part of ongoing best practice and in line with mitigations identified to manage the risk of future major disruptive events.

> *Recommendation 25: we recommend that Heathrow's risk and assurance team continue their planned work to enhance the visibility of functional risks up to and including board level, and that additional resources are allocated to this as necessary. In particular, we recommend:*
>
> *a) Heathrow further elevate high impact, low likelihood functional risks, as well as any high impact risks that might involve potential single points of failure, to the Executive Committee*

for periodic discussion of the total operational consequences involved and decision on whether current controls and mitigations are adequate;

b) *there should be enhanced visibility at the Audit Committee and at SORC of the above assessments, so this information can inform wider decision-making by these committees as appropriate;*

c) *consideration is given to establishing processes between functions to share insights into each other's functional risks horizontally where these might impact wider parts of the Airport outside of one function.*

Recommendation 26: *we recommend that the Operational Resilience team consider opportunities to share information relating to risk identification with critical utility suppliers.*

Recommendation 27: *we recommend the Executive Committee considers recommendations arising from a prior multi-party power outage preparedness exercise to review whether there are any additional relevant learnings that fall outside the recommendations of this Report and that it updates SORC on any proposed next steps. Opportunities should continue to be sought by the Heathrow Operational Resilience team to design or participate in similar preparedness exercises with internal and external stakeholders and suppliers as part of ongoing best practice and in line with mitigations identified to manage the risk of future major critical events.*

General Recommendation 28: *Certain recommendations in the Report have referred to the need for additional resources. These references are non-exhaustive. The Executive team should consider this Report in full and provide a report to the Board on Heathrow's resource requirements to carry out all of the Recommendations.*

23.   **CONCLUSION**

The incident on 21 March involved a fast-moving and unprecedented set of circumstances.

We have concluded that the Airport responded well on the day and was able to restore full operations smoothly the following day. The Review has, however, identified a number of lessons learned and makes several recommendations on how the Airport should now further enhance its ability to respond to major incidents such as this one.

These are also designed to assist Heathrow to fulfil its stated commitments in relation to the renewal and enhancement of its infrastructure resilience, within the constraints of how the Airport has developed over 75 years, the relative challenges of Heathrow, particularly in relation to its size and very high use, compared with other airports, and the various other priorities for investment.

There is clearly an opportunity for the Airport to engage in greater depth with airlines and its other key stakeholders on these questions and others. The Airport owes gratitude to passengers, to its airline customers, to Team Heathrow (including those partners who worked with Heathrow colleagues during the incident) and to its other stakeholders for all their patience and assistance, which no doubt contributed to reducing the impact of the disruption on aviation across the world.

Finally, the Review Committee also would wish to recognise the efforts and hard work of all Heathrow employees who supported the Airport on 21 March and its subsequent return to full operations.

APPENDIX 1 – LIST OF KEY FINDINGS AND RECOMMENDATIONS

KEY FINDINGS

Decision to stop operations

1   The decision to stop operations was the only reasonable decision available in the circumstances. It was made with safety and security as the foremost considerations. Given these are reasonable considerations and it was correct for them to be prioritised, it follows that there was no alternative to closing the Airport.

2   The decision to stop operations until 23:59 on 21 March was a prudent and well-reasoned decision based on the circumstances at that point in time. It was made with safety as the primary objective.

Decisions regarding restoring power supply

3   The decision to reconfigure Heathrow's electricity distribution to two supplies was the only reasonable decision available in the circumstances given the need to restore resilient power to the Airport. The decision was then executed as promptly as possible.

4   The decision to reconfigure the network to revert to the normal three-supply configuration was reasonably made with the objective of ensuring the Airport had the most resilient power supply available, including over the longer term. While this decision may have extended the time in which operations were stopped for parts of the Airport by a matter of a few hours, a different decision would not have resulted in a significantly larger number of flights being operated on 21 March 2025. We consider the decision was nevertheless the correct one.

5   The decision to cancel the planned reversion to the three-supply configuration and maintain the two-supply configuration was reasonably made on the basis of a lack of availability of a resilient supply at North Hyde.

Reopening of the Airport

6   The time taken to restart operations at Terminals 3 and 5 was driven by the need to restore critical safety systems, on the basis it was not considered safe to operate the Airport with manual contingencies in place. These systems were confirmed as tested and restored by 13:00 and at 14:00 Heathrow announced on a Community Call that it would begin accepting flights from 16:00. Between 10:00am and 12:30pm, discussion and consideration of the opportunity to convert back to the three supply configuration may have delayed the reopening of Terminals 3 and 5 by a maximum of a couple of hours or so. We do not find the time spent on this assessment to be unreasonable, given the complexity of this issue. Any such delay may not have impacted the time taken to test and restore the critical safety systems, which were the key issue in reopening Terminals 3 and 5. Standing up cumulatively a number of manual contingencies had practical and risk consequences – especially in order to handle any normal volume of passengers through a terminal building.

7   The decision to prioritise repositioning and repatriation flights was a reasonable decision in the circumstances and was coordinated with airlines as far as practicable. While it was reasonable in light of the safety objective not to open for full operations, Heathrow kept under review whether it could operate additional flights, which it did by operating eight departure flights with passengers.

8   Heathrow relied on information from SSEN to make a reasoned decision to revert to its most resilient network configuration. This may have delayed the point at which Heathrow could resume full operations because of the work required to prepare for this reconfiguration. We have

addressed the reasonableness of the decision to revert to the three-supply configuration in our findings above at Key Finding 4.

Role of CEO overnight on 20/21 March 2025

9   Heathrow's CEO Mr Woldbye was not aware of the incident in the early hours of 21 March as he was not alerted to the F24 notifications or to Mr Echave's calls, but this had no impact on the decisions made between 00:21 – 06:45.

Whether Heathrow Command & Control operated effectively

10   The Command & Control structure operated effectively during the incident by empowering those with technical and operational expertise to make decisions. The primary guiding objective for these decisions was ensuring safety.

Contingency plans deployed during incident

11   A large number of contingency plans were activated during the incident and in general these worked well, although we found some areas where improvements would be possible in the light of lessons learned. Lessons learned from different teams should be collated and presented to SORC. None of our findings on contingency plans suggests there could have been a different outcome on the day or a different timeframe for recovery if there had been any additional plans.

Communications

12   Communications during the incident were clear and consistent and built on lessons learned from the 2010 snow event.

Impact on people in terminal buildings during incident

13   No injuries were reported as a result of the incident, however reports were received of Heathrow employees operating in Terminal 2 without access to lighting and other facilities during the night of 21 March.

Organisational resilience - people

14   Heathrow had a sufficient number of highly qualified and trained staff available to deal with the incident on 21 March. Their efforts prevented the disruption from being worse and lessened the effect on the operation of the Airport in the days that followed.

Identification of risks

15   The risk of a power outage as a result of the configuration and resilience of Heathrow's internal distribution network had been identified by Heathrow and appropriate mitigations and contingency plans had been in place at the time of the incident on 21 March.

RECOMMENDATIONS

Communications during critical incident involving third-party supplier

1   Where the Airport is facing a critical incident that involves a third-party supplier, and there is a significant impact to Heathrow, there should be regular communication between relevant Heathrow contact points and that supplier over the course of the critical incident, as a precaution in case additional information from the supplier impacts situational awareness. This may also help ensure they are receiving timely updates from the relevant supplier of any change of position.

Relationships with critical suppliers

2   The Heathrow Executive Team should consider enhancements to the commonality of understanding between Heathrow and SSEN and development of the relationship with SSEN at a senior level, including the considerations set out in paragraph 12.23 of the Report. Equivalent considerations should apply to Heathrow's relationship with National Grid and all other critical suppliers, to the extent appropriate and where this improves all parties' overall understanding and preparedness for critical incidents where each are impacted.

Critical Safety Systems and Uninterruptible Power Supply back-ups

3   The Review Committee recommends that Heathrow review and, if possible, enhance its ability to monitor whether critical safety systems are operational following a power outage.

4   Due to the importance of these critical safety systems if there is a major disruptive event at the Airport, the Review recommends that Heathrow implements a review into the effectiveness of back-up power supplies for these systems (including how long the supplies last) to establish if enhancements are reasonably practicable. Heathrow should also review which similar enhancements to UPS (or the recharging of UPS) are proportionate and practical to implement for any other operational systems.

The results of these review(s) should be reported to SORC.

5   The Review Committee recommends that Heathrow develop a list of all critical safety systems for which power is supplied by each High Voltage intake, building on the lessons learned from this incident for North Hyde.

System for notification of incidents to key individuals

6   The Review Committee recommends that Heathrow consider enhancements that can be made to the notification process of a critical incident (in addition to F24 calls), including options for notifying key individuals via a second means of contact for significant incidents. Heathrow has already taken steps to implement these enhancements since the incident.

Command & Control

7   The Review Committee recommends that Heathrow determine the most appropriate model for rostering Gold Commander shifts that ensures adequate resilience in the event of an incident of longer than 12 hours duration.

8   To enhance training, the Review Committee recommends that:

   a)   Gold Commander training records are formalised and held by the Operational Resilience team;

b) compulsory elements of training programmes for postholders in Gold Command are clarified and Gold Commanders should attend regular training;

c) Heathrow consider whether measures to upskill those in Command & Control on technology systems can be incorporated into training programmes;

d) compulsory training is provided on recording minutes of meetings.

9   The Review Committee recommends that policy documentation is updated:

a) to enhance guidance on the decision-making responsibilities of Gold Commander, CEO and COO in critical incidents

b) to provide guidance on identifying subject-matter expertise that may be beneficial during an incident.

c) to include guidance on maintaining resilience in Gold Command during prolonged incidents.

d) to clarify that draft minutes should be provided to Gold Commanders as soon as practicable and in any event within 24 hours of an incident's conclusion for finalisation as an agreed record.

10   The Review Committee recommends that Heathrow review its procedures relating to the number of people permitted into APOC during an incident and the designation of break-out spaces for specific recovery aspects to ensure that the Command & Control teams can work in the most effective way possible.

11   The Review Committee recommends that relevant incident management and operational resilience plans are reviewed and updated as necessary to take account of learnings from the incident and as part of continual improvement of policy documentation.

12   The Review Committee recommends that Heathrow considers whether amendments are required to Heathrow's Command & Control framework based on any relevant updates to best practice guidance and any consultation with Heathrow's stakeholders in emergency services as appropriate.

Incident response feedback and evaluation and contingency plans

13   The Operational Resilience team, together with the COO, should coordinate the preparation of a single report to SORC on the different incident response teams' post-event feedback and evaluation sessions and any specific enhancements to written contingency plans that have been identified as lessons learned.

14   The Engineering team should consider whether a contingency plan for wider internal network switching activities (after the UKPNS 33kV substation switching plan is enacted) would be useful and possible to document, taking account of any lessons learned during this incident.

15   Following the work undertaken by the Duty AOM and others in APOC during the first 90 minutes of the incident response, consideration should be given to whether the steps taken and situational awareness enquiries made on the night can be documented into a useful checklist or guidance document for APOC personnel for future use, either in the event of a power failure or other equivalent incidents (such as utility failures).

16   We recommend the ongoing post-incident review being undertaken by IT personnel considers, amongst other matters:

a) whether IT contingency plans relevant to a loss of power event could be strengthened. These might include plans:

    i. that are jointly developed with supply chain partners who are likely to be involved in handling critical incidents;

    ii. that identify which High Voltage intakes power the various IT systems;

b) how information retained on the status of UPS assets and their back up lifespan can be updated or enhanced (including on any registers, schedules and other records); and

c) whether there are particular learning points for specific IT systems that were impacted by the power outage.

Communications

17   We recommend that the Operational Resilience team consider if there is a proportionate solution to provide specific real-time updates to Here to Help and other Heathrow staff members in the recovery phase of critical incidents. This might be done on a location-by-location basis for different Terminals so the most up-to-date information can be provided to passengers and other members of the public in terminal buildings, when other systems such as flight information display systems may not yet have been restored to full functionality.

People in terminal buildings during incident

18   We recommend that the COO conducts a review to understand how many people were impacted by the lack of lighting and other facilities in Terminal 2, whether emergency lighting was working as it should or whether back-up power supplies had drained, and whether there are gaps in emergency lighting coverage in corridors. A copy of the COO's report should be provided to SORC. The report should consider whether any amendments are required to any contingency plans in respect of evacuation protocols or if any enhancements are needed on welfare checks during critical incidents.

Organisational resilience – people

19   The Review Committee recommends that the Chief People Officer consider whether any action is needed in relation to post-incident wellbeing. We recommend that the Chief People Officer seeks views from those involved on 21 March on whether there are changes that Heathrow could appropriately make to support them more effectively during such an incident.

Planning for investment

20   We recommend that the planned work to develop a utilities masterplan is undertaken as a priority with appropriate additional resources being given to relevant teams for this exercise.

21   Further technical studies on an HV Ring should be commissioned to report on the extent to which it might mitigate risks for the Airport of a total loss of power from one of its High Voltage Power Supplies or reduce the time the Airport would need to close in such an event.

22   We also recommend that Heathrow prioritises its engagement with its airline partners and the CAA and other stakeholders around the need for investment in resilience, so that a shared understanding can be reached on this topic as soon as possible, taking account of the features of the Airport's current infrastructure assets, its location and intensity of operations as well as the various legitimate but competing needs for further investment.

Generator or battery back-ups

23   The Review Committee recommends that consideration is given to the retention of the current back-up generator for the CTA Tunnel; and a report made to SORC on any other areas of the Airport where further diesel generator or other battery back-ups could improve resilience during critical incidents.

Ongoing IT investment

24   The Review Committee recommends that Heathrow proportionately prioritises the areas for additional IT investment as set out in our Reserved Findings at paragraphs 21.18 - 21.21.

Risk processes

25   We recommend that Heathrow's risk and assurance team continue their planned work to enhance the visibility of functional risks up to and including board level, and that additional resources are allocated to this as necessary. In particular, we recommend:

    a) Heathrow further elevate high impact, low likelihood functional risks, as well as any high impact risks that might involve potential single points of failure, to the Executive Committee for periodic discussion of the total operational consequences involved and decision on whether current controls and mitigations are adequate;

    b) there should be enhanced visibility at the Audit Committee and at SORC of the above assessments, so this information can inform wider decision-making by these committees as appropriate;

    c) consideration is given to establishing processes between functions to share insights into each other's functional risks horizontally where these might impact wider parts of the Airport outside of one function.

26   We recommend that the Operational Resilience team consider opportunities to share information relating to risk identification with critical utility suppliers.

27   We recommend the Executive Committee considers recommendations arising from a prior multi-party power outage preparedness exercise to review whether there are any additional relevant learnings that fall outside the recommendations of this Report and that it updates SORC on any proposed next steps. Opportunities should continue to be sought by the Heathrow Operational Resilience team to design or participate in similar preparedness exercises with internal and external stakeholders and suppliers as part of ongoing best practice and in line with mitigations identified to manage the risk of future major critical events.

Resourcing

28   Certain recommendations in the Report have referred to the need for additional resources. These references are non-exhaustive. The Executive team should consider this Report in full and provide a report to the Board on Heathrow's resource requirements in order to put the Recommendations into effect.

APPENDIX 2 – GLOSSARY OF TERMS USED IN REPORT

ACE	Heathrow Airport Control Engineer
Airport	Heathrow Airport
AOC	Heathrow AOC Limited (also known as Airline Operators Committee)
AOM / Duty AOM	(Duty) Airport Operations Manager
APOC	Airport Operations Control Centre.
ARA	Heathrow Airport Holdings Limited's Annual Report and Accounts for the financial year ending 2024
Begg Report	Report of the Heathrow Winter Resilience Enquiry (2011), chaired by Professor David Begg
Bronze Command	The command team in Heathrow's Command & Control structure that focuses on the operational level
BSP	Bulk Supply Point
CAA	UK Civil Aviation Authority
CEO	Chief Executive Officer, Thomas Woldbye
Command & Control	The Heathrow structure to manage an incident
Community Call	Calls held on Microsoft Teams during Heathrow incidents, which members of the airport community can join
COO	Chief Operating Officer, Javier Echave
CTA Tunnel	The Central Terminal Area Tunnel, connecting the Central Terminal Area to the M25 and M4 spur
JESIP	Emergency Services Joint Emergency Services Interoperability Principle
F24	The system used to carry out the activation of on call teams in Heathrow's Command & Control structure
Gold Command	The command team in Heathrow's Command & Control structure that focuses on the strategic level decision-making, external communications, and actions
GSP	Grid Supply Point
HAHL	Heathrow Airport Holdings Limited
Here to Help	Volunteer initiative organised by Heathrow by which Heathrow employees attend terminals to liaise with, and provide assistance to, passengers

HV	High Voltage
NESO	National Energy System Operator
NGET	National Grid Electricity Transmission PLC
NOTAM	Notice to Aviation, a notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard
Review Committee	The Kelly Review Committee comprising Ruth Kelly, Joan MacNaughton and Mark Brooker
SGT	Supergrid transformer
Silver Command	The command team in Heathrow's Command & Control structure that focuses on the tactical level and airport-wide communications
SORC	Heathrow's Sustainability and Operational Risk Committee
SSEN	Scottish and Southern Electricity Networks
Team Heathrow	Collective name for Heathrow partners including airlines, ground handlers and retailers
UKPNS	UK Power Networks Services
UPS	Uninterruptible Power Supply

APPENDIX 3 – TERMS OF REFERENCE

TITLE:	Kelly Review Board Committee
FREQUENCY:	Temporary committee to meet as determined by the Chair
CHAIR:	Ruth Kelly, Independent Non-Executive Board member
MEMBERS:	1. Ruth Kelly, Independent Non-Executive Board member 2. Joan MacNaughton, Independent Non-Executive Board member 3. Mark Brooker, Independent Non-Executive Board member

TERMS OF REFERENCE:

Authority:

1. HAHL has commissioned an internal review (the **"Review"**) of circumstances related to the closure of Heathrow airport (the "**Airport**") on 21 March 2025.

2. The Board of Directors of HAHL (the "**Board**") has authorised that the Review be carried out by a special committee of the Board (the "**Committee**") chaired by Ruth Kelly, an Independent Non-Executive Board Member and, inter alia, former Secretary of State for Transport.

Objectives:

3. The outcomes of the Review will be:

   a) to determine the chronology of events leading to the closure of the Airport, the immediate and identifiable impact on stakeholders on the day of the closure and then the chronology of events leading to the Airport's subsequent recovery after the incident;

   b) to determine the causes of the closure of the Airport;

   c) to determine and evaluate the decision-making processes that led to the closure of the Airport; and whether any reasonable steps were available that might have prevented the Airport from closing or otherwise have mitigated the impact of the power outage;

   d) to determine whether any immediate improvements are recommended to the Airport's preparedness, response planning and wider resilience in the event of any future serious power outage; and

   e) to provide such other recommendations as the Committee considers practicable, in the context of this Review and with regard to potential improvements at the Airport, to enable more detailed further consideration, planning and/or follow up actions (as might be applicable) after the conclusion of the Review.

Reporting:

4. At the conclusion of the Review, the Committee shall produce a written report (the "**Report**") which shall be provided to the Board which it is anticipated will be within 4 weeks of the commencement of the Review.

5. The Committee and Chair will be supported by Heathrow's in-house legal team and Heathrow's external lawyers, Pinsent Masons LLP.

These Terms of Reference will be kept under review and may be amended by agreement of the Board.

Annex to the Terms of Reference – Confidentiality, Privacy and Privilege

1. To discharge legal duties under data protection law and the duty of trust and confidence owed by employer to employee, the Committee shall keep confidential all confidential information disclosed as a result of the Review and shall not use nor disclose the same save as provided in this Annex or as required by law.

2. Any legal advice or reports from in-house or external lawyers are privileged and it is a matter for HAHL whether privilege is asserted or waived.

3. Subject to the approval of the Board, the findings of the Review may made public subject to any relevant legal considerations.

4. Personal data (i.e. data from which a person may be identified) will not be included in any published report without the express consent of the person in question.

5. Persons providing information to the Committee for the purposes of the Review are encouraged to do so in an open and "on the record" basis. This will help the Committee to reach fully informed conclusions by enabling the Committee to put information and concerns to other persons for their consideration and comment.

6. Should a person who wishes to provide information request to speak with the Committee and/or the Chair in confidence, the Committee will proceed on a confidential basis but in the event that civil proceedings or an inquiry (governmental, public or regulatory) concerning any matter that was the subject of the Review, HAHL and the Committee may be required to disclose the information provided.

APPENDIX 4 – REVIEW COMMITTEE BIOGRAPHIES

Rt. Hon Ruth Kelly

Rt. Hon Ruth Kelly has previously held UK Government roles including Secretary of State for Transport; Secretary of State for Communities and Local Government; and Secretary of State for Education and Skills. She has also held ministerial roles at the Cabinet Office and HM Treasury. Following her political career, Ms Kelly has held positions as Global Head of Client Strategy at HSBC Global Asset Management and as Pro-Vice Chancellor for Research and Enterprise at St Mary's University, Twickenham.

Ms Kelly was appointed as an Independent Non-Executive Director at Heathrow in April 2019. Ms Kelly is Chair of the Audit Committee and also sits on the Sustainability and Operational Risk Committee and Finance Committee. In addition, Ms Kelly is Chair of Water UK and Chair of Thames Freeport.

Joan MacNaughton CB

Ms MacNaughton has extensive board experience in industry, government, academia and the third sector. After a career in government culminating as the senior official responsible for energy policy in the UK, she spent five years in a power sector company. She has wide international experience, including as Chair of the International Energy Agency and Chair of the World Energy Council Trilemma. She is currently a non-executive member of the Thames Freeport Governing Board, where she chairs the Innovation and Net Zero committee; and Chair of the Clean Growth Leadership Network. She has public procurement, health and safety, regulatory and ED&I experience at Board level.

Ms MacNaughton was appointed as an Independent Non-Executive Director at Heathrow in June 2021. Ms MacNaughton is Chair of the Sustainability and Operational Risk Committee.

Mark Brooker

During his executive career, Mr Brooker held roles including Chief Operating Officer for Trainline, and Chief Operating Officer of Betfair Group plc. Prior to these roles, Mr Brooker spent 17 years in investment banking, working for Morgan Stanley, Merrill Lynch, NatWest and NM Rothschild & Sons. Mr Brooker's currently holds non-executive roles at: eCogra (as Chairman); Resi (as Chairman); Future plc; and Paysafe. Prior to these roles, Mr Brooker's held non-executive posts at: Equiniti, William Hill, the AA, and Findmypast. Mr Brooker holds a Master's Degree in Engineering, Economics and Management from Oxford University.

Mr Brooker was appointed as an Independent Non-Executive Director at Heathrow in April 2022. Mr Brooker sits on the Remuneration Committee and the Sustainability and Operational Risk Committee.

APPENDIX 5 - RESERVED – KEY TO REFERENCES TO RESERVED MATTERS

[*This appendix has been reserved for security purposes.*]